



IDW '06 THE 13TH INTERNATIONAL DISPLAY WORKSHOPS

Workshops on

- LC Science and Technologies
- Active Matrix Displays
- FPD Manufacturing, Materials and Components
- CRTs
- Plasma Displays
- EL Displays, LEDs and Phosphors
- Field Emission Display
- Organic LED Displays
- 3D/Hyper-Realistic Displays and Systems
- Applied Vision and Human Factors
- Projection and Large-Area Displays, and Their Components
- Electronic Paper
- MEMS for Future Displays and Related Electron Devices

Topical Session on

Display Electronic Systems

Final Program

Otsu Prince Hotel Otsu, Japan December 6(Wed) – 8(Fri), 2006

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EXHIBITION

12:00–18:00 Wednesday, Dec. 6 9:00–18:00 Thursday, Dec. 7 9:00–14:00 Friday, Dec. 8 Ohmi 5–7 (2F) Otsu Prince Hotel

Free admission with your registration name tag.

BANQUET

Wednesday, December 6 19:10–21:10 Prince Hall (3F) Otsu Prince Hotel

See page 9 for details

Outstanding Poster Paper Awards Ceremony

Friday, December 8

See page 9 for details

IDW '07

The 14th International Display Workshops

December 5-7, 2007 Sapporo, Japan

PROGRAM HIGHLIGHTS

Scientific and technological advances in research and development on information displays will be found at the 13th International Display Workshops (IDW '06). A feature of the IDW '06 is an integration of the following thirteen workshops and one topical session.

Workshops on

- · LC Science and Technologies
- Active Matrix Displays
- · FPD Manufacturing, Materials and Components
- CRTs
- Plasma Displays
- EL Displays, LEDs and Phosphors
- Field Emission Display
- Organic LED Displays
- 3D/Hyper-Realistic Displays and Systems
- · Applied Vision and Human Factors
- · Projection and Large-Area Displays, and Their Components
- Electronic Paper
- · MEMS for Future Displays and Related Electron Devices

Topical Session on

Display Electronic Systems

The three-day conference will feature 522 papers, including 1 keynote address, 2 invited addresses, 75 invited papers, 163 oral papers, 212 poster papers and 69 late-news papers. Following keynote and invited addresses on Wednesday morning, presentations will begin and continue in six parallel sessions through Friday. Poster sessions and author interviews will enable participants to discuss presented issues in detail. Exhibitions from display and related industries will also be featured from Wednesday to Friday in parallel with workshops and topical session. The IDW '06 should be of interest not only to researchers and engineers, but also to those who manage companies and institutions in the display community.

Workshop on LC Science and Technologies (LCT)

Recent advances in LC materials and device technologies are presented. The session covers from fundamental studies to recent development in LCD technologies. New materials for LCD application, fast response LCDs, LC alignment process, LC mode, flexible LCD, optical design & characterization, and novel devices are discussed.

Workshop on Active Matrix Displays (AMD)

Recent progress in TFT technologies and active matrix displays are widely discussed.

Sessions cover device and process technologies for a-Si, poly-Si, organic and new material TFTs, featuring fifteen topical invited talks.

Their applications to active matrix displays including LC-TVs, mobile displays, electronic paper and OLED displays are presented.

Furthermore, novel applications to sensors, detectors, Braille display and system on panel are discussed.

Workshop on FPD Manufacturing, Materials and Components (FMC)

This workshop includes 11 invited papers dealing with the overview of technical trends and the new related technologies on FPDs. In the technical sessions, papers deal with optical components, lamps, process technologies, measurement systems, recycling technologies, etc. for FPDs.

Workshop on CRTs (CRT)

It is thought that the CRT is declining, because of the growth of the Flat Panel Display. However, still the cost performance of the CRT is the best among all the displays.

In this Workshop, further performance improvements such as novel electron gun design and digital orthogonal scanning will be discussed. Also, the cost reduction technologies such as AK shadow mask application to the real flat tube will be presented.

Workshop on Plasma Displays (PDP)

MgO protecting layer is the highlight of the workshop. By speculating the "Da Vincci Code of MgO," Dr. Tolner tries to clarify its property. There also are several papers introducing innovative processes of the layer. Matsushita explains the property of the 103-in. PDP which is now the world largest. Novel fabrication processes are also introduced in the workshop. One is a "Precision Replication Process" for barrier rib formation, presented by Sumitomo 3M. The technique enables to fabricate 2k/4k-resolution PDPs without difficulty. The other is the "plasma²" in which plasma displays are fabricated by using a plasma processing technology. The substrate modification, as well as phosphor activation can be completed with a 2m-wide processor.

Workshop on EL Displays, LEDs and Phosphors (PH)

This workshop covers the latest R&D achievement in inorganic ELDs, phosphors for emissive displays and solid-state illumination as well as LEDs. Invited talks present phosphors for LEDs, Spindt- and CNT-type FEDs, fine phosphor particles by spray-based methods, and luminescence and biological applications of nanophosphors. Contributed papers also include interesting topics such as luminescent mechanism, thin-film phosphors and new phosphor materials for ELDs, FEDs, LEDs and PDPs. In addition, joint sessions will be held with the FED Workshop.

Workshop on Field Emission Display (FED)

Recent progresses in FEDs with Spindt-type field emitter arrays (FEAs) or carbon nanotube (CNT) FEAs are presented. Phosphors for FEDs and FEA-backlight-units are also presented at the joint session with PH Workshop. Furthermore, various fabrication technologies of CNT field emitters, driving methods suitable for FEDs, and image sensing technology with an active-matrix Spindt-type FEA are discussed.

Workshop on Organic LED Displays (OLED)

This workshop includes recent developments in organic light-emitting materials, devices and display systems. New organic fluorescent and phosphorescent materials are reported, and highly efficient OLEDs using these materials are presented. In addition, durability, the fabrication process and the evaluation system will be also discussed.

Workshop on 3D/Hyper-Realistic Displays and Systems (3D)

This workshop focuses on recent progress in 3D, holography and related visual science. It also covers 3D, hyper-realistic image progressing such as multiview interpolation and high-fidelity color reproduction. Invited talks in this workshop include the topics from forefront of 3D/holographic technologies and the recent researches into advanced display systems.

Workshop on Applied Vision and Human Factors (VHF)

This workshop provides a forum for discussion of the latest industrial and academic R&D in the field of applied vision and human factors associated with display technology, including methods for improved color reproduction and the assessment and improvement of the perceived quality of still and moving images. The workshop constitutes a unique opportunity to interact and discuss the latest advances with world-renowned experts in the field.

Workshop on Projection and Large-Area Displays, and Their Components (LAD)

The worldwide hottest technologies for projection displays will make this workshop exciting. Invited talks will cover topics on emerging technologies such as photonic crystals, semiconductor laser and digital cinema. In the general talks, screen, light valve, light source and optical systems for enhancing display performance will be discussed.

Workshop on Electronic Paper (EP)

This workshop focuses on current topics on electronic paper, rewritable paper, paper-like display, and flexible display. Various novel technologies including electrophoretic, electrochromic, liquid crystal, and toner display systems will be reported. Concepts, systems, devices, and materials in this field are expected to be discussed.

Workshop on MEMS for Future Displays and Related Electron Devices (MEMS)

The workshop is unique in covering all aspects of MEMS and nanotechnologies for future displays, imaging devices, and related electron devices. It seeks to broaden the horizon of display technologies into MEMS technologies. Among MEMS and display conferences in the world, this is the only opportunity where MEMS researchers gather to discuss on such devices. Research areas such as, materials, basic physics and fabrication process are included. Authorities of this field are invited from top research institutions around the world. Invited speakers are from CEA-LETI, Eastman Kodak, Ecole PolyTech., MIT, Qualcomm, Tohoku Univ., Univ. of Cambridge, and Univ. of Tokyo (in alphabetical order). Together with excellent contributed papers, this workshop invites attendants who wish to cut open a new field of display and imaging devices.

Topical Session on Display Electronic Systems (DES)

This session will cover all aspects of display systems in relation to electronics: video data processing, interface technologies, cooperative operations between display components such as cells and backlights, combinations with other input/output devices, applications to the new areas, system performance, or power consumption.

Since this session is newly introduced, a number of speakers are invited to clarify our focusing fields and objectives. We will have interesting speeches on the recent hot topics such as high dynamic range display systems, high quality video processing and mobile display technologies.

Outstanding Poster Paper Awards Ceremony

A limited number of outstanding poster papers will be awarded on December 8, from 12:10 to 13:50 in Prince Hall (3F), Otsu Prince Hotel following Otsu Festival.

Exhibition

The exhibition will open at 12:00 on December 6 and close at 14:00 on December 8 in Ohmi 5-7 of Otsu Prince Hotel. The latest researches, technologies and products for display device, material, components, systems, application, manufacture, measurement, software and others related to this workshop will be presented. Please take these opportunities to enjoy informative discussions with exhibitors.

December 6: 12:00 - 18:00 December 7: 9:00 - 18:00 December 8: 9:00 - 14:00

GENERAL INFORMATION

SPONSORSHIP

IDW '06 is sponsored by the Institute of Image Information and Television Engineers (ITE) and Society for Information Display (SID).

WORKSHOP SITE

Otsu Prince Hotel 7-7, Nionohama 4-chome Otsu-shi, Shiga 520-8520, Japan

ON-SITE SECRETARIAT

Telephone and fax machines for IDW '06 use will be temporarily set up in the secretariat room at Otsu Prince Hotel (Room Eizansumire 2, 1F) (December 5-8).

Phone/Fax: +81-77-526-2606

BANQUET

A buffet-style banquet will be held on December 6 from 19:10 to 21:10 in Prince Hall (3F), Otsu Prince Hotel. As the number of tickets is limited, you are urged to make an advance reservation by completing the enclosed registration form and returning it with payment.

EVENING GET-TOGETHER WITH WINE

A get-together will be held on December 5 from 18:00 to 20:00 in Otsu Prince Hotel (place to be noticed at registration desk). Wine (sponsored by Merck Ltd., Japan) will be served to participants with a relaxed atmosphere for informal discussion.

OUTSTANDING POSTER PAPER AWARDS CEREMONY AND OTSU FESTIVAL

Poster Awards will be given to a limited number of outstanding poster papers, following Otsu Festival, on December 8 from 12:10 to 13:50 in Prince Hall (3F), Otsu Prince Hotel.

REGISTRATION

Registration is available in advance and also on site. However, proceedings book might not be guaranteed for the on-site registrants in case of the unexpected excess of the on-site registration. Advance registration is strongly recommended.

Registration Fees

The registration fee for IDW '06 includes admission to the conference, a copy of the proceedings in book or in USB memory, and CD-ROM. The proceedings in USB memory can be selected only by those who registered and paid by 24:00, November 8 (Japan Standard Time).

	Paid by Nov. 8	After Nov. 8
Member of SID/ITE/ASO*	¥ 30,000	¥ 40,000
Non-Member	¥ 35,000	¥ 45,000
Student**	¥ 8,000	¥ 10,000
Life Member of SID/ITE	¥ 8,000	¥ 10,000
Banquet	¥ 8,000	¥ 10,000

*ASO: Academic Supporting Organizations

(See p. 11 as well as "Supporting Organizations and Sponsors" at the end of each workshop/topical session section.)

**Student ID is required.

Please note that the reduced registration fee must be paid by November 8. In case of the payment after November 8 or on site, prices after November 8 will be applied even if you sent the registration form by

November 8, 2006. Also note that the number of banquet tickets to register on site is limited.

For additional sets of the proceedings book or USB memory*, and CD-ROM

	Book & CD-ROM	USB & CD-ROM*
At the conference site	¥ 8,000	¥8,000
Airmail after the conference	¥12,000	not available
Sea/Domestic mail after the confe	rence ¥10,000	not available

*Additional Sets of USB memory and CD-ROM can be selected only by the application with payment by November 8.

Payment

Three ways are provided for the registration.

(1) e-Registration

Access the following URL.

http://idw.ee.uec.ac.jp/regist.html

The e-Registration is acceptable until November 21, 2006.

(2) Mail or Fax Registration

Complete the registration form (FORM A) at the centerfold and send it to the secretariat together with all necessary payments no later than November 21, 2006.

IDW '06 Secretariat c/o ABEISM CORPORATION 4-30-12 Kamimeguro, Meguro-ku, Tokyo 153-8571, Japan Phone: +81-3-5720-7022 Fax: +81-3-6203-8238 E-mail: idw@abegroup.jp

The registration fee should be remitted by one of the following methods.

1. Bank transfer (only applicable to domestic participants) to:

Account name: IDW Account No.: 1054350 (ordinary account) Bank Name: Mizuho Bank Branch Name: Azamino Branch Please attach a copy of your bank remittance form with the registration form to avoid possible troubles.

2. Bank check made payable to "IDW" together with the registration form

3. Credit card (only VISA or MasterCard accepted)

All above payments should be made in **JAPANESE YEN**.

Also, please note that personal and traveler's checks are not accepted.

(3) On-site Registration

Conference registration desk will be open:

December 5 (Tue.)	17:00-20:00
December 6 (Wed.)	8:30-18:00
December 7 (Thu.)	8:30-18:00
December 8 (Fri.)	8:30-15:00

The on-site registration fee will be payable by:

1. Cash (JAPANESE YEN only)

2. Credit card (VISA or MasterCard only)

Bank transfer, bank check, and personal/traveler's checks are not accepted. Payment by cash is recommended.

Cancellation Policy

Refunds for registration, banquet, additional sets of proceedings etc. will be made on written cancellation received by IDW '06 secretariat by **November 8**. For cancellations received after November 8 or no-shows, refunds will not be made. However, after IDW '06 closes, a set of the proceedings book/USB memory and CD-ROM will be sent to the registrants who have paid the registration fees.

INQUIRIES

IDW '06 Secretariat c/o ABEISM CORPORATION 4-30-12 Kamimeguro, Meguro-ku, Tokyo 153-8571, Japan Phone: +81-3-5720-7022 Fax: +81-3-6203-8238 E-mail: idw@abegroup.jp

Please pay attention to the website (http://idw.ee.uec.ac.jp/) for latest information.

ACADEMIC SUPPORTING ORGANIZATIONS

The Chemical Society of Japan The Electrochemical Society of Japan (ECSJ) The Illuminating Engineering Institute of Japan The Imaging Society of Japan Information Processing Society of Japan The Institute of Electrical Engineers of Japan The Institute of Electronics, Information and Communication Engineers (IEICE) The Institute of Image Electronics Engineers of Japan Japan Ergonomics Society (JES) The Japanese Liquid Crystal Society (JLCS) The Japan Society of Applied Physics The Virtual Reality Society of Japan

Fund for the conference is furnished in part by: Shiga Prefecture

IDW Tutorial in Japanese

Tuesday, December 5 Ohmi 10 (2F) Otsu Prince Hotel

Detail information will be available in October: http://www.sidchapters.org/japan/wiki.cgi

> Contact address: idw.tutorial@tmdisplay.com

HOTEL AND TRAVEL INFORMATION

HOTEL RESERVATIONS

The IDW '06 executive committee has secured enough rooms for the participants. Participants who want to stay in Otsu area during IDW '06 should make reservations directly with the hotel by themselves as follows. Reservation will be made on a first-come, first-served basis.

Methods of Application

1. Through the IDW '06 website (http://idw.ee.uec.ac.jp/hotelform.html) 2. By fax, using the enclosed Form B (Please copy the form.)

Confirmation from the Hotels

- 1. Confirmation will be sent to the applicants directly from the hotel a few days after receiving your application.
- If your application is not accepted by the hotel, please select another hotel and send your request for a reservation to the hotel through the web or by fax using Form B.
- 3. In case there is no vacancy for your request again, please follow the procedure described above.

VISAS

Visitors from countries whose citizens must have visas should apply to a Japanese consular office or diplomatic mission in their respective country. For further details, please contact your travel agent or the local consular office in your country.

Attention: For some countries' citizens, official documents prepared by the IDW '06 committee will be needed. Please ask the IDW '06 secretariat for its application at least two months before the conference.

JAPAN RAIL PASS

Tourists visiting Japan from abroad can save with a Japan Rail Pass. These 7-, 14-, or 21-day passes are valid for unlimited travel on the Shinkansen trains (except NOZOMI) and other JR lines, plus its buses and ferries.

For details, please ask your travel agent and purchase an exchange order at an authorized agent before coming to Japan. This pass cannot be purchased in Japan.

After you arrive in Japan, you turn in the exchange order to receive your JAPAN RAIL PASS at an applicable JR station that has a JAPAN RAIL PASS exchange office.

LA.		
Narita Airport	Travel Service Center	11:30-19:00
	Ticket Office	6:30-11:30, 19:00-21:45
Narita Airport Terminal 2	Travel Service Center	11:30–19:00
	Ticket Office	6:30-11:30, 19:00-21:50
Kansai Airport	Ticket Office	5:30-23:00
JR Tokyo Station	Travel Service Center	10:00–19:00
		(Marunouchi North)
	Travel Service Center	10:30–19:30
		(Yaesu Central)
	Ticket Office	5:30-22:45
JR Nagoya Station	JAPAN RAIL PASS	10:00–18:00
	Exchange Corner	
JR Kyoto Station	Ticket Office	8:30-23:00

CLIMATE

The average temperature in Otsu during the period is around 7° C, with 11° C in the daytime and 2° C at night on the average.

Ev

OTSU CITY

Otsu City is located on the southern edge of Lake Biwa, which is the largest lake in Japan at 672 km^2 . It is the capital of Shiga Prefecture and is rich in history and natural beauty. About 1,300 years ago, it was the capital of Japan for a brief period of time. At the end of the 8th century, Kyoto became the heart of Japan, and Otsu prospered as a gateway to Kyoto for both land and water transportation systems. It was also a center for Buddhism.

Now, it is a tourist center and a port for excursion boats on Lake Biwa. The views from Otsu Prince Hotel are magnificent. Around twilight, Lake Biwa gradually changes its colors and the city starts to light up along the shore. The city's industrial products include electrical appliances, textiles, precision instruments, computer components, and machinery.

PLACES OF INTEREST

Lake Biwa

Lake Biwa occupies 1/6 of Shiga Prefecture. More than 450 rivers flow into the lake and there is only one natural outlet, the Seta River. The lake supplies water to some 14 million residents around and downstream of the lake including Osaka, Kyoto and Kobe Cities. There are a number of historic sites, hot springs, and other attractive tourist spots around the lake. Several types of boat cruises start from Nagisa-Koen Park as well as from Otsu Prince Hotel.

Enryakuji Temple

The temple was founded in 788 by the Buddhist Priest Saicho (767-822) to protect the former capital of Kyoto from evil spirits from the northeast. It was (and still is) the headquarters of the Tendai sect, the Buddhist sect that was popular among the aristocracy of the time and served as the foundation for a number of later sects. At the peak of its power, Enryakuji Temple was a huge complex of 3,000 subtemples. A powerful army of warrior monks occasionally engaged in power struggles with other monasteries and political leaders. In 1571, warlord Oda Nobunaga ended this Buddhist militancy by attacking and razing the huge temple complex on Mt. Hiei. Currently, there are 200 temple buildings and its forest environment has great scenic charm. The temple itself is in an excellent state of preservation and the main buildings are National Treasures. Enrvakuii Temple was registered as a UNESCO World Heritage site in 1994. It is located 10-min. walk from Enryakuji station of Hieizan-Sakamoto Cablecar Line. It takes about 25 min. to get to JR Hieizan Sakamoto station from JR Otsu station.

Miidera (Onjoji) Temple

Located at the foot of Mt. Hiei, this temple was founded in 686 by Emperor Tenmu in honor and memory of his brother. The name "Midera", literally means "Temple of Three Wells". It comes from the springs at the temple which were used for the ritual bathing of newborns. The Evening Bell of Miidera is one of the well-known Omi Hakkei (Best Eight Views of Omi, Shiga Pref.). Miidera is also famous for the color of its autumn leaves and is an excellent place to enjoy beautiful Japanese autumn scenery until early December. Take the Keihan Bus from JR Otsu station to Miidera bus-stop, or take the Keihan Ishiyama Sakamoto Line to Miidera. The temple is 10-min. walk from Miidera station.

More information is available on http://www.pref.shiga.jp/index-e.html http://www.jnto.go.jp/eng/location/regional/shiga

Outstanding Poster Paper Awards Ceremony

and Otsu Festival

Friday, December 8 12:10–13:50 Prince Hall (3F) Otsu Prince Hotel

See page 9 for details

AD '07

Asia Display 2007 March 12–16, 2007 Shanghai, China

http://ad07.ecnu.edu.cn/

SID 2007

Society for Information Display Symposium, Seminar & Exhibition

> May 20–25, 2007 Long Beach, CA, U.S.A. http://www.sid.org



⁽as of July, 2006)

*Information of this page may be changed. Please confirm the details in each company.





Otsu Station



Four bus services an hour (shuttle + route) will be available. See http://idw.ee.uec.ac.jp/

EVENING GET-TOGETHER WITH WINE

Tuesday, December 5 18:00–20:00 Otsu Prince Hotel Meeting place will be noticed at the registration desk.

(Sponsored by Merck Ltd., Japan)

See page 9 for details

EXHIBITION

12:00–18:00 Wednesday, Dec. 6 9:00–18:00 Thursday, Dec. 7 9:00–14:00 Friday, Dec. 8 Ohmi 5–7 (2F) Otsu Prince Hotel

Free admission with your registration name tag.

Outstanding Poster Paper Awards Ceremony and Otsu Festival

Friday, December 8 12:10–13:50 Prince Hall (3F) Otsu Prince Hotel

See page 9 for details

ICDL 2007

The 1st International Conference on Display LEDs Jan. 31–Feb. 2, 2007 COEX, Seoul, Korea

ICDL '07 will provide the state-of-the-art LED related technologies, in particular, LCD backlights, LED Displays, LED chips, etc.

Prince Hall

IDW '06

Wednesday, December 6

9:00 - 9:10

Opening

Master of Ceremony: K. Nunomura, Executive Chair

Opening Remarks 9:00

Y. Shimodaira, General Chair Y. Iimura, Program Chair

9:10 - 9:50

Prince Hall

Keynote Address

Co-Chairs: Y. limura, Program Chair Y. Shimodaira, General Chair

Keynote Address Multispectral Imaging -Present and 9:10 Promise-

Y. Miyake Chiba Univ., Japan

Multispectral imaging is one of the hottest topics in the field of color science and technology. XYZ, RGB and CMY values have been used for recording and display of imaging systems. Those values, however, depend on the spectral characteristics of imaging devices and the spectral power distribution of the illumination. Therefore, it is important to record and reproduce the reflectance spectra of the object for true device independent color reproduction and high accurate recording of the scene. In this presentation, I introduce the fundamentals and theory of Multispectral imaging for high accurate color recording and reproduction of the object. I also introduce some applications of Multispectral imaging to digital archives, medical imaging and identification.

----- Break -----

Prince Hall

10:00 - 11:20

Invited Address

Co-Chairs: T. Miyashita, Program Vice-Chair M. Uchidoi, Program Vice-Chair

Invited Address - 1 Innovation in Digital AV Products and Key 10:00 Technologies

K. Okamura, H. Oka Matsushita Elec. Ind., Japan

Displays and video content have been developed while influencing each other. Rapid growth of large screen displays in recent years has brought a new challenge for the video content. In this paper, the current trend and the relationship of displays and video contents are described at first. Then the key technologies and future prospects of these technologies are introduced.

Invited Address - 2 GxL Laser Dream Theater at the Aichi Expo 10:40 (Equivalent to 2005-in. TV)

N. Eguchi Sony, Japan

At the 2005 World Exposition in Aichi, Japan, Sony presented "Laser Dream Theater", where high-quality images were projected with lasers onto one of world's largest screens. The ultra-wide, 2005-inch screen. GxL ("G-by-L") system is the projection system that combines high-output laser technologies and cutting-edge micro-electromechanical systems (MEMS). By using red, green and blue (RGB) lasers, it is able to exceed twice the vividness of color produced in cathode-lay tube (CRT) televisions.

IDW '07

The 14th International Display Workshops

December 5-7, 2007 Sapporo, Japan

Workshop on LC Science and Technologies

Wednesday, December 6

13:20 - 14	:30	Ohmi 1
	LCT1: New Materials	
Chair: Co-Chair:	V. G. Chigrinov, Hong Kong Univ. of S&T, Ho H. Seki, Hachinohe Inst. of Tech., Japan	ng Kong

LCT1 - 1: Invited Bimesogenic LCs: New Materials for High 13:20 Performance Flexoelectric and Blue Phase Displays

H. J. Coles Univ. of Cambridge, UK

New bimesogenic N* liquid crystals with high flexoelectro-optic coefficients, e/K≈1.5 CN⁻¹ m⁻¹, high switching angles, > 160°, μ s. response times, gray scale capability, in both ULH and USH textures, an optimum optical in plane switch of 45°, for E= 4V μ m⁻¹, high optical contrast >1000:1 with a unique optically isotropic "field off" black state, using "in plane" electric fields are described as are wide temperature range (>50°C) highly reflective RGB electrically switchable, in ms, Blue Phase devices and lasers.

LCT1 - 2: Invited Carrier Transport Properties of Liquid 13:45 Crystalline Oligothiophene Semiconductors and Their Device Applications

M. Funahashi, F. Zhang, N. Tamaoki Nat. Inst. Advanced Ind. S&T, Japan

Asymmetrically substituted oligothiophene derivatives were synthesized and around room temperature, they exhibited highly ordered smectic phases in which fast electronic carrier transport. In particular high electron mobility exceeding over 0.2 cm²/Vs was observed in propyl(4pentylphenyl)terthiophene. This compound was applied to thin film transistors fabricated with solution process. In addition to smectic phases, electronic charge carrier transport was also observed in the cholesteric phase of phenylquarterthiophene derivatives with extended p-conjugated system which emitted circularly polarized light by UV light excitation.

LCT1 - 3 Towards Faster LCs at Lower Driving Voltage 14:10

P. Kilickiran, T. Roberts, N. Hollfelder, B. Schueller, A. Masutani, G. Nelles, A. Yasuda Sony Deutschland GmbH, Germany

Response times and switching voltages of liquid crystals are improved by addition of small amounts of non-planar diaromatic-ethers. The amount of changes in rotational viscosity and dielectric anisotropy of liquid crystals upon addition of diaromatic-ethers are reflected as reduction in the response times and the switching voltages. With negative type liquid crystals no detrimental change in the liquid crystal alignment was observed, contrast ratios and brightness remained unaffected. Voltage holding ratios of all mixtures remained same as without dopant.

----- Break -----

15:00 - 10	6:25 Ohmi 1
	LCT2: LC Alignment (1)
Chair:	I. Hirosawa, Japan Synchrotron Radiation Res. Inst.,
Co-Chair:	M. Funahashi, Nat. Inst. Advanced Ind. S&T, Japan
LCT2 - 1: 15:00	Invited Medical Display by Using Plasma Beam Alignment Technology

C.-Y. Lee, H.-C. Tang, P.-H. Su^{*}, S.-H. Yang^{*}, Y.-J. Chen^{*}, Y.-J. Shih, C.-H. Su, C.-H. Liu, C.-W. Chen, C.-H. Lin, C.-D. Lee ITRI, Taiwan ^{*}Chi Mei OptoElect., Taiwan

In this study, the alignment-layer polyimide was treated with a plasma beam in order to realize its full potential. Furthermore, to evaluate the alignment process, a test cell and real panel (TFT + CF) samplestructures were fabricated. A brilliant performance, including high contrast ratio and excellent viewing angle were obtained. In addition, this work also developed a successful 20.8 inch QXGA Grayscale Medical Display from a G3 size panel using the plasma beam alignment technique.

LCT2 - 2Multi-Step Ion-Beam Alignment Process for IPS15:25LCDs with Polyimide Film

Y. Sasaki, T. Suzuki, J. Matsushima, M. Sugimoto, H. Tanaka^{*}, C. Mizoguchi^{*} NEC LCD Tech., Japan ^{*}NEC Kagoshima, Japan

We investigated a multi-step ion-beam alignment process for IPS LCDs. The multi-step process consists of the first step to induce anisotropy by a high energy ion-beam and the second step to control surface conditions by a low energy ion-beam. As a result, we achieved about 7% higher contrast ratio than the best by the conventional ion-beam process.

LCT2 - 3 15:45 V. G. Chigrinov, H. S. Kwok, H. Takada^{*}, H. Takatsu^{*} Hong Kong Univ. of S&T, Hong Kong ^{*}Dainippon Ink & Chems., Japan

Liquid crystal (LC) photo-alignment using azo-dyes is reviewed. It will be shown that this photo-aligning method can provide a controllable pretilt angle and strong anchoring energy of the liquid crystal cell, as well as high thermal and UV stability. The application of this method to the alignment and fabrication of various types of liquid crystal devices for display and photonics applications is also discussed.

LCT2 - 4 Alignment Structures of Cholesteric LC Induced by 16:05 Stretched Polymer Filaments

H. Fujikake, H. Sato, H. Kikuchi, T. Kurita NHK, Japan

We observed cholesteric liquid crystal alignment induced by a stretched polymer filament. The molecular alignment of the cellulose filament surface anchors liquid crystal molecules in the stretching direction. When the polymer filament was fixed in a cholesteric liquid crystal cell, helical axis of liquid crystal alignment near the filament was controlled to be perpendicular to the filament direction. The polymer filament can induce cylindrical-symmetry helical alignment.

----- Break -----

16:40 - 18:05		Ohmi 1	
	LCT3: LC Alignment (2)		
Chair: Co-Chair:	H. J. Coles, Univ. of Cambridge, UK M. Kimura, JSR, Japan		
LCT3 - 1: 16:40	Invited Application of Vapor Deposition Polymerization to LCDs -Synthesis of Poly in Vacuum-	mer Films	

Y. Takahashi So-ken, Japan

Vapor Deposition Polymerization (VDP) developed by the author and coworkers in 1984 is a technology to form films of polymers such as polyimide using a dry process. VDP polymer films have been analyzed and the mechanisms of film formation have been clarified. This report summarizes research and development results achieved to date. The process of VDP is described first for the basic knowledge, and then its LCDs applications are summarized.

LCT3 - 2 Recent Progress in New Alignment Layers and Its 17:05 Applications

F. S. Y. Yeung, Y. W. Li, H. L. Cheung, K. K. Li, H. S. Kwok Hong Kong Univ. of S&T, Hong Kong

Variable pretilt angles can be obtained by a new alignment layer consisting of a mixture of polyimides. This process does not involve any untested new materials and it is compatible with existing manufacturing techniques. Recent progress of this new alignment layer will be discussed. Fast response color-filterless No-Bias-Bend (NBB) and Optically Compensated Bend (OCB) liquid crystal displays have been fabricated by using this high pretilt angles alignment layers.

LCT3 - 3 Multi-Domain Alignment Transflective LCD with Ink-17:25 Jet Printed Polyimide

Y. A. Sha, P. J. Su, C. H. Hsieh, K. H. Chang, C. C. Hsiao, J. W. Shiu, S. Y. Fuh, W. Y. Cheng, Y. C. Liao, J. C. Yang, K. L. Lo, D. W. Lee, K. C. Lee, Y. P. Chang ITRI, Taiwan

By using the ink jet printing technology, we fabricated a transflective liquid crystal display with the hybrid alignment in the reflective region and the homogeneous alignment in the transmission region. Compared with the traditional technologies, our technology provided the advantages of easy process, high yield, fast throughput, and less material usage. We also applied this technology to the 2.4 inch prototype. This panel could be implemented in the handheld product applications.

LCT3 - 4 Molecular Orientation of Rubbed Polyimide Film 17:45 Studied by Grazing-Incidence X-Ray Diffraction

I. Hirosawa, T. Koganezawa, T. Sakai^{*} Japan Synchrotron Radiation Res. Inst., Japan ^{*}Nissan Chem. Ind., Japan

We investigated effect of rubbing on polyimide (PMDA-ODA) film to align liquid crystal by grazing incidence X-ray diffraction and reflection ellipsometry. It was not only rubbing aligned polymer chains near to film surface in rubbing direction, but also polymer chains were elongated. Coherency (crystallinity) of polymide was also increased by rubbing. However, there was no apparent dependence of in-plane distribution of polymer chain on rubbing condition.

Author Interviews

18:00 - 19:00

13:20 - 16	20 Ohmi 5-7
	Poster LCTp1: New Materials
LCTp1 - 1	Synthesis of Novel Dichroic Dyes and Study on the Relationship between Molecular Structure and Property of Azo-Dye
	KL. Cheng, SH. Liu, YC. Lin, LL. Lai [*] ITRI, Taiwan [*] Nat. Chi Nan Univ., Taiwan

A series of novel N,N-disubstituted- 4-[(4-aminophenyl)diazenyl]benzylidene-4'-alkyl anilines dichroic dyes were synthesized via the reactions of the specific benzaldehyde with alkylanilines. These azo dyes exhibited a nematic and SmC phases during the thermal process. In addition, the order parameter and miscibility were studied by investigating a leading sample. The Genetic QSPR (Quantitative Structure- Property Relationship) study assisted to explore how the structures and order parameter values of dichroic dyes are associated.

LCTp1 - 2 Carbon Nanotube-Doped Twisted Nematic LC Cells

C. Y. Huang, H. C. Pan, C. T. Hsieh Nat. Changhua Univ. of Education, Taiwan

We investigated the electrooptical properties of CNT-doped LC cells. A tiny CNT dopant increases the threshold voltage and decreases the fall time of cells due to the increase in the elastic constant of LC-CNT dispersion. At a higher CNT concentration, the increase in the dielectric anisotropy of LC-CNT dispersion decreases the rise time and threshold voltage of the cell. We also found that the hysteresis reduction in CNT-doped LC cells is not completely attributed to the ion trapping by CNTs.

13:20 - 16:20			Ohmi 5-7
	Poster	LCTp2: LC Alignment	

LCTp2 - 1 Pretilt Angle Dependence on Rubbing Conditions

M. Honma, T. Nose Akita Prefectural Univ., Japan

The pretilt angle on polyimide films, which are rubbed using a tiny metal ball, is evaluated. The relationship between the pretilt angle and frictional work is investigated under the various rubbing conditions. We propose that the averaged frictional work can be expressed as the sum of two frictional work components contributing to an elastic and a plastic deformations. It is clarified that the contribution by the plastic deformation is the most important factor for controlling the pretilt angle.

LCTp2 - 2 Gray Scale Generation and Stabilization in Photo-Aligned Ferroelectric LC

X. Li, A. Murauski, A. Muravsky, P. Xu, H. L. Cheung, E. Pozhidaev^{*}, V. Chigrinov Hong Kong Univ. of S&T, Hong Kong ^{*}Lebedev's Physical Inst., Russia

Intrinsic gray scales generation and stabilization in photo-aligned ferroelectric liquid crystal display (FLCD) have been proposed. The frequency dependence of the FLC hysteresis loop is discussed for steady bistable switching under passive addressing. The dependence of transmission on the amplitude of switching pulse is discussed for the criterion of memorized gray scale generation and stabilization. Based on this, passive 160X160 multiplex addressing photo-aligned $5\mu m$ reflective FLCD with high contrast and four memorized gray scale levels is developed and demonstrated.

LCTp2 - 3 Alignment of Ferroelectric LC on SiO₂ Films by Oblique Ion-Beam Deposition

A. Murauski, X. Li, V. Chigrinov, A. Khokhlov^{*}, E. Khokhlov^{*} Hong Kong Univ. of S&T, Hong Kong *IZOVAC, Belarus

Investigation of alignment properties of SiO₂ thin films produced by oblique ion beam deposition on substrate surface is presented. Suitable uniform alignment properties of the ferroelectric liquid crystals can be received on the alignment layer prepared by this method. Large deposition angle from 80° to 70° can be used for thin SiO₂ layer deposition (from 10 to 20 nm). Linear design of the ion beam sputtering source gives a possibility to work with large size substrates.

LCTp2 - 4 The Surface Morphology of Plasma Beam Treated Polymer Films for LC Alignment

S.-S. Lin^{*,**}, C.-D. Lee^{*}, Y.-D. Lee^{**} ^{*}ITRI, Taiwan ^{**}Nat. Tsing Hua Univ., Taiwan

The surface morphology of the plasma-treated polymer films was examined by using atomic force microscopy (AFM). It shows that the microgrooves are aligned periodically in the scan direction of the plasma beam. The microgrooves become more pronounced as the number of scans increases. The depth of the microgrooves and the azimuthal anchoring energy also increase with the number of the plasma beam scans.

LCTp2 - 5 Azo-Dyes as Photo-Alignment Agents for Polymerizable LCs

O. Yaroshchuk^{*,**}, J. Ho^{*}, V. Chigrinov^{*}, H. S. Kwok^{*} ^{*}Hong Kong Univ. of S&T, Hong Kong ^{**}NASU, Ukraine

We show that sulfuric bisazodyes, earlier distinguished as highly effective photoalignment materials for conventional liquid crystals (LC), exhibit excellent photoalignment of polymerizable liquid crystals (PLC). These dyes excel in high affinity to various substrates, extremely low exposure dose (less than 50 mJ/cm²) for PLC alignment, and insolubility in LC and their solutions. The alignment can be easily patterned using minimal number of masks and exposure steps. We emphasize potential of new photoalignment materials for the production of patterned optical films requested by modern LCD technologies.

LCTp2 - 6 In-Plane Switching Mode LCD Using Ion Beam

S. P. Lee, J. H. Seo, T. H. Yoon, J. C. Kim Pusan Nat. Univ., Korea

In general, ion-beam alignment based liquid crystal displays has a relatively lower anchoring energy than rubbed polyimide alignment based LCDs [1]. We investigated the effects of lower anchoring energies on in-plane-switching mode LCD by means of computer simulation, the LC cell was fabricated and its electro-optics properties were studied.

LCTp2 - 7 Withdrawn

LCTp2 - 8 Direction-Selective Polyimidization for LC Alignment

J.-H. Seo, S. P. Lee, P. K. Son, T.-H. Yoon, J. C. Kim Pusan Nat. Univ., Korea

In this paper we investigated direction-selective polyimidization (DSP) method by means of ion- beam treatment and its alignment properties of nematic LC. The characteristics of the DSP were observed by photo elastic modulator (PEM). The degree of its direction is proportional to that of the phase retardation, which can be changed according to the experiment conditions. Nematic LC is homogeneously aligned along the direction of the polyimidization and its degree of the homogeneity is proportional to the degree of DSP.

LCTp2 - 9 Interplay between Elastic Constant Ratio K₃₃/K₁₁, Stripe Width Area Ratio and Alignment of a Nematic LC

T. N. Oo, M. Kimura, T. Akahane Nagaoka Univ. of Tech., Japan

We have theoretically analyzed and experimentally investigated alignment properties of a nematic liquid crystal (LC) in contact with a micropatterned polyimide surface. The patterns were formed by stripes of alternating planar and homeotropic anchorings. To understand the director configuration inside a micropatterned LC cell, two-dimensional finite-element modeling was performed. In this study, we will discuss the influence of elastic constant ratio K_{33}/K_{11} and stripe width area ratio on the micropatterned alignment of a nematic liquid crystal.

LCTp2 - 10L Vertical Alignment of Liquid Crystal on SiOC Film Surfaces by the Low-Energy Ion Beam Exposure

S. S. Cha, P. K. Son, J. H. Park, J. H. Lee, J. C. Kim, T.-H. Yoon, S. J. Rho^{*}, B. K. Jeon^{*}, J. S. Kim^{*}, S. K. Lim^{*} Pusan Nat. Univ., Korea ^{*}LCD Business, Samsung Elect., Korea

In this paper we demonstrate the vertical alignment of LC(liquid crystal) on SiOC film surface by the low-energy ion beam exposure. LC can be aligned vertically (pretilt angle: 80°C-89°C) by the rotational oblique evaporation of oxygen-doped amorphous SiOC films at the room temperature. We found that in-plane order parameter of a LC layer aligned on SiOC films is lower than that of a LC layer aligned on the polyimide layers and SiO_x films.

LCTp2 - 11L The Studies of Effect of Washing on Polyimide Film Using Synchrotron Radiation Grazing Incidence Xray Diffraction

T. Koganezawa, I. Hirosawa, I. Sakai^{*} Japan Synchrotron Radiation Res. Inst., Japan ^{*}Nissan Chem. Ind., Japan

We investigated effect of washing on rubbed polyimide (PMDA-ODA) film by reflection ellipsometry, X-Ray reflectivity and grazing incidence X-ray diffraction (GIXD). By acetone washing, optical anisotropy become smaller than non-washing film, however, a thickness of polyimide layer and crystallized volume were increased.

LCTp2 - 12L The Stability Improvement of LC Alignment by Low Temperature Hydrogen Passivation Process

J. B. Kim, K. C. Kim, H. J. Ahn, B. H. Hwang, D. C. Hyun, H. K. Baik Yonsei Univ., Korea

The stability of liquid crystal alignment property is important for the image quality of liquid crystal display (LCD). Although the ion beam irradiation process is the options for conventional alignment process with many advantages, it suffers from the stability of alignment layer. To overcome this problem, we developed the hydrogen passivation process at low temperature and got the improvement of stability of liquid crystal alignment.

Ohmi 5-7

13:20 - 16:20

Poster LCTp3: LCD Modes

LCTp3 - 1 Color Sequential Display Based on Stacked Bistable Ferroelectric LCD

P. Xu, X. Li, W. S. Chang, C. S. Chong, K. Y. Wong, V. Chigrinov Hong Kong Univ. of S&T, Hong Kong

A new color sequential display based on stacked bistable ferroelectric liquid crystal (FLC) has been proposed. The optimized parameters for the new structure including the orientation of the polarizers and ferroelectric liquid crystal cells, the cell gap of the cells have been found. The optical performance and color coordinates of the output of the system have been examined in simulation. The results show that bistable FLC has a good potential in color sequential display applications.

LCTp3 - 2 Transflective Single Cell Gap Twisted Nematic LCD Using a Patterned Polarizer and a Twisted LC Retarder

H. Y. Mak, V. G. Chigrinov Hong Kong Univ. of S&T, Hong Kong

A single cell gap Twisted Nematic (TN) liquid crystal display (LCD) is optimized for transflective LCDs, using MOUSE-LCD software. This TN LCD uses a single cell gap approach with patterned and twisted LC retarder for enhancing the optical performance. The display exhibits high contrast ratio, wide viewing angle and achromatic switching in both the transmissive mode and reflective mode. It also possesses perfect dark state. This TN LCD configuration is easy to fabricate and suitable for high quality transflective TFT-LCDs.

LCTp3 - 3 Multi-Domain Vertical Alignment LCD by Using Ink-Jet Printing Technology

Y. A. Sha, K. H. Chang, P. J. Su, C. H. Hsieh, C. C. Hsiao, J. W. Shiu, S. Y. Fuh, W. Y. Cheng, Y. C. Liao, J. C. Yang, K. L. Lo, D. W. Lee, K. C. Lee, Y. P. Chang ITRI, Taiwan

By using the ink jet printing technology, a novel method to fabricate a multi-domain vertical alignment liquid crystal display was developed. Depending on the ink jet printing technology, the location of alignment materials with different alignment properties could be defined. Combining with the homeotropic aligned region and the hybrid aligned region in one pixel, the reorientation of liquid crystal in the on-state could be controlled and thus creating multi-domain vertical alignment effect, and enhancing wide viewing angle characteristic.

LCTp3 - 4 A Single-Cell-Gap Transflective Hybrid LCD

C. C. Hsiao, Y. A. Sha, P. J. Su, C. H. Hsieh, K. H. Chang, J. W. Shiu, S. Y. Fuh, W. Y. Cheng, Y. C. Liao, J. C. Yang, K. L. Lo, D. W. Lee, K. C. Lee, Y. P. Chang ITRI, Taiwan

The novel hybrid transflective LCD is provided by combining plastic color filter and glass TFT backplane. Photo spacers on glass TFT backplane is used to maintain the cell gap uniformity. Based on the modification of color filter and cell fabrication process procedure, the total pixel misalignment is below 12 micro meters and the cell gap variation is improved. These proposed methods provide valuable manufacturing process for portable LCDs applications and further accelerate the improvement of manufacturing process for flexible LCDs.

LCTp3 - 5 Consideration of Optical Design in the Dual-Mode Transflective LCDs

C. H. Hsieh, Y. A. Sha, P. J. Su, K. H. Chang, C. C. Hsiao, J. W. Shiu, S. Y. Fuh, W. Y. Cheng, Y. C. Liao, J. C. Yang, K. L. Lo, D. W. Lee, K. C. Lee, Y. P. Chang ITRI, Taiwan

In this paper, we propose an optical design for dual-mode transflective LCDs. The design can increase the optical transmittance and reflectivity of dual-mode transflective LCDs by modifying the parameters, e.g., cell gap, alignment layer and optical films. The simulation results revealed that the transmissive and reflective regions in the transflective LCDs have similar performance.

LCTp3 - 6 Optical Switching in a Plane of LC Layer

A. Maksimochkin^{*,***}, S. Pasechnik^{*}, V. Tsvetkov^{*}, D. Yakovlev^{**}, G. Maksimochkin^{*}, V. Chigrinov^{***} ^{*}Moscow State Univ. of Instr. Eng. & Computer Sci., Russia ^{**}Saratov State Univ., Russia ^{***}Hong Kong Univ. of S&T, Hong Kong

Experimental method and a set-up to control light beams in thin liquid crystal (LC) layer were developed. The topic of our work is the switching of light by reflection and refraction of light beams propagating in a plane of LC layer from the boundaries, which separates the regions of LC cell with different director orientations and refractive indices. This boundary can be produced by electric field applied to the part of LC layer with a homogeneous planar orientation. Also, we studied experimentally a waveguide formed between two transition orientation areas and effect of light defocusing. We propose some ways for optimization of switching parameters, and a possibility of deflection of light beam from the initial direction. Further experimental study and theoretical modeling of light beams propagation in thin anisotropic LC layer with orientational inhomogeneity is under way.

Wednesday

LCTp3 - 7 Optimization of Viewing-Angle Optical Properties in OCB-LCD Compensated with Hybrid-Aligned Discotic LC Films and C-Plates

I. Fukuda, T. Nakata, Y. Sakamoto, T. Ishinabe^{*}, T. Uchida^{*} Kanazawa Inst. of Tech., Japan ^{*}Tohoku Univ., Japan

We investigated the relationships between the viewing-angle optical properties and the device parameters in an OCB-LCD compensated with hybrid aligned discotic liquid-crystal films and C-plates. We verified that the polar angle dependence of the sum of the retardation of the LC layer and the compensation films, Ret_{total}, is a useful guideline for optimizing the design parameters, and that a wide viewing angle could be achieved by optimizing all design parameters of the compensation films.

LCTp3 - 8 High Transmittance MVA-LCD with Small Color Shift

C. H. Lin, K. Y. Huang, H. Y. Lin TPO Displays, Taiwan

A new pixel structure is developed for improving the color shift of the high transmittance multi-domain vertical-alignment liquid crystal display (MVA-LCD). According to this structure, low color shift of a high transmittance MVA-LCD at large viewing angle was demonstrated without sacrificing viewing angle and contrast ratio. Potential application for mobile display is emphasized.

LCTp3 - 9 A Novel Design of the Slit Pattern on the Patterned Vertical Alignment (PVA) Mode

J. H. Son, S. W. Choi, W. R. Lee, K. M. Kim, Y. H. Choi, J. S. Yang, J. J. Lju^{*}, K. H. Kim^{*}, G. D. Lee Dong-A Univ., Korea *Samsung Elec., Korea

We studied the liquid crystal (LC) dynamic stability of the defect around the slit edge (wing pattern) in the patterned vertical alignment (PVA) cell. LC dynamics is very unstable near the edge of the slit because there is a strong competition of strain energy of LC director around active area and edge on the wing pattern, so that we can easily find unstable defect line on the slit. It is possible to control LC dynamics near the edge of the slit by using different wing shape. In this paper we propose an advanced wing shape which includes defect trap for sticking the defect moving to the out of the active area. This shape prevent the generation of the defect core on the slit in the active area even if we increase the operation voltage, so that LC dynamics around the wing pattern can be very stable. This result indicates that advanced wing shape increase the transmittance and response time.

LCTp3 - 10 Optical Design of Wide-Viewing-Angle Transflective OCB-LCD

I.-A. Yao, H.-L. Ke^{*}, C.-L. Yang, C.-J. Chen, J.-P. Pang, T.-J. Chen^{*}, J.-J. Wu^{*} InnoLux Display, Taiwan ^{*}Nat. Taipei Univ. of Tech., Taiwan

A novel transflective display with wide viewing angle and fast response time has been designed by associating with an optically-compensatedbend (OCB) liquid crystal mode. By optimizing the parameters of compensation films and a liquid crystal cell, the normalized voltage dependences of transmittance and reflectance curves overlap completely, which means the single driving method can be applied. Moreover, it shows wide viewing angle characteristic in both transmissive and reflective areas and these results are verified by using the Poincare sphere analysis.

LCTp3 - 11 A Novel Pixel with Small Color Shift for Fringe Field Switching Mode LCD

Y.-C. Lin, C.-Y. Wang, C.-Y. Chi, C.-J. Chen, C.-L. Yang, J.-P. Pang InnoLux Display, Taiwan

In this article, we will demonstrate a novel pixel for FFS mode LCD with a shape of string (String FFS). With designed pixel pattern, String FFS has better color performance at off-axis angle while maintaining the same viewing cone and contrast as original FFS. We have achieved the String FFS with response time of 16ms, viewing angle U/D/L/R 88°/88°, low color shift of \triangle u'v' less than 0.02, and D-value of gamma curves less than 0.12 at all viewing angle.

LCTp3 - 12 A Method to Characterize the Hybrid-Aligned Discotic LC Compensation Film for TN-LCDs

R.-B. Li, W.-C. Chen, S.-Y. Chien, K.-H. Yang HannStar Display, Taiwan

We have developed a theoretical model to fit the total phase difference of a hybrid-aligned discotic LC film fabricated on a TAC substrate as a function of incident angles to the experimentally measured results. Such model allows us to calculate the pretilt angle and the birefringence of each discotic LC layer within the hybrid-aligned discotic LC film.

LCTp3 - 13 A Fringe-Field Driven Hybrid Aligned Nematic LCD for Narrow Viewing-Angle Displays

J. W. Ryu, J. Y. Lee, Y. J. Lim, M.-H. Lee, S. H. Lee Chonbuk Nat. Univ., Korea

Liquid crystal displays (LCDs) that exhibits a high image quality only at normal direction have been investigated. For this purpose, a hybrid aligned nematic LC cell driven by a fringe field was chosen and its electro-optic characteristics with optimal cell structure were evaluated. The device exhibits a high transmittance of 90%, low driving voltage and narrow viewing angle less than 20° in terms of CR 2:1 along horizontal direction, which is highly effective for private display application.

LCTp3 - 14 Viewing Angle Switching of Vertical Aligned LCD

E. Jeong, M. O. Choi, Y. J. Lim, G.-D. Lee^{*}, S. H. Lee Chonbuk Nat. Univ., Korea ^{*}Dong-A Univ., Korea

New display technology to control the viewing angle has been developed. Conventional Vertical Aligned (VA) mode offers the advantages of a high contrast ratio in the front and simple optical configuration. Conversely Vertical Aligned (VA) mode with no compensation film showed very poor viewing angle performance. But Vertical Aligned (VA)-LCDs with the negative C- plate and Positive A-plate showed excellent viewing angle performance. So we replaced Positive A- plate by a Homogeneous liquid crystal layer. As of a result, Vertical Aligned (VA) mode with nonbiased homogeneous layer showed wide viewing angle and Vertical Aligned (VA) mode with biased homogeneous layer realized Narrow viewing angle.

LCTp3 - 15 Wide-Viewing-Angle Single-Cell-Gap Transflective LCD on PVA Mode

W. K. Choi, Y. H. Wu, M. L. Lee, K. H. Chen, Y. F. Luo Nat. Taiwan Univ., Taiwan

In this paper, we propose a new design for achieving a single-cell-gap Transflective TFT-LCD (TR-LCD) that is based on PVA (Patterned Vertically-Aligned) LC mode. By modifying the PVA electrode design and, in particular, by introducing a new "half-electrode" design in the reflective region, the R-V and T-V curves of a single-cell-gap PVA TR-LCD can become more matched and hence result in improved optical efficiency.
LCTp3 - 16 Single-Cell-Gap Transflective TFT-LCD Using Partial Switching

W.-K. Choi, R.-C. Lee, C.-C. Tasi, S.-T. Wu^{*} Nat. Taiwan Univ., Taiwan ^{*}Univ. of Central Florida, USA

In this paper, we propose a new design for achieving a single-cell-gap Transflective TFT-LCD. Narrow striped electrode is used in the reflective (R) region such that the electric fields generated there are dominated by fringing fields. This results in reduction in LC switching angle in the R region and hence much better matched R-V and T-V curves with optical efficiency of \geq 90% at the same applied voltage.

LCTp3 - 17 Analysis of Transmittance Unbalance at Low Gray Level in Two-Domain Fringe-Field Switching (FFS) Mode

O. S. Son, J. B. Park, S. H. Park, E. J. Park, I. C. Park, H. Y. Kim, J. Y. Lee BOE_CTO_CRI, Korea

We have investigated the transmittance difference between upper and bottom domain at low gray level in 2-domains fringe-field switching (FFS) mode structure. Also we found out total deviation angle of rubbed liquid crystal (LC) from measurement and simulation. And, polarizing optical microscope (POM) texture also confirms LC deviation angle. As LC director in bottom domain is rotated to ideal alignment direction at low voltage, the transmittance decreases.

LCTp3 - 18 Influence of Cell Design with Homogeneous LC Alignment on L0 Gray

J. B. Park, S. H. Park, E. J. Park, I. C. Park, H. Y. Kim, J. Y. Lee BOE_CTO_CRI, Korea

In this paper, we investigated L0 influenced by cell gap (d) and birefringence (Δ n) using simulation and experimental results. Basically, the less cell retardation, the less L0 and L255. In normal rubbing area, the more cell gap increases, the more L0. In abnormal rubbing area, the more Δ n increases regardless of cell gap, the more L0.

LCTp3 - 19 Novel Patterned Vertical Alignment LCD for Mobile Application with Excellent Optical Performance and Reliability

J. H. Kim, Y. S. Yeo, W. S. Park, S. K. Lee, S. H. Ahn, C. W. Kim Samsung Elec., Korea

We developed a novel Patterned Vertical Alignment (PVA) LCD for mobile application with excellent optical performance and cost efficiency by optimizing the design rule, fabrication process and materials such as LC and polarizer. Our new design rule and process architecture enabled an increase of 36% aperture ratio (A/R) and better electro-optical performance compared with those of the conventional PVA design.

LCTp3 - 20 Improved Performance of Homogeneous Mode Transflective LCDs with Low Driving Voltage and Wide Viewing Angles

Y. Sakurai, T. Ohnishi, Y. Sakamoto, I. Fukuda Kanazawa Inst. of Tech., Japan

We studied the feasibility of enhancing the performance of our recently proposed homogeneous-mode transflective liquid-crystal displays (LCDs) with low driving voltage and wide viewing angles. We further reduced the power consumption of the LCD by raising the off-state voltage from 0V to a threshold voltage of approximately 0.5V, which did not affect the display characteristics. We also realized considerably improvement in the optical properties of the viewing angle in the transmissive part by incorporating a two-domain structure.

LCTp3 - 21 Improvement of Diffraction Efficiency in High Temperature Region for Holographic Polymer Dispersed LC

A. Ogiwara, K. Shingai Takamatsu Nat. College of Tech., Japan

The H-PDLC device using the liquid crystal materials consisting of various Nematic-Isotropic(N-I) transition temperatures is fabricated. The device fabrication conditions for those liquid crystal materials are discussed to realize the high diffraction efficiency and polarization dependence. The diffraction efficiency in high temperature region is improved by the control of a process temperature corresponding to the N-I point of liquid crystal materials.

LCTp3 - 22 White Fluorescent LCD Using Guest-Host and Scattering Modes

R. Yamaguchi, K. Moriyama, S. Sato Akita Univ., Japan

White fluorescent display properties in LC cells with dichroic dyes emitting complimentary or trichromatic colors have been reported. The fluorescent intensity was improved by using the cholesteric scattering mode. The back scattered light of a ambient white light was added to the white emission light and the visibility at outdoor or in a bright room could be increased.

LCTp3 - 23 π-Bistable Twisted Nematic Device Sustained by Polymer Walls

J.-H. Shin, C. G. Jhun, J.-I. Baek, M.-C. Oh, T.-H. Yoon, J. C. Kim Pusan Nat. Univ., Korea

A bistable twisted nematic (BTN) liquid crystal cell can generally be fabricated by adding a chrial additive to the liquid crystal materials. In this paper, we propose a novel BTN liquid crystal mode sustained by polymer walls without any chiral dopant. With parallel rubbed substrates, the π twist state can be stabilized by utilizing the fluorinated-polymer wall. Therefore, bistable characteristics can be achieved without any chiral dopant. We demonstrate switching process between two stable states which show permanent memory time.

LCTp3 - 24 Dual Mode Switching for Viewing-Angle Control with a Single LC Panel

J.-I. Baek, Y.-H. Kwon, J. C. Kim, T.-H. Yoon Pusan Nat. Univ., Korea

We propose dual mode switching of liquid crys-tal (LC) by which we can control the viewing-angle characteristics with a single panel. In the wide viewing-angle (WVA) mode, the dark state is con-served at off-axes, whereas the dark state of nar-row viewing-angle (NVA) mode shows the leakage of light at off-axes. Dark states of both modes show no leakage of light at normal, which guaran-tees the high contrast ratio (CR) at the front.

LCTp3 - 25L Low-Cost High-Yield High-Contrast Wide-Viewing-Angle MVA with the Elimination of both Protrusion and ITO Slit Geometries

H. L. Ong, J. S. Chou, W. C. Lan^{*}, J. H. Guo^{*}, I. H. Chen^{*} Kyoritsu Optronics, Taiwan ^{*}Prime View Int., Taiwan

We successfully fabricated low cost high contrast, high brightness, wide symmetrical viewing angle multi-domain vertical alignment (MVA) LCDs with the elimination of both protrusion and ITO slit geometries. The fabrication process is simple, high yield, and high reliability with currently the lowest fabrication cost, which is even lower than the cost for the wide-viewing angle TN/LCDs. This device is based on new pixel designs using the amplified intrinsic fringe field controlled MVA that was invented recently by Ong.

LCTp3 - 26L i-LCD Technology of AFFS Tablet for Superior Outdoor Readability

B. H. Kim^{*,**}, S. Choi^{*}, J. B. Park^{*}, S. J. Baek^{*}, S. J. Jang^{*}, S. R. Lee^{*}, H. Y. Kim^{*}, J. Y. Lee^{*}, J. Jang^{**} ^{*}BOE HYDIS, Korea ^{**}Kyunghee Univ., Korea

We have developed novel pixel design of ad-vanced fringe-field switching (AFFS) mode with high transmittance and reflectance for superior outdoor readability. The concept of this design, so called i-LCD is to increase aperture ratio without BM and in addition, use reflected light by metal layer on BM-less region into transmissive component under outdoor environment. Compared with conventional design with BM, reflectance in-creases 117% and additional 65% of reflectance is increased with Top_Mo etch process.

LCTp3 - 27L Controllable Viewing Angle LCD Using One LC Cell

W.-J. Shin, T. Won Inha Univ., Korea

In this paper, we report the controllable viewing angle LCD, which uses one LC cell. This structure is applicable to the different mode such as PVA, MVA and so on. Electro-optical properties of these cells are calculated with 3D FEM numerical solver, TechWiz LCD, which is commercially available in the market.

Wednesday

LCTp3 - 28L Comparison of Continuous Pinwheel Alignment (CPA) Mode with Conventional VA Mode in Terms of Electrical Optical Properties

S. Y. Cho, C. S. Lee^{*}, T. Y. Won Inha Univ., Korea ^{*}Sanayi Sys., Korea

In this paper, we report our theoretical study on the electro-optical properties of continuous pinwheel alignment (CPA) mode. We performed 3D-FEM simulations and compared our simulation results with the performance of the conventional vertical alignment (VA) mode. CPA mode can exhibit better performance than VA mode in terms of transmission as well as viewing characteristics. Transmittance of CPA mode is higher than VA mode by 81 %. In addition, viewing angle of the CPA mode can be improved by 22%.

LCTp3 - 29L Design of Twisted-VA Transflective LC Cell in Single Cell-Gap

T. I. Kim^{*,**}, G. S. Lee^{*}, S. R. Lee^{*}, J. C. Kim^{*}, T.-H. Yoon^{*} ^{*}Pusan Nat. Univ., Korea ^{**}Samsung SDI, Korea

In this paper we propose a structure for a twisted VA transflective liquid crystal cell in single cellgap, in which different twist angles are introduced for each part, reflective and transmissive parts. By using patterned inner retarder, we achieved not only a good optical performance but also single gamma.

LCTp3 - 30L The Gamma Curve Control by Using Variation of Gray Scale Level

J.-B. Lee, T. Won Inha Univ., Korea

In this paper we proposed a novel algorithm to achieve consistent LCD color performance. The novel algorithm has been developed for automated tuning and programming of LCD gamma. The method is to change 8-bit digital values which are inputted in the serial interface receiver to store in the data drive IC. That is, we can convert it into the 8-bit digital values to fit target gamma. For an exemplary 8-bit resolution, the simulation verified adequacy of the proposed algorithm.

LCTp3 - 31L Design of High Performance Viewing-Angle-Controllable LC Panel

K. Hiyama, R. Ogawa, T. Ishinabe, T. Uchida Tohoku Univ., Japan

We investigated the design conditions of the view-ing-angle-controllable (VAC) liquid crystal panel by using a Poincare sphere representation. As a result, we clarified a VAC LC panel using vertically-aligned (VA) LC cell and negative C-plate has a high light shielding efficiency.

Ohmi 5-7

13:20 - 16:20

Poster LCTp4: Characterization

LCTp4 - 1 Determination of Surface Anchoring Energy of Vertically Aligned Nematic LC Cells Measured by Saturation Voltage Method

Y. Sasaki, H. Ichinose^{*}, H. Naito Osaka Pref. Univ., Japan ^{*}Merck, Japan

A new saturation voltage method is proposed for determining the anchoring energy of nematic liquid crystals (NLCs) with negative dielectric anisotropy in vertically aligned NLC cells by measuring capacitance of the NLC cells as a function of voltage applied to NLC cells. To show the validity of the anchoring-energy measurement, the capacitance-voltages characteristics of the NLC are numerically examined. By means of this method, the anchoring energies of each pixel in vertically aligned NLC display can be determined.

LCTp4 - 2 Pretilt Angle Measurement Using PEM

Y. W. Li, F. S. Y. Yeung, L. Tan, J. Y. L. Ho, H. S. Kwok Hong Kong Univ. of S&T, Hong Kong

A new method of measuring arbitrary pretilt angle for LCD using photoelastic modulator is discussed. Different from crystal rotation method, it is able to measure pretilt angles accurately from 0 to 90 degree. No cell gap and wavelength information is required. It is also possible to determine two-dimensional liquid crystal cell parameter distributions at real time.

LCTp4 - 3 Fast Inspection for Bended Flexible Display

Y.-R. Lin, S.-C. Jeng, W.-T. Hsu, C.-C. Liao, C.-C. Chen^{*}, Y.-H. Lien^{*}, T.-J. Shy^{*} ITRI, Taiwan ^{*}Tsing Hua Univ., Taiwan

We develop a fast inspection system for measuring the electro-optical characteristics of any region of a flexible display such as resistance, birefringence, Transmittance versus Voltage curve (T-V), response time, and spectrum under bending condition. Birefringence of plastic substrate and resistance of conducting layer IZO (Indium Zinc Oxide) on plastic substrate in different radius curvature are investigated in this paper.

LCTp4 - 4 Influence of Chiral Dopant and Monomer Concentration on the Electro-Optical Characteristics of the Reverse Mode Polymer Stabilized Cholesteric Texture Cell

Y. S. Chih, S. W. Ke, C. Y. Huang Nat. Changhua Univ. of Education, Taiwan

Reverse mode polymer stabilized cholesteric texture cells with various chiral and monomer concentrations were investigated. The electrooptical measurements indicate that the chiral dopant increases the hysteresis width and decrease the field-off response time, the monomer decreases the hysteresis width and increases the field-off response time of the cell. The field-on response time is independent of the monomer and chiral concentration and the thinner cell has the smaller hysteresis width.

LCTp4 - 5 Biphotonic Z-Scan Studies of the Nonlinear Optical Effect in the Azo-Dye Doped LC Films

H.-C. Lin, A. Y.-G. Fuh Nat. Cheng Kung Univ., Taiwan

The nonlinear optical effects of azo-dye-doped liquid crystals are investigated using biphotonic Z-scan technique. The effects measured using the red light Z-scan can be modulated/switched with the simultaneous application of a green light. Similar results can be using the green light Z-scan with a red light simultaneously. In the former case, the nonlinear properties are dominated mainly by thermal effects, while the effects are resulted from the molecular reorientation of liquid crystal induced by photoisomerized dyes in the latter one.

LCTp4 - 6L Line Profile Measurement for Anisotropy of Rubbed Polyimide Film on Actual LCD Panel

T. Tanooka, T. Kikuchi, A. Takai, K. Kaneko, Y. Horiguchi, M. Kawata, T. Miyashita^{*}, T. Uchida^{*}, I. Hirosawa^{**} Moritex, Japan ^{**}Tohoku Univ., Japan ^{**}Japan Synchrotron Radiation Res. Inst., Japan

For display devices, the measurement for evaluations in a large area has been demanded. We developed a method to measure line profiles for the anisotropy of rubbed polyimide films for the LCD by using difference Speedy Measurement by Polarization conversion (d-SMP) method. This method has advantages of low noises and high speed. It has the possibility to evaluate orientation defects of rubbed polyimide films immediately after a rubbing process.

Thursday, December 7

9:00 - 10:20

Ohmi 1

LCT4: LCD Modes (1)

Chair: K. Takatoh, Sci. Univ. of Tokyo in Yamaguchi, Japan Co-Chair: S. Komura, Hitachi Displays, Japan

LCT4 - 1 Flexible LCDs, The "Kent Approach" 9:00

J. West, B. Taheri^{*}, A. Khan^{**} Kent State Univ., USA ^{*}Alpha Micron, USA ^{**}Kent Displays, USA

A consortium of Northeast Ohio companies and Kent State University have taken an alternative approach to producing flexible liquid crystal displays. We utilize liquid crystal effects that do not require polarized light and can be addressed with a passive matrix. Unlike other competing technologies our approach is compatible with commercially available flexible substrates. Using this approach consortium companies are producing and selling flexible displays and related devices.

LCT4 - 2 A4-Sized LCDs with Flexible Light Guide Plate 9:20

H. Sato, H. Fujikake, Y. Fujisaki, S. Suzuki^{*}, D. Nakayama^{*}, T. Furukawa^{**}, H. Kikuchi, T. Kurita NHK, Japan ^{*}Minebea, Japan ^{**}Kyodo Printing, Japan

We have developed an A4-paper-sized ferroelectric liquid crystal (FLC) display that includes a flexible backlight sheet. The flexibility of the backlight was achieved by a combination of a side light consisting of three-primary-color LED chips and a thin flexible-polymer light-guide plate. Colored moving images were displayed on a flexible screen by driving with an active matrix technique using an external switch transistor-array based on a field-sequential-color method.

LCT4 - 3 High Efficiency Optical Rewritable Device 9:40

A. Muravsky, A. Murauski, X. Li, V. Chigrinov Hong Kong Univ. of S&T, Hong Kong

We developed new Optical Rewritable (ORW) liquid crystal technology and utilize it to create display. ORW display carries no electrodes on board and uses polarizer as substrates. Its simple construction secures durability and low cost. The on screen information is changed in writing unit that consists of LCD-mask and exposure source based on LED, low power and cheap solution in comparison with Hg-lamps or lasers. The main target of Optical Rewritable device is the plastic card display application.

LCT4 - 4 Fast Horizontal Switching of Bistable Chiral Splay 10:00 Nematic LC with Patterned Electrodes

C. P. Chen, C. G. Jhun, T.-H. Yoon, J. C. Kim Pusan Nat. Univ., Korea

Bistable chiral splay nematic (BCSN) has been added to the repertoire of LCDs as a novel bistable device. Unlike BiNem, BCSN belongs to the bulk switching bistable LCD and allows both vertical and horizontal operation. For each operation, it requires the transition from splay state to π twist state or vice versa. In this letter, a practical method of realizing fast horizontal switching by using patterned electrodes is to be proposed.

10:40 - 12:10

Ohmi 1

LCT5: LCD Modes (2)

Chair:J. West, Kent State Univ., USACo-Chair:H. Okada, Toyama Univ., Japan

LCT5 - 1: Invited Fast In-Plane Switching Mode in Vertically 10:40 Aligned Banana-Shaped LCs

H. Takezoe, Y. Shimbo, Y. Takanishi, K. Ishikawa, E. Gorecka^{*}, D. Pociecha^{*}, J. Mieczkowski^{*}, K. Gomola^{*} Tokyo Inst. of Tech., Japan ^{*}Warsaw Univ., Poland

We have studied a new display mode using banana-shaped liquid crystals. This display mode possesses all the advantages, i.e., high contrast, wide viewing angle, fast switching and continuous gray scale, of the existing liquid crystal displays such as VA, IPS, FLC and V-shaped switching modes. The switching was interpreted based on SHG data, which were well simulated by 2-D Langevin process.

LCT5 - 2: Invited Peeping Prevention Technology: Control of 11:05 LCD Viewing Angle Properties

K. Takatoh, S. Kobayashi, S. Kimura^{*}, N. Okada^{*}, T. Kanetsuna^{*}, N. Hirama^{*}, S. Kurogi^{*}, S. Sekiguchi^{*}, K. Uemura^{*} Sci. Univ. of Tokyo in Yamaguchi, Japan ^{*}Toshiba Elect. Eng., Japan

New peeping prevention technology to control the viewing angle properties of TFT-LCDs has been developed. In this technology, an additional LC panel in which the whole area is divided into two kinds of small visible domains of different LC alignment directions is used. New twisted nematic type of LCD with quite unique properties for the purpose of this device has been developed. The products have been applied to commercially available notebook computer and so on.

LCT5 - 3 Multi-Domain Vertically Aligned LCDs with Small 11:30 Color Shift

C.-C. Liu, Y.-P. Chang, M.-C. Tai, M.-H. Chang, M.-T. Wang Chunghwa Picture Tubes, Taiwan

New MVA pixel with two independent divided sub-pixels was successfully developed to improve the off-axis image quality of liquid crystal display. By our artful pixel circuit and structure, there is a suitable voltage discrepancy between the transparent electrodes of those sub-pixels. The light-skin at a diagonal viewing angle appears natural. Its u'v' change is from 0.03 to 0.01. Moreover, the kickback voltage, dVp of each sub-pixel can be adjusted independently to improve the image quality.

LCT5 - 4 Optimization of the Edge Disclination in FFS Mode 11:50 TFT-LCDs

Y. B. Lee, C. T. Liao, A. Chao, C. H. Yu, T. S. Jen HannStar Display, Taiwan

In this paper, we present an optimized design of the pixel electrode structure in FFS Mode TFT-LCDs. We simulated and evaluated various kinds of pixel edge design. From analysis of LC texture and transmittance we could find out a proper electrode edge structure. Then, a novel FFS pixel structure with high transmittance was proposed and demonstrated. This pixel structure improves transmittance by 30-40% compared to traditional FFS pixel. These structures reduce the disclination area and improve the transmittance of FFS mode TFT-LCDs.

----- Lunch -----

13:50 - 15:20

Ohmi 1

LCT6: LCD Modes (3)

Chair: H. Takezoe, Tokyo Inst. of Tech., Japan Co-Chair: M. Inoue, TOYO, Japan

LCT6 - 1: Invited Recent Advance in Transflective LCDs

X. Zhu, J.-H. Lee, Z. Ge, Y.-H. Lin, S.-T. Wu Univ. of Central Florida, USA

Three new transflective liquid crystal displays (LCDs) are reported in this paper. The first one uses color sequential method for transmissive mode with an LED backlight. The second utilizes a wire-grid-polarizer in the reflective part without any phase retardation film. The third is a polarizer-free transflective LCD based on the absorption and scattering mechanisms of dye-doped negative LC gel.

LCT6 - 2: Invited A New Transflective IPS-LCD with High 14:15 Contrast Ratio and Wide Viewing Angle Performance

O. Itou, S. Hirota, J. Tanno^{*}, M. Morimoto^{*}, K. Igeta^{*}, H. Imayama^{*}, S. Komura^{*}, N. Tetsuya^{*} Hitachi, Japan ^{*}Hitachi Displays, Japan

A new transflective IPS-LCD with in-cell retarder on the reflective display portion is designed to improve contrast ratio and viewing-angle performance of transmissive displays. The in-cell retarder and liquid crystal layer are designed as they make a wide band quarter-wave plate composed by a quarter-wave plate, a half-wave plate and a polarizer. Contrast ratio higher than 500: 1 and viewing-angle performance comparable to transmissive IPS-LCD is obtained, and thickness of LCD panel is reduced at same time.

LCT6 - 3 14:40 High Efficiency ECB-Mode Transflective LCD C.-S. Cheng, C.-J. Hu, C.-M. Chang, W.-L. Liau AU Optronics, Taiwan

For the better optimization of transflective liquid crystal displays (TR-LCDs), a new design concept adopted is inevitable. We have developed a novel TR-LCDs that utilizes a specific pixel structure and electric controlled birefringence effect of a liquid crystal cell with normal black operated mode under single cell gap. This display has the advantages: (1) lower power consumption than conventional TR-LCDs with normal white operated mode. (2) it can simplify the fabrication process to obtain the higher yield. (3) higher transmissive open ratio and higher reflectance.

LCT6 - 4 Fast Response and High Contrast OCB Display 15:00 Using LED Backlight and Novel Driving Scheme

Y. Tanaka, H. Takahara, T. Fukami, S. Kawaguchi, K. Nakao, A. Takimoto Toshiba Matsushita Display Tech., Japan

A newly developed OCB LCD (referred to as OCB-III) using an LED blinking backlight is re-ported. The key technology of OCB-III is a novel driving scheme that is made possible by combination of OCB and LED both having fast response characteristics. We demonstrated high performance of MPRT (4.7msec) and contrast ratio (1000:1) with 9-inch WVGA OCB-III panel. We conclude that OCB-III is an innovative technology that realizes a display of CRT-quality with LC panel.

----- Break -----

Ohmi 1

15:40 - 17:05

LCT7: Characterization

LCT7 - 1: Invited Recent Measurement of LC Material 15:40 Characteristics

M. Inoue^{*,**}, K. Takatoh^{**}, S. Kobayashi^{**} ^{*}TOYO, Japan ^{**}Sci. Univ. of Tokyo in Yamaguchi, Japan

We have developed many kinds of Liquid Crystal Measurement Systems such as VHR, Ion Density, Residual DC and Elastic Constant since 1990. In this paper, we summarize some results of measurements by means of the above mentioned systems and report our new measurement method for Liquid Crystal material characteristics.

LCT7 - 2 Towards a Better Understanding of the Reverse Flow 16:05 Effect in Multi-Domain VA-LCDs

N. Dessaud, S. J. Roosendaal, J. R. Hector^{*}, J. R. Hughes^{*}, D. K. G. de Boer Philips Res. Europe, The Netherlands *Cross Oak Lane, UK

Reverse flow is present in multi-domain VA-LCDs and can be the cause of relatively slow switching. To allow good motion portrayal, it is important to understand what affects this unwanted flow and therefore optimize the LC parameters, drive schemes and pixel designs to reduce/remove its effect. Using simple test cells and 1D simulations allowing twist deformations a good agreement between experimental and simulation results was found.

LCT7 - 3 Verification of the Lateral Ion Transport in MVA Mode 16:25 Display

P. M. Liu, C. T. Chen, J. L. Tung, T. C. Lai, J. J. Su, T. J. Chang, W. L. Liau, A. Lien AU Optronics, Taiwan

The physical phenomenon of Line Shape Sticking caused by the lateral ion transport in the MVA mode AMLCD is clarified. Long-term verification of the real panels with some static test patterns under high temperature has been done, and the phenomenon is checked at the gray levels after burning-in.

LCT7 - 4L Azimuthal Bistable Nematic Display with Dual In-16:45 Plane Switching Based on Nano-Imprinting Technology

J. S. Gwag^{*}, M. Yoneya^{*,**}, H. Yokoyama^{*,**} ^{*}Japan S&T Agency, Japan ^{**}Nat. Inst. of Advanced Ind. S&T, Japan

Based on nanoimprinting lithography, a novel bistable nematic device driven simply by dual in-plane electric fields is proposed. The bistability is created from a composite action between two easy axes, having mutually orthogonal directions. The azimuthal direction of the bistability can be controlled by the appropriate combinations of two mutual anchoring strengths. This novel bistable display has a good optical characteristics as shown in the in-plane switching nematic liquid crystal mode.

Author Interviews

18:40 - 19:40

Supporting Organizations:

LC Physics and Condensed Matter Forum, JLCS Chemistry and LC Material Forum, JLCS Liquid Crystal Display Forum, JLCS LC Photonics and Optical Device Forum, JLCS Soft Matter Form, JLCS Molecular Alignment Electronics Forum, JLCS Technical Group on Information Display, ITE Technical Committee on Electronic Information Displays, Electronics Society, IEICE

IDW Tutorial in Japanese

luesday, December 5 Ohmi 10 (2F) Otsu Prince Hotel

Detail information will be available in October: http://www.sidchapters.org/japan/wiki.cgi

Contact address: idw.tutorial@tmdisplay.com

Workshop on Active Matrix Displays

Wednesday, December 6

AMD1: LC-TV

13:00 - 14:25

Ohmi 2

Chair: H. Hamada, Sanyo Elec., Japan Co-Chair: M. Tsumura, Future Vision, Japan

AMD1 - 1: Invited Perspective on Large-Sized High-Quality 13:00 LCD-TV

K. Okamoto Sharp, Japan

As the result of the intensive effort to overcome weaknesses of the LCDs such as viewing angle, moving picture quality and contrast ratio, LCD-TVs are now widely accepted in the consumer market. Innovations to resolve these weaknesses have been reviewed, and perspective on upcoming new generation imaging era by the high-quality LCD-TVs will be discussed.

AMD1 - 2: Invited Advanced MVA with High CR and Wide 13:25 Viewing Angle for TV-LCDs

P.-L. Chen, Y.-P. Huang, W.-K. Huang, C.-H. Tsao, J.-J. Su, T.-R. Chang, H.-L. Hou, Y.-C. Lin, K.-Y. Lin, C.-W. Wang, C.-T. Liu AU Optronics, Taiwan

No abstract was submitted.

AMD1 - 3 Low Power Consumption TFT-LCDs with 2Z-13:50 inversion Pixel Structures

H. C. Liu, C. T. Liao, T. C. Chung, M. T. Lin, D. S. Lee, S. L. Lee, T. S. Jen HannStar Display, Taiwan

LCDs need low power consumption feature with high image quality for recent using habit. We present a brand-new pixel structures with the simplest driving scheme to achieve both requirements. It named 2Z-inversion, which implemented 2V1H twin-dot inversion on array plate with low power column-inversion driver ICs. We design the unbalance spacing layout to improve the horizontal Mura caused by 2Z-inversion layout. 12inch XGA panel with around 40% power saving could be obtained as compared to tradition dot inversion driving scheme.

AMD1 - 4L Column Line Inversion Driving for IPS-Pro LCD-TVs 14:10

K. Endo, R. Oke, K. Ono Hitachi Displays, Japan

A column line inversion driving method was used to overcome the limited charging capability of TFTs and temperature increase in data driver IC. The method dramatically reduced the LCD alternating frequency, thus reducing not only heat in the IC, but also cost. The technology has been successfully introduced into TFT-LCDs fabricated by IPS Technology with superior moving picture performance under 120 Hz driving.

----- Break -----

14:40 - 16:15

Ohmi 2

AMD2: TFT Novel Applications

Chair: K. Okamoto, Sharp, Japan Co-Chair: K. Takatori, NEC LCD Techs., Japan

AMD2 - 1: Invited A Capacitive Fingerprint Sensor with 14:40 Integrated Comparator Based on LTPS TFTs

H. Hara, M. Miyasaka, C. Iriguchi, S. W. B. Tam^{*}, S. Inoue, T. Shimoda Seiko Epson, Japan ^{*}Cambridge Res. Lab. of Epson, UK

This paper introduces and discusses a low-temperature polycrystalline silicon thin film transistor (LTPS-TFT) fingerprint sensor (FPS) based on a capacitive detection method. We have integrated a comparator circuit as an analog-to-digital converter (ADC) on a glass substrate that recognizes a ridges and valleys of a fingerprint by adjusting the reference voltage. Using this method, we have succeeded in taking fine fingerprint images at operating voltage of 4V. This paper also describes minute TFT devices and circuits for further low-voltage operation.

AMD2 - 2: Invited Flexible Braille Sheet Display with Organic 15:05 FETs and Plastic Actuators

T. Takamiya, T. Sekitani, Y. Kato, H. Kawaguchi^{*}, T. Someya, T. Sakurai Univ. of Tokyo, Japan ^{*}Kobe Univ., Japan

Organic FETs (OFETs) are integrated with actuators, and a Braille sheet display is demonstrated. A newly developed back-gated OFETs SRAM and the circuits technology for the Braille sheet display to enhance speed, yield and lifetime are presented, which will be essential for future large-area electronics made with OFETs.

AMD2 - 3: *Invited* Two Methods of Realizing Double Display 15:30 Screen

G. Hamagishi, S. Takemoto, N. Sugiyama, Y. Tanaka^{*}, T. Yata^{*}, T. Washizawa^{*} Seiko Epson, Japan ^{*}Sanyo Epson Imaging Devices, Japan

A double display screen that simultaneously provides a different image depending on whether one is sitting in the driver's seat or passenger seat has been developed as a new display for in-vehicle applications. A barrier method like that used in 3-D displays was developed as a means to separate the images. A method of controlling the directivity of polarized light was developed as a means to create even more added value.

AMD2 - 4 TFT Nonvolatile Memory Cell Using Sequential 15:55 Lateral Solidified LTPS Process

H. T. Chen, C. Y. Tseng, Y. H. Yeh ITRI, Taiwan

A novel nonvolatile memory cell with field enhanced trapping structure in low temperature poly-Si TFTs have been fabricated and demonstrated successfully on glass substrate. A program/erase window of 2 V has been achieved with high P/E speed (1ms/10ms), good endurance of 10^4 P/E cycles, while a 1.5V window remained after 10^4 seconds at 85°C for data retention and negligible read/write disturbances.

----- Break -----

Ohmi 2

AMD3: SOG/Mobile

Chair: Y. Nakajima, Sony, Japan Co-Chair: H. Hara, Seiko Epson, Japan

AMD3 - 1: Invited Narrow-frame System-On-Glass LCD with Low 16:25 Voltage Interface Circuitry

M. Murase, Y. Kida, D. Ito, M. Tonogai, Y. Takahashi, Y. Nakajima Sony, Japan

A system-on-grass liquid crystal display, which fully integrates a low voltage 6-bit RGB parallel interface circuitry, has been developed by using a pulse switching DC-DC converter and an offset-cancel level shifter. This technology allows for lowering power supply voltage of external LCD controllers. We also have developed a serial signal processing method to reduce a width of horizontal drivers that forms the narrowest frame width in system-on-grass displays to date.

AMD3 - 2: Invited New High-Speed Logic Circuitry and Power-16:50 Supply System using LTPS-TFT Technology for SOG/SOF

Y. Suzuki, K. Umeda^{*} Tokai Univ., Japan ^{*}NEC Elect., Japan

In this paper, a new high-speed logic circuitry and a new power-supply system for SOG/SOF is introduced. The new logic circuitry can be operated with the frequency by around 3-10 times higher than that of the conventional circuit by using the bootstrapped technology. Also, the power-supply system can convert +5V single power-supply voltage to about +15V voltage. Moreover, a stable voltage can be obtained even if the fluctuation of ambient temperature and power-supply voltage occurred in the new power-supply system.

AMD3 - 3: Invited The 12.1-in. Wide-Format Low-Temperature 17:15 Polysilicon (LTPS) TFT LCD for Mobile Notebook PC Application with 0.2mmt Glass Substrate and LED Backlight System

H. Maeda Toshiba Matsushita Display Tech., Japan

Toshiba Matsushita Display Technology developed the world's first thinnest and lightest weight 12.1-inch wide-format low-temperature polysilicon (LTPS) TFT LCD for notebook PC applications. It use two high technologies, one is a new LED backlight system and the other is a glass-etching technology that achieve the 0.2mm-thickness glass substrates. This approach results in a module with thickness of 2.9mm (at the thinnest part) and weight of 183g, which is about half thickness and 32% reduction of weight compared with current product.

AMD3 - 4a-Si TFT Gate Driver Circuit Having Dual Pull-Down17:40Structure with Shared Node Controller

H. N. Cho, Y. H. Jang, S. Y. Yoon, B. Kim, M. D. Chun, S. C. Choi, K. S. Park, T. Moon, H. Y. Kim, C. I. Ryoo, N. W. Cho, S. H. Jo, C.-D. Kim, I. J. Chung LG.Philips LCD, Korea

A novel gate driver circuit using a-Si TFTs has been developed. Shared node controller reduced the area of circuit without performance degradation. The AC driving method using dual pull-down TFTs relieved the gate driver circuit from stress to TFTs. The novel gate driver circuit has been successfully integrated with a single bank form in a 14.1" XGA (1024*RGB*768) TFT-LCD panel and shows proper operation for over 1,000hours at 60°C.

Author Interviews

18:00 - 19:00

Thursday, December 7

9:00 - 10:25

Ohmi 2

AMD4/OLED4: AM-OLED

Chair: R. Hattori, Kyushu Univ., Japan Co-Chair: M. Inoue, TPO Displays Japan, Japan

AMD4/0LED4 · 1: Invited Current Status of, Challenges to, and 9:00 Perspective View of AM-OLED

H. N. Lee, J. W. Kyung, S. K. Kang, D. Y. Kim, M. C. Sung, S. J. Kim, C. N. Kim, H. G. Kim, S. T. Kim LG Elect., Korea

ZnO and IGZO TFTs were fabricated by conventional photo-lithography and wet-etching process. ZnO and IGZO TFTs showed high mobility of $66 \text{ cm}^2/\text{Vs}$ and 157 cm²/Vs, and high on/off ratios of 7.6 x 10⁶ and 1.1 x 10⁷, respectively. In addition, the IGZO TFT array was successfully fabricated to drive the OLED device on it. Therefore, it can be suggested that the oxide TFT be one of the promising candidates as a backplane for OLED device.

AMD4/0LED4-2: Invited Novel Active-Matrix Panel with Organic Light-9:25 Emitting Field-Effect Transistor

Y. Oku, N. Shimoji, T. Tanabe^{*}, S. Akiyama^{**}, T. Oyamada^{***}, H. Uchiuzou^{***}, C. Adachi^{*****}, K. Matsushige^{*****} Rohm, Japan ^{*}Pioneer, Japan ^{**}Mitsubishi Chem., Japan ^{**}Chitose Inst. of S&T, Japan ^{***}Kyushu Univ., Japan ^{****}Kyoto Univ., Japan

We successfully demonstrated a novel active-matrix panel having an organic light-emitting field-effect transistor (OLEFET) on a Si substrate. An OLEFET, a switching transistor, and a capacitor were integrated into each pixel. As an OLEFET material, tetraphenylpyrene (TPPy) doped with rubrene at 1wt% was employed. The switching transistor was fabricated with pentacene. All organic transistors are bottom-contact-type, using conventional photolithography. An 8x8 display panel clearly showed moving characters.

AMD4/OLED4-3 Pulse-Width Modulation with Current 9:50 Uniformalization for TFT-OLEDs

M. Kimura, M. Kato, Y. Hara, S. Sawamura, H. Hara^{*}, T. Okuyama^{*}, S. Inoue^{*}, T. Shimoda^{*} Ryukoku Univ., Japan ^{*}Seiko Epson, Japan

A novel driving concept, "pulse-width modulation with current uniformization", is proposed for TFT-OLEDs. An example of this driving concept is a combination of "pulse-width modulation with self-biased inverter" and "time-ratio grayscale with current uniformization". Its driving operation is confirmed using circuit simulation. It is found that this driving method can compensate characteristic deviations and degradations of both TFTs and OLEDs and exceedingly improve luminance uniformity. Moreover, it does not need high-speed scanning even for high-resolution and many-grayscale displays.

AMD4/OLED4-4L A New Pixel Circuit Employing Data Reflected 10:10 Negative Bias Annealing to Improve the Current Stability of a-Si:H TFT AMOLED

S.-M. Han, H.-S. Park, J.-H. Lee, M.-K. Han Seoul Nat. Univ., Korea

We proposed a new pixel circuit employing data reflected negative bias annealing to improve the current stability of a-Si:H TFT AMOLED. The proposed 5 TFTs pixel is can apply the negative V_{GS}, which is proportional to the previous emitting V_{GS} of the TFT, to the driving a-Si:H TFT by using its own data signal so that suppress its degradation induced by positive gate bias effectively. The data reflected negative bias annealing of pixel was proved by a SPICE simulations.

----- Break -----

10:40 - 12:00 Ohmi 2 AMD5: Emerging TFT Technologies Ohmi 2 Chair: J. Jang, Kyung Hee Univ., Korea Co-Chair: Y. Yamamoto, Sharp, Japan AMD5 - 1: Invited Characterization of Sputter-Deposited ZnO

AMD5 - 1: Invited Characterization of Sputter-Deposited ZnO 10:40 Thin Film and Its Application to Thin-Film Transistors

M. Furuta^{*,**}, T. Matsuda^{*,**}, T. Hiramatsu^{**,***}, H. Furuta^{*,**} T. Hirao^{*,**}, M. Yoshida^{***}, H. Hokari^{***}, H. Ishii^{***}, M. Kakegawa^{***} Kochi Univ. of Tech., Japan ^{**}Kochi Ind. Promotion Center, Japan ^{***}Casio Computer, Japan ^{****}Kochi Casio, Japan

Film properties and microstructure of sputter deposited ZnO films have been investigated. Thermal stability of film resistivity strongly depended on the deposition conditions of the ZnO films. Thin-film transistors with ZnO channel have been successfully fabricated by novel top-gate processes. Field effect mobility of $50.3 \text{ cm}^2/\text{V} \cdot \text{sec}$, threshold voltage of 1.1 V, and on/off current ratio of 4.6 x 10^6 were achieved. A 1.46" diagonal TFT-LCDs were first demonstrated by ZnO-TFTs.

AMD5 - 2 Pixel Controlling Substrates Using Crystalline 11:05 Silicon LSI Chips Embedded in Flexible Organic Films

R. Ishizuka, K. Ohdaira, H. Matsumura, M. Ishikawa^{*} JAIST, Japan ^{*}JST Plaza Ishikawa, Japan

The purpose of this work is to fabricate pixel controlling substrates (PCS) by using LSI chips with a size of a few hundred μ ms instead of conventional TFTs. A method to deposit LSI chips on flexible substrates is extensively studied. The chips embedded in organic substrates are wired by sputtering and vacuum evaporation of metals. The method is one of the most feasible techniques for fabrication of highly functional flexible displays.

AMD5 - 3 Joule-Heating Induced Crystallization Using a 11:25 Conductive Layer (JICCL): Millisecond-Crystallization

W.-E. Hong, J.-Y. Lee, J.-S. Ro Hongik Univ., Korea

An electric field was applied to a conductive layer to induce Joule heating in order to generate the intense heat needed to carry out the crystallization of amorphous silicon. Polycrystalline silicon was produced via Joule heating through a solid state transformation. Uniformly distributed fine grains were obtained due to enormously high heating rate of this process. Blanket crystallization was accomplished within the range of millisecond, thus demonstrating the possibility of a new crystallization route for amorphous silicon films.

AMD5 - 4L LTPS Ambient Light Sensor with Temperature 11:45 Compensation

S. Koide, S. Fujita, T. Ito, S. Fujikawa^{*}, T. Matsumoto Sanyo Epson Imaging Devices, Japan ^{*}Seiko Epson, Japan

We have developed an LTPS Ambient Light Sensor with temperature compensation that shows promise in applications for LCD panels. The sensor has two serial PIN diodes, the output current of which can be nearly constant at any temperature under normal conditions. Also, the Ambient Light Sensor has a reflector below that enables it to detect dim ambient light and be produced in the same process as LTPS TFT-LCDs.

Author Interviews

18:40 - 19:40

14:00 - 17:00			Ohmi 5-7
	Poster	AMDp: Active-Matrix Displays	
AMDp - 1	Amorp Micro I	Amorphous Silicon Thin-Film Transistors Made b Micro Imprint Lithography	
	JS. C	hoi, BK. Choo, NY. Song, SH. Kim	i, KC. Park,

J. Jang Kyung Hee Univ., Korea

We made hydrogenated amorphous silicon (a-Si:H) thin film transistor (TFTs) using an ultra violet micro imprint lithography (UV-MIL). UV-MIL a-Si:H TFTs exhibited a field-effect mobility of 1.2 cm²/V · s, threshold voltage of 1.9 V and on/off current ratio of 10⁸. We investigated threshold voltage shift (\triangle Vth) of UV-MIL a-Si:H TFTs induced by gate bias stress and bias temperature stress (BTS). We confirmed that UV-MIL a-Si:H TFTs have electrical and thermal stability for application to long term active-matrix liquid-crystal display (AMLCD).

AMDp - 2 Dual-Layer Gate Dielectrics Design for Reduction of Self Heating Effect of LTPS Devices

C. H. Fang, C. J. Shih, C. Y. Huang Chunghwa Picture Tubes, Taiwan

The reduction of self-heating effect under high drain power of dual SiNx/ SiOx gate insulator has been investigated. We found that the dual layer design can not only enable much better electric characteristics of LTPS devices, but also suppress the Joule heating significantly. The degradation of threshold voltage for PMOS devices under high drain current stress can be reduced up to 50%. This structure can enables much better reliability of devices for high-level active matrix displays.

AMDp - 3 Study on Stability of a-Si TFTs Fabricated by Catalytic Chemical Vapor Deposition (Cat-CVD) Method

S. Nishizaki, K. Ohdaira, H. Matsumura JAIST, Japan

This paper is to study on V_{th} stability in a-Si TFT fabricated by Cat-CVD method. There appears no serious degradation in both a-Si active layer and the boundary properties between a-Si and gate silicon nitride (SiN*x*). It is speculated that the main factor deciding the V_{th} shift of Cat-CVD a-Si TFT is electron traps in SiN*x*. To clarify the relationship between V_{th} shift and the SiN*x* property, TFT performance is investigated for SiN*x* gate films prepared by various deposition conditions.

AMDp - 4 High Performance Pentacene OTFTs with Photo-Patterned Gate Dielectric

S. H. Lee, S. H. Han, Y. R. Son, K. J. Lee, W. S. Kim, G. S. Cho, D. J. Choo, J. Jang Kyung Hee Univ., Korea

We have fabricated pentacene organic thin-film transistor with photopatternable gate dielectric layer on plastic substrate. The gate dielectric was spin coated from a solution and patterned by UV exposure through a photomask. We achieved a high-performance OTFTs on plastic substrate exhibiting a field-effect mobility of > 1.0 cm²/ Vs and on/off current ratio of 10⁷. But photo-patternable gate dielectric shows large hysteresis characteristics. The large hysteresis characteristics could be eliminated by passivation using poly(para-xylene) layer and annealing in a vacuum oven.

AMDp - 5 Methods for Improving Color Washout Performance on MVA Mode LCD-TV Panel Applications

H.-L. Hou, Y.-P. Huang, W.-K. Huang, C.-H. Tsao, J.-J. Su, T.-J. Chang, P.-L. Chen, Y.-J. Lin, K.-Y. Lin AU Optronics, Taiwan

In this paper, three different technologies were proposed to improve the color washout per-formance of LCD panel in the oblique view. The technologies, including C.C. (Coupled Capaci-tance), GFI(Gray Frame Insertion) and Pixel rendering, were applied on 32 inch MVA LCDs to demonstrate the performance and for evaluating the other impacts.

AMDp - 6 Thermally Stable Pentacene TFT with Organic/ Inorganic Hybrid Passivation Layers on Plastic Substrate

Y. R. Son, S. H. Han, S. H. Lee, K. J. Lee, W. S. Kim, G. S. Cho, D. J. Choo, J. Jang Kyung Hee Univ., Korea

We studied the organic/inorganic hybrid passivation of high performance pentacene TFT. Double layers of parylene and SiN_x were deposited on the OTFT to protect it from vapor adsorption. The OTFT exhibited a field-effect mobility of 1.12 cm²/V \cdot s, on-off current ratio of 10⁷ after the passivation. With the hybrid passivation layers on OTFT, it was found to be stable under bias-temperature annealing. This indicates that OTFT can be used for a high performance display with long lifetime.

AMDp - 7 Temperature Dependence of Threshold Voltage for Low Temperature Polysilicon TFTs

M. Matsumura, T. Kaitoh^{*}, M. Hatano Hitachi, Japan ^{*}Hitachi Displays, Japan

The temperature dependence of threshold voltage (VT) for low temperature poly-silicon (LTPS) thin-film transistors (TFTs) were investigated. The TFTs with the lower trap density showed the smaller temperature coefficient. The temperature dependence was explained by the density of space-charges originated from charged traps.

AMDp - 8 Low-Temperature Formation of Si Oxide Film by Using Silicone Oil and Ozone Gas

K. Toriyabe, K. Nishioka, S. Horita JAIST, Japan

Si oxide films were formed by using thermal reaction between silicone oil and ozone gas on the Si substrate at more than 200°C. The deposition profile was like cheveron. FT-IR spectra showed that the film was consisted mainly of mainly Si-O bonds and contained a small amount of OH bond. The nitrogen annealing at 300°C reduced the amount of OH bond in the film and made the electrical properties almost similar irrespective of deposition temperature.

AMDp - 9 Novel Design for a-Si:H TFTs with Promising Mechanical Reliability on Flexible Substrate

P.-C. Chen, K.-Y. Ho, M.-H. Lee, C.-C. Cheng, Y.-H. Yeh ITRI, Taiwan

In this paper, we investigated several kinds of a-Si:H TFTs structures fabricated on polyimide (PI) substrate at 160 °C under 1x10⁴ cycles of mechanical bending stress. After mechanical bending stress, the threshold voltage of different a-Si:H TFTs structures have different shift. It is a critical task to optimize suitable design for a-Si:H TFTs on flexible substrate. L-shape design a-Si:H TFTs with better stability after bending stress. It is a good candidate for the SOP or pixel array on flexible substrate.

AMDp - 10 Process Optimization of Ink-Jet Printing for Organic Thin-Film Transistors

K. T. Han, D. H. Song, M. H. Choi, D. L. Choi, A. Sautter^{*}, J. Jang Kyung Hee Univ., Korea ^{*}H.C. Starck, Germany

We studied the organic thin-film transistor (OTFT) with a solution based DH4T (dihexylquaterthiophene) by inkjet printing. In order to obtain a smooth and uniform film of DH4T, the substrate temperature was elevated to 60°C and the printing was performed by an overlapping method. The OTFT on plastic exhibited an on/off current ratio of -10^7 , a threshold voltage of -0.25 V, a gate voltage swing of 0.45 V/decade and a field-effect mobility of 0.043 cm²/Vs in the saturation region.

AMDp - 11 Electric Field Induced Reduction of Trap States in Poly-Crystalline Silicon Thin-Film Transistors

S. Yan, O. Hung, T.-H. Hsieh, C. Yang, J.-P. Pang InnoLux Display, Taiwan

In this study, the electric field induced reduction of trap states in polycrystalline silicon thin film transistors has been demonstrated. Even though the threshold voltage of the TFT is slightly increased after static or near-static stress due to hole injection into the gate insulator, the mobility and sub-threshold swing are improved to compensate the driving current. A static or near-static stress condition at off state of the TFTs introduces a constant junction electric field to reduce the trap states at source/drain junction and alleviate the leakage current.

AMDp - 12 Organic Thin-Film Transistors with Reduced-Photosensitivity

C.-S. Chuang, S.-T. Tsai, F.-C. Chen, H.-P. Shieh Nat. Chiao-Tung Univ., Taiwan

OTFTs with reduced-photosensitivity have been made by blending titanium dioxide (TiO_2) nanoparticles into the polymer dielectric layer. The minimized shift of threshold voltage and more stable photocurrent are attributed to the introduction of recombination centers induced by the doping of TiO_2 . The localized energy levels deep in the energy gap and away from highest occupied molecular orbital (HOMO) and lowest unoc-cupied molecular orbital (LUMO) of pentacene may serve as the recombination centers, which can enhance substantially the recombination process in the OTFTs.

AMDp - 13 Amorphous Silicon Gate Driver with Low Power Consumption and Highly Driving Capability for High Resolution Mobile Displays

W.-K. Lee, J.-H. Lee, H.-S. Park, S.-J. Kim, M.-K. Han Seoul Nat. Univ., Korea

We propose a new a-Si gate driver with low power consumption and high driving capability for high resolution mobile displays. The proposed a-Si gate driver has reduced the power consumption by 27.48% compared with the conventional one due to the reduced input signal level. The proposed a-Si gate driver has a highly driving capability by separating the gate input signal and the carry signal so that the distortion of the gate signal would be prevented.

AMDp - 14 The Effects of Preoxidation by N₂O plasma on the Silicon Dioxide as a Gate Insulator of Poly-Si Thin-Film Transistor on a Flexible Substrate Application

J. H. Park, S. M. Han, S. G. Park, S. H. Choi, W. C. Lee, J. S. Jung^{*}, J. Y. Kwon^{*}, M. K. Han Seoul Nat. Univ., Korea ^{*}SAIT, Korea

In order to improve the SiO₂/poly-Si interface characteristics, we have investigated the interface treatment on a flexible substrate application. The preoxidation by N₂O plasma reduces the transition layer, which is deposited during the initial growth stage, between poly-Si and SiO₂. The C-V characteristics of SiO₂ by N₂O plasma irradiation were considerably improved due to the decrease of interface defect densities. The B-V characteristics are also improved from 0.7 MV/cm² to 2.4 MV/ cm² by the preoxidation.

AMDp - 15 Effective Luminance Compensation: Advanced Driving Method to Improve LCD Response Time

S. K. Lee, Y. H. Kim Pohang Univ. of S&T, Korea

Overdriving has become a general technique to improve the slow electro-optical response time of TFT-LCD panels. However, even when overdriving is used, there is a difference between the target luminance and the effective luminance in moving pictures. This paper proposes a new driving method that compensates the effective luminance, which can improve not only the optical response time but also the effective luminance deviation. In experiments, the proposed method showed better motion picture quality than previous overdriving methods.

AMDp - 16 Application of Supercritical Fluids for Amorphous Silicon Thin-Film Transistors

C.-T. Tsai, T.-C. Chang^{*}, P.-T. Liu^{**}, P.-Y. Yang^{**} Nat. Tsing Hua Univ., Taiwan ^{*}Nat. Sun Yat-Set Univ., Taiwan ^{**}Nat. Chiao Tung Univ., Taiwan

Supercritical fluid technology is employed for the first time to passivate the defect states in amorphous silicon thin film transistors at low temperature (150°C). Experiment results indicate that superior transfer characteristic is obtained and the density of states is reduced significantly after the treatment of supercritical fluids mixed with water/ propyl alcohol. The supercritical fluids have gas-like properties of diffusivity and viscosity that allow it to efficiently carry H_2O molecule into amorphous thin film and passivate defects at low temperature.

AMDp - 17 The Effect of Surface Plasma Treatment for n⁺ Contact Layer on Photocurrent Reduction in a-Si:H TFTs for AMLCDs

Y.-S. Lee, F.-Y. Gan, C.-W. Lin^{*}, C.-C. Shih, T.-Y. Hsu, J.-K. Chang, H.-T. Lin, S.-J. Lin AU Optronics, Taiwan ^{*}Tatung Univ., Taiwan

Not only the heavily doping efficiency during the deposition of n⁺ a-Si:H layer but also a suitable plasma treatment upon the surface of deposited n⁺ a-Si:H layer can reduce the photocurrent in a-Si:H TFTs. The enhancement of the doping efficiency by a surface plasma treatment of H₂ and PH₃ gases upon n⁺ a-Si:H layer is probably due to both the replenishment of phosphorus atoms to connect with silicon atoms and the compensation of dangling bonds with hydrogen atoms.

AMDp - 18 A Nobel a-Si:H Gate Driver with High Reliability

J. H. Koo, J. W. Choi, Y. S. Kim, M. H. Kang, K. W. Ahn, J. Jang Kyung Hee Univ., Korea

We propose two kinds of a-Si:H gate driver with less threshold voltage shift, longer life time and more simplified structure. The one is the gate driver with only one pull down transistor for driving small panel, the other is the gate driver with two pull down transistors for driving large panel. These pull down transistors of gate drivers are under AC bias which show much less degradation than those under DC driving.

AMDp - 19 A Novel Repair Method for Integrated Gate Driver Circuit

Y. H. Yeh, C. C. Wei, S. H. Lo, Y. E. Wu AU Optronics, Taiwan

We have designed a repair structure that can be used for repairing integrated gate driver circuit. This structure consists of several wires to connect the redundant circuit and the shift register for repairing. We have developed 12.1 inches WXGA a-Si TFT-LCD prototype panels with the repair structure, and there is no horizontal line defect occurred after panel repairing. The output of the repair structure is confirmed to be the same with normal gate driver by the experimental results.

AMDp - 20 The Structure of Hydrogenated Microcrystalline Silicon (μc-Si:H) TFTs Deposited by PECVD

C.-Y. Wu^{*}, Y.-Y. Tsai^{*}, C.-C. Lai^{*}, C.-H. Ma^{*}, Y.-H. Chien^{*,**}, W.-Y. Uen^{**} ^{*}Chunghwa Picture Tubes, Taiwan ^{**}Chung Yuan Christian Univ., Taiwan

Hydrogenated microcrystalline silicon is prepared by PECVD with controlling factors included SiH4/H2 gas flow rate, RF power, and pressure, respectively. Surface morphology is observed, and grain size is about 20-30nm. The behaviors of Vth and mobility under bias gate stress, light illuminated and thermal treatments, indicate unobvious difference to a-Si:H TFTs. Crystallization distribution by Raman spectrometer and HRTEM, it's proven the transistor channel between μ c-Si:H/SiNx interface its structure is still the amorphous state.

AMDp - 21 Activation Behavior of SLS poly-Si after Ion Shower Doping

B.-J. Jin, S.-J. Oh, D.-H. Kim^{*}, T. Uemoto^{*}, C.-W. Kim^{*}, J.-S. Ro^{*} Hongik Univ., Korea *Samsung Elect., Korea

Thermal activation was carried out using SLS poly-Si or ELC poly-Si after B⁺ ion shower doping. Reverse annealing was found in the temperature ranges between 400°C and 650°C investigated in this study. Grain boundaries seemed to play a critical role for dopant activation in poly-Si at low temperatures. The RTA treated samples were observed to exhibit lower sheet resistance than the FA treated one. The reverse annealing is believed to play an important role for activation efficiency.

AMDp - 22 Effects of Grain Boundaries on the Anomalous Subthreshold Behavior of Excimer Laser Crystallized Poly-Silicon TFTs

D.-K. Shih, F.-T. Chu, H.-T. Chen, Y.-H. Yeh ITRI, Taiwan

We investigated the grain boundary effect on the abrupt subthreshold behavior, which related to the impact ionization effect occurring near the drain-end region of the channel, of LTPS n-TFTs fabricated by 2-shot SLS and conventional ELA crystallization methods. The results showed that the ELA-TFTs had a higher drain voltage to trig the abrupt subthreshold behavior than that of the SLS-TFTs. The results also suggested that both SLS- and ELA-TFTs were damaged once the abrupt subthreshold behavior occurred.

AMDp - 23 Selective Crystallization of a-Si by Using a Shadow Mask

K. H. Kim, S. J. Park^{*}, Y. M. Ku^{*}, E. H. Kim^{**}, J. H. Bae, S. K. Kim, B. H. Kwon, C. O. Kim^{***}, J. Jang^{**} Kostek Systems, Korea ^{*}BOE Hydis Tech., Korea ^{**}Kyung Hee Univ., Korea ^{**}Han Yang Univ., Korea

Amorphous silicon on glass substrate was selectively crystallized by scan of Nd:YVO₄ CW laser. By adopting shadow mask on top of the a-Si during laser crystallization, photolithography for pre-patterning a-Si can be avoided. About 35 μ m wide sequential lateral crystallization (SLC) region with almost 6 ~ 7 μ m wide grains are observed at the laser power of 10 W and the scan speed of 250 mm/s. This means high performance LTPS on glass can be achieved more easily.

AMDp - 24 Passivation of Inkjet Printed Organic Thin-Film Transistor

D. H. Song, M. H. Choi, D. L. Choi, K. T. Han, A. Sautter^{*}, J. Jang Kyung Hee Univ., Korea ^{*}H.C. Starck, Germany

We fabricated printed organic thin-film transistor (OTFT) using α, ω dihexylquaterthiophene (DH4T) and passivated it to protect organic semiconductor from O2 and H2O. The passivation layer on the DH4T was formed with use of poly-para-xylylene (parylene-C). The passivation slightly decreases its on-state current and field-effect mobility. The OTFT after the passivation exhibited the field-effect mobility of 0.013 cm2/Vs, threshold voltage of -1.44V, and on/off ratio of -106. We also investigated the instability of the OTFT under the gate bias stress and found that the threshold volt-age shifted a little.

AMDp - 25 Stable Modification of Surface Energy Using UV Irradiation

B. K. Choo, J. S. Choi, N. Y. Song, K. C. Park, J. Jang Kyung Hee Univ., Korea

We have studied the surface modification of Cr by ultra violet (UV) irradiation. We achieved high contact angle difference of 108.94° after monochromatic UV irradiation through attaching polydimethylsiloxane (PDMS) on Cr surface. Area of high surface energy was formed by O₃ treatment and area of low surface energy by methyl compound transfer from PDMS surface to Cr surface during UV exposure. Surface energy can be controlled by UV exposure without chemical treatment.

AMDp - 27 Thermal-Cured Polyacrylate Insulators for Plastic-Based Organic Thin-Film Transistors

G. H. Kim, S. M. Yoon, K. H. Baek, S. Y. Kang, I. K. You, S. D. Ahn, K. S. Suh ETRI, Korea

Chemically and thermally stable, thermal-cured polyacrylate having a hydrophobic nature, which were prepared by mixing polyacrylate having reactive sites and functional-anhydride, exhibits good insulation properties and high breakdown voltage (> 4.0 MV/cm) as a dielectric. Plastic-based organic thin-film transistors with the thermal-acryl dielectric layer showed typical I_{DS} -V_{DS} characteristics; the field-effect mobility was calculated to be 0.22 cm² V⁻¹ s⁻¹, while the threshold voltage was approximately - 8 V. It has been found that thin dielectric layers gave higher field-effect mobility.

AMDp - 28 Enhanced Organic Thin-Film Transistors with 14:00 Polymer Gate and Double Polymer Dielectric Layer

J. H. Seo, J. H. Kwon, N. R. Kim, Y. H. Lee^{*}, B. K. Ju Korea Univ., Korea ^{*}Nano Device Physics Lab., Korea

Enhanced organic thin-film transistors (OTFTs) using double polymer dielectric layer (PVA+PVP, 370nm) for bendable device is fabricated by spin-coating and photolithograph patterning. These OTFTs have a merit to adapt a soluble process with stable, high performed dielectric layer so that achieve good characteristics. There measured $\epsilon_r=8.4$ of PVA+PVP double layer, $I_D{=}6.45\,$ A at $V_G{=}\,25V,$ $I_D{=}3.3\,$ A at $V_G{=}\,15V$ of output current, 2.64 $\,\times\,$ 10^3 of on/off ratio and 0.011cm²/Vs of mobility, respectively.

AMDp - 29 Liquid Controller

14:00

C.-K. Yen, Y.-T. Li, H.-H. Chen, W.-D. Tyan ITRI, Taiwan

We demonstrate that this meniscus can act as an optical scanner, which is a device that can control the position of a light beam in one or more orthogonal spatial dimensions. It is showed that the incident light can be deflected by switching the electrode drive voltage of the liquid device. This idea is key to the design of the proposed liquid prism that can allow a beam scan between the discrete states of the applied voltage.

AMDp - 30Excimer Laser Annealing of Hydrogen Modulation14:00Doping a-Si Film for Flexible Display

A. Heya, T. Serikawa^{*}, N. Kawamoto^{**}, N. Matsuo Univ. of Hyogo, Japan ^{*}Osaka Univ., Japan ^{**}Yamaguchi Univ., Japan

Novel crystallization method for low temperature process was proposed, named excimer laser annealing of amorphous silicon (a-Si) with hydrogen (H) modulation-doped layer (ELHMD). The effects of H on low energy crystallization by conventional ELA and ELHMD were investigated. The film exfoliation by H_2 burst can be suppressed by using HMD a-Si film. It is considered that high quality polycrystalline silicon films can be obtained by ELHMD and H modulation doping has effect of controlling the nucleation site toward film thickness.

AMDp - 31L Effects of Source and Drain Impurity Profile on Breakdown Voltage of High-Performance Si TFTs

S. Tsuboi, G. Kawachi, M. Mitani, T. Okada Advanced LCD Tech. Dev. Ctr., Japan

The effects of the source and drain junction depth on breakdown voltage of high-performance Si TFTs have been studied. It was found that decreasing the junction depth results in a substantial increase in the source-drain breakdown voltage (V_{BD}). The improvement in V_{BD} is primarily due to suppression of impact ionization. Reduced impact ionization originates from suppression of the body potential elevation in the shallow junction structure that allows for penetration of the excess holes beneath the source n+ region.

AMDp - 32L High Performance Mobile Application with the High Aperture Ratio FFS (HFFS) Technology

D. H. Lim, H. Y. Lee, J. P. Kim, K. J. Lee, H. J. Yun, K. Y. Han, Y. H. Jeong BOE HYDIS Tech., Korea

We have developed a high performance 2.03-in TFT-LCD for mobile application using the high aperture ratio FFS technology. The display shows high transmittance as well as high color gamut, high contrast ratio, and wide viewing angle over 160°.

AMDp - 33L Advanced Transmissive-LCDs with High Reflectance in RGBW Color System

C. Y. Tsai, M. C. Lee, Y. C. Tsai, Y. J. Chang, W. C. Chang, D. L. Ting TPO Display, Taiwan

Last year we introduced ATR technology to improve reflectance of a transmissive LCD. It is suitable for portable cellular phone or notebook application. Now, we make progress on outdoor readability for high saturated and resolution transmissive LCD. In this report, we introduce a new RGBW color system, which combines RGBW architecture with ATR technology. It could greatly not only enhance the reflectance, but also optimize reflective image quality. Reflectance could go up to 2.3% and contrast ratio is about 5.

AMDp - 34L N- and P-Channel Poly-Si TFTs with Very-Low Substrate-Temperature Sputter-Deposited SiO₂ Films

T. Serikawa, T. Miyamoto^{*}, H. Ueno^{*}, Y. Sugawara^{*}, Y. Uraoka^{*}, T. Fuyuki^{*} Osaka Univ., Japan ^{*}Nara Inst. of S&T, Japan

N- and P-channel poly-Si TFTs were fabricated by sputter-depositing gate SiO₂ films at substrate temperature down to room temperature. Electrically measurements clarified that characteristics of mobility, threshold voltage, subthreshold slope and on-off current ratio are improved with decreasing of substrate temperature for both n- and p-channel poly-Si TFTs. This leads to that poly-Si TFTs with sputter-deposited gate SiO₂ films, especially for room temperature deposited SiO₂ films, are highly potential in realizing advanced flat panel displays.

14:00 - 17:00	Ohmi 5-7

Poster AMD/OLEDp: AM-OLED

AMD/OLEDp - 1 2-in. QQCIF Top-Emission AMOLED Drived by Low Temperature Poly Silicon TFT on Flexible Metal Foil with BCB Planarization

> D. J. Park, Y. H. Kim, M. H. Lee, J. H. Moon, C. H. Chung, Y. H. Song ETRI, Korea

We have developed a 2 inch QQCIF LTPS-TFT AMOLED display with a top emission structure on a 50- μ m-thick metal foil with BCB planarization. The p-channel poly-Si TFT on flexible metal foil exhibited the field-effect mobility of 54cm²/Vs, the on/off current ratio of 10⁶, the threshold voltage of -3V, and the subthreshold slope of 0.8V/dec. Finally, a images from prototype monochrome AMOLED displays are successfully presented, with 64 × 88 pixels and 56-ppi resolution.

AMD/OLEDp - 2 A Novel Compensation Pixel Circuit of AMOLED Display for Stable OLED Current

M. H. Kang, J. W. Choi, J. H. Koo, Y. S. Kim, K. W. Ahn, J. H. Hur, S. W. Lee, J. Jang Kyung Hee Univ., Korea

We propose a new pixel circuit for a-Si:H AM-OLED display. The voltage-programming method is used in the pixel circuit for compensating the threshold voltage shifts of a-Si:H TFTs. One of the switching TFTs takes a role of preventing the peak current flowing to OLED during reset and compensation periods. We have designed an Emission Control Pulse (ECP) generator based on gate signals to control the switching TFT. The operation and stability of proposed pixel circuit are proved by SPICE simulation.

AMD/OLEDp - 3 A Voltage Driver IC with Automatic Luminance Control for 256-Level Full Color Active-Matrix OLED Displays

J. H. Lee, D. C. Park, C. H. Park, S. H. Kim, H. K. Yun, G. N. Kim, I. S. Kang, B. N. Kim Samsung Elect., Korea

An AMOLED driver IC using voltage driving scheme, one of driving methods to drive AMOLED, is developed. The developed driver IC can automatically control the luminance and has 256 gray levels for LTPS QVGA full-color AMOLED Displays. To reduce the chip size, the developed driver IC also uses one source amplifier for RGB. As a result, it has 240 source outputs and the separated serial gamma circuits.

AMD/OLEDp - 4 New Pixel Circuit Employing Fast V_{TH} Detection Scheme for LTPS AMOLED

H.-S. Shin, W.-K. Lee, S.-G. Park, S.-H. Choi, M.-K. Han Seoul Nat. Univ., Korea

We propose a novel pixel design employing fast threshold voltage detection scheme for active matrix organic light emitting diode (AMOLED) displays using low temperature polycrystalline silicon thin film transistors (LTPS-TFTs). The proposed pixel circuit, which consists of 5 p-type TFTs and 2 capacitors, has a fast threshold voltage detection scheme using the clock signal. The simulation results show that the proposed pixel circuit exhibits a scan time less than 7 micron second and successfully compensates V_{th} variation of poly-Si TFT.

AMD/0LEDp - 5 Capacitive Compensation to Suppress Sample-and-Hold Non-Idealities in Switched-Current AMOLED Pixel Circuits

X. Guo, S. R. P. Silva Univ. of Surrey, UK

A simple and effective capacitive compensation method is presented to suppress the sampling and hold (S/H) non-idealities in switched-current (S-I) AMOLED pixel circuits for inverting structure top-emitting OLEDs, and thus greatly improve the output linearity of the circuit. The method can also be used to design the p-TFT S-I pixel circuit for normal structure top-emission OLEDs, and some other configurations of S-I AMOLED pixel circuits, or even voltage-mode driven pixel circuits.

Thursday

AMD/OLEDp-6 A Novel Threshold Voltage Compensation Pixel Circuit with High Immunity to the Supply Voltage Drop for AMOLED Displays

H.-Y. Lu, P.-T. Liu, T.-C. Chang^{*}, S. Chi Nat. Chiao Tung Univ., Taiwan ^{*}Nat. Sun Yat-Sen Univ., Taiwan

A new pixel circuit employing LTPS TFT for AMOLED is proposed. The proposed one can eliminate both the threshold voltage variation of the driving TFT and the supply voltage drop. The simulation results indicate that the proposed circuit significantly improves the non-uniformity of output current by the new compensation operation.

AMD/OLEDp - 7 A New Drive Method for Large Organic Light-Emitting Diode Displays

J. C. Rutherford, C. A. Wedding, D. K. Wedding^{*} Imaging Syss. Tech., USA ^{*}Univ. of Toledo, USA

This new drive method eliminates obstacles that affect the performance of very large organic light-emitting diode displays on plastic substrates. Increased component tolerances reduce problems caused by dimensional instability of plastic substrates. The enhanced performance enabled by using this drive method is not matched by other active matrix drive methods.

AMD/OLEDp+8L Polarity Inversion Driving Method to Reduce the Threshold Voltage Shift in a-Si:H TFT AMOLED

H.-S. Park, J.-H. Lee, J.-H. Jeon^{*}, M.-K. Han Seoul Nat. Univ., Korea ^{*}Hankuk Aviation Univ., Korea

We have proposed a new driving method to improve the current stability of a-Si:H TFT for AMOLED. The proposed scheme performs the negative bias annealing on a-Si:H TFTs during a certain period of a frame time. The amplitude of negative bias to cure the degradation of a-Si:H TFTs is determined by the previously applied positive voltage which displays the original image. Our simulation result shows that it can suppress the degradation of a-Si:H TFT and provide the good screen uniformity.

Friday, December 8

9:00 - 10:25		Ohmi 2
	AMD6: TFT Technologies (1)	

Chair: M. Furuta, Kochi Univ. of Tech., Japan Co-Chair: T. Noguchi, Univ. of Ryukyus, Japan

AMD6 - 1: Invited Printing Formation of Low-Temperature Poly-9:00 Si TFTs

M. Furusawa, H. Tanaka, T. Kamakura, T. Shimoda Seiko Epson, Japan

The solution processing and printing formation of LTPS TFTs are described. We have developed a novel liquid precursor that can form amorphous silicon films by spincoating and baking the precursor. The amorphous silicon was converted to poly-Si by laser crystallization to fabricated top-gate LTPS TFTs using standard fabrication steps except silicon film. The TFTs operated with the mobility of 108 cm²/Vs. Inkjet printing of the silicon precursor and nano-particle base silver ink to fabricate LTPS TFTs are also described.

AMD6 - 2 Floating-Body and Self-Heating Effects 9:25 Characterization of Poly-Si TFTs through AC Output Conductance Measurement

K. Takatori, H. Asada, S. Kaneko NEC LCD Techs., Japan

The AC output conductance of poly-Si TFT is measured in the frequency domain. The increase of the conductance related to the floating-body effect (FBE) is observed in the higher drain bias region. The FBE is suppressed with increase of frequency. The conductance increase caused by the self-heating effect (SHE) suppression is observed in the frequency regions over 0.1[MHz]. Although the changes caused by FBE are bias-dependent, those caused by SHE are bias-independent. Longer channel width shows larger frequency dependency.

AMD6 - 3 The Mechanisms of On/Off Currents for the Dual-9:45 Gate a-Si:H Thin-Film Transistors with Various Lengths of Indium-Tin-Oxide Top Gate

C. Y. Liang, F. Y. Gan, T. C. Chang^{*}, P. T. Liu^{**}, F. S. Yeh^{***} AU Optronics, Taiwan ^{*}Nat. Sun Yat-Sen Univ., Taiwan ^{**}Nat. Chiao Tung Univ., Taiwan ^{***}Nat. Tsing Hua Univ., Taiwan

With various sizes of ITO top gate length, we clearly identify that the various on currents for the dual-gate TFTs with dual-gate driving are due to the high resistance of the parasitic intrinsic a-Si:H regions between the back electron channel and the source/drain contact. For the off state of the dual-gate TFTs, the Poole-Frenkel effect is also enhanced due to the back channel accumulation holes in the vicinity to the source/drain contact.

AMD6 - 4 Performance Evaluation and Design Guidelines of 10:05 Sub-100-nm Source/Drain Unilateral-Crystallized Poly-Si TFTs for SoP Applications

X. Guo, A. A. D. T. Adikaari, S. R. P. Silva Univ. of Surrey, UK

The thickness spatial modulation method can realize high-performance source/drain unilateralcrystallized (SDUC) poly-Si thin-film transistors (TFTs). The resulted thick source/drain, un-doped thin-channel device structure is also very promising for ultra-scaled device design. With a calibrated simulation model, the performance and process sensitivity of sub-100-nm SDUC TFTs were predicted by numerical simulations. The results indicate the manufacturability of the devices and highlight guidelines of optimizing the devices for different requirements of low-power or high-performance applications.

----- Break -----
Ohmi 2

10:40 - 11:40

AMD7: TFT Technologies (2)

Chair:	M. Furusawa, Seiko Epson, Japan
Co-Chair:	M. Ikeda, Toshiba Res. Consulting, Japan

AMD7 - 1 Characterization of Trap Density at Grain Boundaries 10:40 Using Doped Poly-Si TFTs

T. Yoshino, M. Kimura, T. Sameshima^{*} Ryukoku Univ., Japan ^{*}Tokyo Univ. of A&T, Japan

Trap density at grain boundaries has been characterized using doped poly-Si TFTs. First, using C-V characteristics, Fermi levels and dopant densities are determined. Next, using I-V characteristics, field-effect mobility and potential barriers over the grain boundaries are determined. Finally, by varying dose densities, an energy profile of the trap density is extracted. This is one of the complementary methods to characterize the trap density at grain boundaries.

AMD7 - 2 Single Shot Laser Heat Retaining Enhanced 11:00 Crystallization for High Performance Poly-Silicon Thin-Film Transistors

J.-X. Lin, H.-T. Chen, H.-H. Wu^{*}, G.-R. Hu, P.-F. Lee, C.-L. Chen, Y.-C. Chen ITRI, Taiwan ^{*}Nat. Chiao-Tung Univ., Taiwan

High performance poly-silicon crystallization method, Heat Retaining Enhanced Crystallization, is developed. 14μ m fully lateral grown polysilicon was obtained through single shot laser irradiation. Transient reflectance analysis on the HREC method demonstrated a long melt duration of 1100ns. A dual gate HREC TFT was fabricated, exhibiting a field effect mobility of 260 cm²/Vs. The single shot laser HREC method enabled a high throughput of 26 sheet/hr, concluding that HREC is potential, reliable, and cost-effective for high performance poly-silicon TFT production.

AMD7 - 3 Stable and High Mobility Low Temperature 11:20 Microcrystalline Silicon TFTs to Drive OLEDs

K. Kandoussi, T. Mohammed-Brahim, C. Simon, N. Coulon, C. Prat^{*} Univ. Rennes 1, France ^{*}Thomson, France

Low temperature (180°C) deposited PECVD μ c-Si films are used as active layer of top-gate TFTs using a maximum process temperature of 200°C. These TFTs exhibit an electron mobility of 2 cm²/V.s and a high stability under gate bias stress. The on-current of 100 μ m / 20 μ m TFTs at a drain voltage of 3V is shown to be sufficient to drive 1 mm² wide Thomson green OLEDs device.

14:00 - 15:25

Ohmi 2

AMD8: Organic TFT (1)

Chair:	S. Horita, JAIST, Japan
Co-Chair:	M. Ando, Hitachi, Japan

AMD8 - 1: *Invited* Passivation of Organic Thin-Film Transistors 14:00 for Flexible Displays

J. Jang, S. H. Han Kyung Hee Univ., Korea

We studied the effect of passivation on the stabilities of the pentacene thin-film transistor (TFT) fabricated on plastic with self-organized process. The degradations in on-current, threshold voltage and field-effect mobility of the TFT are greatly reduced by the organic multilayer passivation. The on current is stable under negative or positive bias stress after the passivation with the layers of PVP and photo-acryl. It is also stable under heat treatment at 150°C.

AMD8 - 2Field-Sequential Color LCD Panel Driven by Low-14:25Voltage Operation Organic TFT

Y. Fujisaki, H. Sato, T. Yamamoto, H. Fujikake, T. Kurita NHK, Japan

A field-sequential color LCD panel, which integrates organic TFT (OTFT) with fast-response ferroelectric liquid crystal (FLC), has been fabricated on a plastic film. The fabricated pentacene based-OTFT with Ta_2O_5 gate insulator showed a mobility of 0.3 cm²/Vs and a current on/ off ratio of 10⁷ at a low drain voltage of -5V. The OTFT and the FLC with polymer networks and walls were assembled by the printing technique. Fast-response speed and color display operation are successively demonstrated.

AMD8 - 3 Carrier Mobility Enhancement in Organic TFTs with 14:45 a Polymer Gate Insulator showing Low Surface Energy

T. Houryu, Y. Fukuba, Y. Kouda, Y. limura Tokyo Univ. of A&T, Japan

In order to improve carrier mobility of pentacene organic TFTs (O-TFTs), we have studied the effect of gate insulating materials on the mobility. Despite the reduction of the grain size, a gate insulating polymer material having low surface free energy, which is used for vertically alignment film of liquid crystals, significantly enhances the carrier mobility from 0.4cm²/Vs up to 2.0cm²/Vs.

Friday

AMD8 - 4 High-Performance N-type Organic Field-Effect 15:05 Transistor with Poly(4-vinyl phenol) as Gate Dielectric

C. F. Sung, Y. Z. Lee, K. Cheng, C. W. Chu^{*} ITRI, Taiwan *Academia Sinica, Taiwan

We have fabricated organic thin-film transistors (OTFTs) based on a [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) with cross-linked poly-4-vinyl phenol (CPVP) as gate dielectric. Better performance is observed compared to the device fabricated with SiO₂. The PCBM thin-film transistor with cross-linked PVP dielectric exhibits a mobility of 0.0132 cm² V⁻¹ s⁻¹, an I_{on}/I_{off} ratio of 10⁵, and a sub-threshold slope of 0.87 Vdecade⁻¹. This solution process with excellent dielectric property leads to an achievement of high electron mobility in OTFTs.

----- Break -----

 15:35 - 17:00
 Ohmi 2

 AMD9: Organic TFT (2)
 M. Kimura, Ryukoku Univ., Japan

 Co-Chair:
 M. Kimura, Ryukoku Univ., Japan

 Co-Chair:
 Y. Inoue, NHK, Japan

 AMD9 - 1:
 Invited Alignment-Free Printable Process for Organic

 15:35
 Thin-Film Transistors

 M. Ando^{*,**}, M. Kawasaki^{*,**}, S. Imazeki^{*,**}, T. Minakata^{**,***}, Y. Natsume^{**,***}, T. Inoue^{*}, K. Noda^{*}, T. Arai^{*}, M. Fujimori^{*}, M. Ishibashi^{*}, M. Kato^{*}, T. Shiba^{*}, T. Kamata^{****}, K. Kozasa^{****}, S. Uemura^{*****}

*Hitachi, Japan

**OITDA, Japan

*** Asahi-Kasei, Japan

*****AIST, Japan

Recent progress of the self-aligned self-assembly (SALSA) process for organic TFTs was reviewed. SALSA TFTs exhibited the field-effect mobility over 0.1 cm²/Vs, in which semiconductor, source/drain electrodes and gate insulator were all solution processed. 100x100 matrix arrays of 85 ppi resolution were fabricated, in which solution-processed source electrodes and drain lines were self-aligned to gate line patterns specially designed for SALSA process. Materials and process newly developed for flexible plastic substrates were also introduced.

AMD9 - 2: Invited Full Fabrication Process for AM-OLED Using 16:00 Solution-Processed Tetrabenzoporphyrin Thin-Film Transistor

R. Hattori, C.-H. Shim, S.-G. Lee, M. Tazoe, T. Nakashima, S. Aramaki^{*}, A. Ohno^{*}, Y. Sakai^{*} Kyushu Univ., Japan ^{*}Mitsubishi Chem., Japan

Full fabrication process of An AM-OLED pixel with solution processed organic TFTs composed of metal-complex tetrabenzoporphyrin as an active layer and polystyrene as a passivation layer was presented. The TFTs were isolated using an RIE process and miniaturized for implementation into a pixel size of 100 μ m x 300 μ m.

AMD9 - 3 Plastic Thin-Film Transistor with Printed Electrodes 16:25 by Using Nanoprinting with h-PDMS Stamp

J. Jo, J.-H. Choi, K.-Y. Kim, E.-S. Lee, M. Esashi^{*} KIMM, Korea ^{*}Tohoku Univ., Japan

No abstract was submitted.

AMD9 - 4L High Speed Organic TFT for Electronic Paper 16:45 *H. Kondo^{*,**}, A. Kaneko^{*}, H. Kondoh^{**}, K. Kudo^{*,***}*

H. Kondoʻ, A. Kaneko, H. Kondoh, K. Kudoʻ ^{*}OptoElect. Ind. & Tech. Dev. Assn., Japan ^{**}RI, Japan ^{***}Chiba Univ., Japan

An organic TFT having a novel structure, FVC (Floating metal Vertical Channel)-type TFT has been developed. Both the reduction of gate capacitance and short channel length can be realized in this structure, which are necessary for the fast response of TFT by simple fabrication process. FVC-type TFT shows the I-V characteristics similar to those of conventional TFT, and the cutoff frequency of 400KHz was confirmed, which is very high value as an organic TFT.

Author Interviews

17:00 - 18:00

Supporting Organizations:

LC Physics and Condensed Matter Forum, JLCS Chemistry and LC Material Forum, JLCS Liquid Crystal Display Forum, JLCS Technical Group on Information Display, ITE Technical Committee on Electronic Information Displays, Electronic Society, IEICE Technical Committee on Electron Devices, Electronics Society, IEICE Technical Committee of Silicon Devices and Materials, IEICE Thin Film Materials & Devices Meeting

Workshop on FPD Manufacturing, Materials and Components

Wednesday, December 6

13:20 - 14:	20	Ohmi 3
	FMC1: Color Filters	
Chair: Co-Chair:	K. L. Lo, ITRI, Taiwan T. Tomono, Toppan Printing, Japan	

FMC1 - 1: Invited Film Base FPD Components by Roll-to-Roll 13:20 Process

S. Otsuki, T. Eguchi TRADIM, Japan

TRADIM is developing the film base FPD components manufacturing by Roll-to-Roll process that taking full advantage of its material. We have developed color filters, photo-alignment layers directly on the color filters, achromatic circular polarizer using of photo-alignment technology and a single component backlight system, each component by Roll-to-Roll process. We call this system "TRADIM system". We intend proposing the total solution as TRADIM system in order to grow the plastic film base FPD industry.

FMC1 - 2 Flexible Color Filter Formed on Optical Retardation 13:40 Film by Transfer Technique and Characteristics of Reflective Plastic LCD

T. Kitamura, T. Furukawa Kyodo Printing, Japan

We have already developed the technique of transferring the color filter and electrode pattern on a plastic substrate simultaneously. This time, we will report on the flexible color filter formed on the optical retardation film using the same transfer technique. By using the flexible color filter it becomes possible to fabricate LCD with one of the substrates omitted. We have actually fabricated a reflective plastic LCD by this technique, and conducted evaluation of the characteristics of the product.

FMC1 - 3 A New Method to Improve the Alignment Accuracy 14:00 for Flexible Color Filter Development

K. L. Lo, W. Y. Cheng, D. W. Li, J. W. Shiu, Y. A. Sha, J. H. Chi^{*}, C. C. Tsai^{*} ITRI, Taiwan ^{*}Chi Mei OptoElect., Taiwan

We had developed a 3.5-inch QVGA color filter with high definition of 118 ppi on plastic substrate by using pigment dispersion color resists and photolithography method. Thermal deformation of plastic substrate was a serious problem during color filter development, because it would affect the alignment accuracy of different color layers. Some handling methods were adopted to control the thermal process and ensured that each color layer could be developed in its related position accurately.

----- Break -----

15:00 - 16:00

Ohmi 3

FMC2: Optical Films (1)

Chair: H. Seiberle, Rolic Tech., Switzerland Co-Chair: Y. Fujimura, Nitto Denko, Japan

FMC2 - 1: Invited Volume Photo-Aligned Retarders

H. Seiberle, T. Bachels, C. Benecke, M. Ibn-Elhaj Rolic Techs., Switzerland

Coated retarders based on liquid crystal materials are typically aligned by brushing or photo-alignment. Recently, we have managed to combine the aligning and retarder function into a single material. Alignment of the new volume photo-alignable retarder (VPR-) material is induced in the bulk upon exposure to linearly polarized light. The new alignment mechanism opens up a new dimension for the design of optical retarders, especially when combined with conventional surface alignment, which allows to induce complex tilt and twist profiles.

Euro Display '07

September 17–20, 2007 Moscow, Russia

FMC2 - 2: Invited Improved Reactive Mesogen Materials for 15:20 Incell Optical Films

R. Harding, O. Parri, S. Marden, K. Skjonnemand, M. Verrall^{*}, B. Fiebranz^{**} Merck Chems., UK ^{*}Merck Display Techs., Taiwan ^{**}Merck KGaA, Germany

The viewing performance of Liquid Crystal Displays is routinely enhanced by the use of compensation films, usually laminated to the outside of the LC cell. Now, there is renewed interest in using Reactive Mesogens to create such films inside the LC cell. This concept places many new demands onto the RM films, e.g. increased thermal durability, hardness, adhesion etc. This paper details the new materials/ formulations Merck has developed to address these needs and openly assesses them against the requirements.

FMC2 - 3 Vertically Aligned LCD Designs Optically 15:40 Compensated by Thin Crystalline Films

S. Palto^{*,**}, S. Remizov^{*}, I. Kasianova^{*}, N. Guselnikov^{*}, A. Lazarev^{*} ^{*}Crysoptics, Russia ^{**}Inst. of Crystallography, Russia

We developed optical compensation for Vertically Aligned mode LCDs using thin coatable birefringent films produced by Crysoptix Ltd. The new coatable retarder films compensate both the liquid crystal layer and polarizers. The new retarders provide near perfect viewing angle properties in the visible spectral range. We present data of numerical optimization and experimental results for Vertical Alignment mode LCD.

----- Break -----

16:40 - 1	18:00	Ohmi 3
	FMC3: Optical Films (2)	
Chair [.]	J S Yu I G Chem Korea	

FMC3 - 1 Novel Optical Configuration of In-Plane Switching 16:40 Mode with Positive Biaxial Films

H. Mori, Fuji Photo Film, Japan

M. Hirota, S. Okude, T. Hori, K. Arakawa ZEON, Japan

We designed the novel optical configuration of an In-Plane Switching (IPS) mode with positive biaxial films on the both sides of a liquid crystal cell. By using an optical calculation, we confirmed that positive biaxial films could compensate a black state of an IPS mode. Then, the viewing angle characteristics of this novel optical configuration were experimentally evaluated. As a result, a high contrast ratio for a wide viewing angle range was performed.

Co-Chair:

FMC3 - 2 Novel Method for the Design of Compensation Film 17:00 for LCDs

B. K. Jeon, C. H. Yun, M. S. Park, J. S. Yu LG Chem., Korea

We have developed a novel simulation model for all kinds of birefringent films, such as uniaxial and biaxial films. By using this model, the fast axis and retardation value at any viewing angle are easily found. The polarization state is completely described by fast axis and retardation value on the Poincare sphere. We can easily optimize the design of compensation film in LCD for improving wide-viewing property by analyzing the polarization state at target viewing angle.

FMC3 - 3 Design of an Anti-Glare Treatment under Ambient 17:20 Conditions

D. Hamamoto, S. Kusumoto, T. Shouda Nitto Denko, Japan

We examined a technical issue about the surface appearance of displays having anti-glare (AG) treatment under ambient conditions, and clarified the relationship between the surface shape and the surface appearance. Then based on the results of this examination, we have succeeded in developing an AG treatment to lessen surface deterioration of the appearance caused by "glare" and "white blur". Scratches on the surface were also solved by an AG treatment that hardened the surface.

FMC3 - 4 New Surface Film Suitable for Large Size LCD-TVs 17:40

N. Matsunaga, S. Kato, T. Arai, T. Ito Fuji Film, Japan

We have succeeded in the development of a new surface film (new CV Film), it has the function of anti-glare and low-reflection. The new CV Film has two excellent features of 'Excellent image display quality' and 'Excellent physical properties' necessary for LCD-TVs especially. As the new CV Film, we have lined up CV-04 Film which is suitable for large size LCD-TVs attaching importance to contrast ratio, besides CV-02 Film which is the standard type attaching importance to the anti-glittering.

Author Interviews 18:00 - 19:00

Thursday, December 7

9:00 - 10:20 Ohmi 8 FMC4: Manufacturing Technologies (1)

Chair: C. Annis, Displaysearch, Japan Co-Chair: D. Freeman, Photon Dynamics, USA

FMC4 - 1: Invited Challenges of Electrical TFT Array Test for 9:00 LCD-TV Panels

D. Freeman Photon Dynamics, USA

The television application for LCD displays has spawned new and complex pixel designs to im-prove viewing angle, brightness, and black level performance. These new pixel designs will be in-troduced in combination with a comparison of the resulting impact to leading array test technologies. Arguments will be presented to conclude that array electrical test using electro optic Voltage Imaging technology has a sustainable operating advantage over competing test technologies.

FMC4 - 2 In-Line Automatic Defect Inspection and Repair 9:20 Method for Possible Highest Yield TFT Array Production

H. Honoki, N. Nakasu, T. Arai, K. Yoshimura, T. Edamura Hitachi, Japan

We have developed an automated circuit defect inspection and repair method that can be used to improve the yield ratio of Thin Film Transistor substrates for liquid crystal displays. The method focuses on correcting resist patterns after the development process to ensure shape regularity. We built a prototype system and confirmed that the method is valid. This method can be used to produce a high yield of TFT-LCD at a low cost and eliminate defects.

FMC4 - 3Introduction of the New Electrical Test Method for9:40LCD Cell Manufacturing Process

Y. Miyake, K. Chikamatsu, M. Goto, J. Mizoguchi Agilent Techs. Int. Japan, Japan

We propose a new electrical test method bringing repeatable and unambiguous test results which solves the drawback of the current lighting test for LCD Cell manufacturing process. This paper shows the basic scheme and the wide test coverage for cell process defects of this test method, and at last gives the examples of the actual measurement result.

FMC4 - 4 Enlargement of Large Scale Photo Mask and Multi 10:00 Tone Mask

S. Kanai HOYA, Japan

Improving placement accuracy is technical challenge with upsizing of LSPM (Large Scale Photo Mask). SLM (Stacked Layer Mask) which has HT (Half Tone) film is a sort of MTM (Multi Tone Mask) and the key-factor for decreasing the number of PEP (Photo Engraving Process). As a LSPM maker, to solve these technical challenges will contribute to the increase of production efficiency and improving the yield late of LCD production process.

----- Break -----

10:40 - 12:20 Ohmi 8 FMC5: Manufacturing Technologies (2)

Chair: K. Sarma, Honeywell Int., USA Co-Chair: Y. Ukai, Sony, Japan

FMC5 - 1: Invited Regional TFT LCD Manufacturing Equipment 10:40 Trends for Large Glass Substrates

> C. Annis DisplaySearch, Japan

TFT LCDs are manufactured primarily in the 4 regions of Japan, Korea, Taiwan and China. Recently local equipment industries have arisen in line with the ever increasing demand for continuous on-site support and to reduce costs and risks associated with shipping huge machines for large glass processing. Furthermore, machine price competition has helped local equipment companies successfully enter multiple markets. This paper presents research results, which investigate investment by region, local equipment infrastructure and future trends.

FMC5 - 2: Invited Development of Laser Annealing Technology 11:00 and System in Application of Low Temperature Poly Silicon

D. H. Kim, D. J. Kim KORNIC Syss., Korea

LTPS technology using a high power laser have been widely applied to TFTs for liquid crystal, organic light emitting diode display, driver circuit for system on glass. In this paper, we report the recent result of our development with conventional excimer laser and frequency doubled YAG laser annealing system. The KORONA[™] GLTP annealing system which uses a high powered green laser as a light source has successfully demonstrated the lateral grown large p-Si grains by overlapping exposure.

FMC5 - 3 Performance of Solid Green Laser Annealing System 11:20 for LTPS TFTs

K. Nishida, R. Kawakami, J. Izawa, N. Kawaguchi, F. Matsuzaka, M. Masaki, M. Morita, A. Yoshinouchi, Y. Kawasaki Ishikawajima-Harima Heavy Ind., Japan

We developed the laser annealing system using the new pulsed green laser of 261W(5kHz) and 75.5mJ/pulse(2kHz). We confirmed that energy margin of this system was much wider than that of excimer laser, and that a substrate scanning speed when using top-flat beam was $2 \sim 4$ times as fast as that when using gaussian beam. It was found that large grains were formed by using s-polarized beam, and that small grains with good uniformity were formed by using p-polarized beam.

FMC5 - 4 Withdrawn 11:40

FMC5 - 5 Fabrication of Thin Film Transistor Arrays Using 12:00 Electrostatic Inkjet Printing

K. Sugi, H. Nakao, Y. Hara, I. Takasu, Y. Nomura, I. Amemiya, S. Uchikoga Toshiba, Japan

The electrostatic inkjet printing technique was adapted to fabricate an active matrix backplane for the first time. This technique has the advantage of fine patterning as compared to piezoelectric inkjet, because kinetic energies of droplets are increased by electric field. Using this technique, we have developed TFT arrays with desirable shape, high accuracy of position, and matrix with the interlayer. Electrostatic inkjet printing is a technique available for fabricating an active matrix backplane.

----- Lunch -----

Ohmi 9

14:00 - 15:20

FMC6: Materials

Chair:	C. C. Lee, ITRI, Taiwan
Co-Chair:	T. Unate, Seikisui Chem., Japan

FMC6 - 1: *Invited* Development of SiO₂ Dielectric Layer Formed 14:00 by Low-Temperature Solution Processing

T. Kodzasa, S. Uemura, K.Suemori, M. Yoshida, S. Hoshino, T. Kamata AIST, Japan

We have developed a technique to prepare a SiO₂ gate dielectric layer by low temperature solution process using UV-ozone oxidization reaction. The prepared SiO₂ film showed very flat surface and excellent dielectric properties. As maximum process temperature was below 200°C, it is possible to prepare the SiO₂ dielectric layer on a plastic substrate. This newly developed solution process of a SiO₂ film is useful to prepare a gate dielectric of a printed TFT.

FMC6 - 2 New Column Spacer with Wide Margin for Cell Gap 14:20 Defect

M. Suezaki, T. Takahashi, Y. Nishimura, N. Hanatani, K. Kawamura, T. Matsukubo, S. Kobayashi, A. Nakasuga Sekisui Chem., Japan

Some defects of LCD panels, for example gravity defect and cold bubble happen from difference of thermal expansion coefficient between liquid crystal and spacer. However, our cell gap simulation showed that elastic modulus of spacer greatly influences to happen these defects. Therefore, we tried to control elastic modulus of column spacer and verified that these defects are reduced by using low elastic modulus column spacer.

FMC6 - 3 The Effect of Adding Plasticizer into Coating 14:40 Photoresist to Improve the High Speed Coating Property

S. Takahashi^{*}, J. Shimakura^{*}, S. Kurihara^{**} ^{*}AZ Elect. Marerials, Japan ^{**}Kumamoto Univ., Japan

The higher coating speed is required to photoresist for slit coating method. Authors studied the effect of the matrix compounds to improve the coating speed from the point of view of film thickness uniformity. Methyl stearate showed two good effects to make improved photoresist. One was the improving film thickness uniformity of diluted photoresist. The other was the reduction of dispense volume of photoresist. Authors confirmed that the evenness of the photoresist film surface was improved by adding the matrix compound from AFM observation.

FMC6 - 4 TMAH Developer Recycling Technology for LCD 15:00 Manufacturing

M. Kikukawa Nagase CMS Tech., Japan

Recently, the membrane separation technology applied as a recycling technology of the TMAH developer usage in the TFT-LCD manufacturing. Also, we are developing the complete Recycling from waste of the TMAH developer. However, there are a lot of problems to the recycling technology that the accelerated requirements for larger substrate sizes and high-resolution in the LCD industry during the past several years. In order to reduce waste in the photolithography process as well as the global environmental load, we think that it is necessary to cooperate with the LCD manufacturers and the photo-resist manufacturers and the developer manufacturers the development system manufacturers and us.

Author Interviews

18:40 - 19:40

14:00 - 17:00

Ohmi	5-7
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Poster FMCp: FPD Manufacturing, Materials & Components

FMCp - 1 High Speed and Sensitivity Array Tester for LTPS-TFT LCD and OLED

K. Chikamatsu, Y. Miyake, T. Fujisaki, M. Goto, J. Mizoguchi Agilent Techs. Int. Japan, Japan

The high speed and sensitivity array tester has been developed and utilized for mass-production of advanced LTPS LCD (SOG/COG). It realizes fast enough TACT enabling 100% inspection with better than 1fF sensitivity. Its superior sensitivity is demonstrated in MURA detection of an OLED panel. In addition, a test solution for small-sized COG devices, for which array test has been rarely done due to probing difficulty, is shown with the excellent defect detection capability.

FMCp - 2 Rubbing MURA Detection Method with High Speed and High Sensitivity Using New Ellipsometer

H. Murai, K. Ekawa, J. Takashima, H. Naito, N. Nakatsuka OMRON. Japan

We have developed the new ellipsometer that can measure ellipsometric parameters along a line on a sample in one measurement using a slit beam and a CCD liner sensor. It can sensitively measure a line profile of anisotropy using data analysis for generalized ellipsometry. Our ellipsometer is suitable for rubbing MURA detection with high speed and high sensitivity.

FMCp - 3 Ion Beam Irradiation System for LC Alignment Process

T. Matsumoto, N. Hattori^{*}, Y. Matsuda, M. Tanii, M. Konishi, Y. Andoh, Y. limura^{*} Nissin Ion Equipment, Japan ^{*}Tokyo Univ. of A&T, Japan

We have developed an ion beam irradiation system to control liquid crystal (LC) alignment for LC display production and investigated its performance such as the spatial uniformity of the ion beam. The spatial distributions of current density, incident angle, divergence angle of the ion beam, and the substrate potential are shown to be quite uniform. We successfully demonstrate that a large-sized test panel fabricated by the present system shows almost comparable display quality to that by a conventional rubbing method.

FMCp - 4 Test Method of Plastic Sealant on Flexible LCD

C. C. Hsiao, Y. C. Liao, K. H. Chang, S. Y. Fuh, D. W. Lee, Y. A. Sha, P. J. Su, C. H. Hsieh, J. W. Shiu, W. Y. Cheng, J. C. Yang, K. L. Lo, K. C. Lee, Y. P. Chang ITRI, Taiwan

In this work, we provided a novel test method to verify the sealing materials for flexible LCD. The ultraviolet type curing sealing material with low process temperature was suitable for flexible LCD cell assembly. We also proposed the sealing materials which passed 13200 times bending test within 20 mm curvature. Results in this work could accelerate the application of plastic substrates on portable TFT-LCD.

FMCp - 5 A Handling Method for Flexible Display -Deformation Control of PC film

W. Y. Cheng, K. L. Lo, Y. A. Sha, P. J. Su, C. H. Hsieh, K. H. Chang, C. C. Hsiao, J. W. Shiu, S. Y. Fuh, Y. C. Liao, J. C. Yang, D. W. Lee, K. C. Lee, Y. P. Chang ITRI, Taiwan

We have demonstrated a handling method for flexible display by controlling the deformation of PC film. To avoid the deformation of PC film carried on a holder to obtain a well-developed color filter, the issue of stress release during color filter development is very important. In this article, two kinds of handling methods have been compared to explore the influence of PC deformation in the accuracy of superposition between different color layers that usually occurred during color filter development.

FMCp - 6 Low Temperature Colour Filter Resist for Flexible Displays

G. de Keyzer, D. Hoelzle, L. Craciun^{*}, S. Homma^{**} Ciba Specialty Chem., Switzerland ^{*}Ciba Specialty Chems., USA ^{**}Ciba Specialty Chems., Japan

By replacing the methacrylate cross linker in a standard pigmented colour filter photo resist it became possible to lower the drying temperature to maximum 50°C and leave out the post bake. This enables the possibility to produce a colour filter directly on an E-paper display or on a plastic substrate. The material will also be optimised for the use in ink jet processes.

FMCp - 7 Optimum Design Characteristics of a Direct Type Backlight Unit

M. S. Lee, Y. S. Oh, S. Y. Kim, J. Y. Lee BOE Tech. Group, Korea

We focused on improving of the optical efficiency in the direct type Backlight Unit. We could achieve the optical efficiency by reducing the thickness of BLU and making the prism shapes on a reflection sheet. Raised efficiency made if possible to reduce the numbers of lamps used.

FMCp - 8 Nano-Sized Yttria Protective Coatings for Flat Backlight Lamps

S. K. Evstropiev, J. S. Park, T. H. Park, S. H. Cho, D. H. Jung Samsung Corning, Korea

An investigation reports about the preparation of yttria nano-sized coating on the glass and on the surface of multi-component phosphor layer by simple and industrially available spraying of acidic aqueous or mixed water/alcohol solutions of yttrium salt. This method allows forming very small (diameter of particles less than 15 nm) yttria particles with narrow size distribution or very thin (less than 15-20 nm) continuous protective coatings for flat backlight lamps.

FMCp - 9 Design of LC Fresnel Lens and Its Applications

M. Tada, K. Shibata, J. Miyashita, I. Fujieda Ritsumeikan Univ., Japan

We propose to replicate a Fresnel lens structure on an ITO-coated substrate, form a cell with another ITO-coated substrate, and fill the gap with a liquid crystal (LC) material. An appropriate bias can create a retardation distribution similar to that of a spherical lens. As a preparation to building such a lens, we have exposed polymer-network LC material to UV light through a phase mask. It can modify incoming wavefronts and we discuss its application for a backlight.

FMCp - 10 Efficiency Improvement of OLED Backlight for TN-LCD

F. Rahadian, M. Tada, J. Miyashita, I. Fujieda Ritsumeikan Univ., Japan

Attaching an optical film on the transparent substrate of an OLED improves its efficiency by out-coupling the light trapped in the substrate. We attached various prism sheets, diffuser sheets and grating films to two types of OLEDs. A TN-LC cell was placed on such an illuminator and an angular distribution of the output light was measured. We obtained the best result with a combination of a prism sheet and a highly- reflective OLED.

FMCp - 11 Thin Backlight with Electronic Control of Luminance Angular Distribution

I. Fujieda, Y. Takagi, K. Imai, Y. Inaba, T. Fujii Ritsumeikan Univ., Japan

Viewing angle control is desired for a small-sized liquid crystal display. We have proposed to place a liquid crystal (LC) device between an LED and a light-guide of a backlight. A polymer-network LC cell, an LC phase grating, or an LC lens can be used. A bias applied to such a device controls the angular distribution of the propagating light. Output couplers built in the light-guide translate the changes in the propagation angles into those of the output light.

FMCp - 12 Effects of Reshaping Micropyramids and Prisms on the Optical Performances of Light Collimating Films in the Field of LCD Backlight

J.-Y. Lee, K.-B. Nahm, J.-H. Ko, J. H. Kim^{*} Hallym Univ., Korea ^{*}Samsung Elect., Korea

Optical performances of micro-pyramid arrays and one-dimensional micro-prisms were simulated by ray tracing technique for the application of LCD backlight. The angular distribution of the luminance was investigated as a function of several parameters such as the apex angle, the refractive index, and the density. The effects of reshaping, in particular, cutting the apex region on the optical performances were investigated, and found that the angular distribution of the luminance around the on-axis direction became sharper than the uncut cases.

FMCp - 13 A Slim and Bendable Backlight System Manufactured by a Roll-to-Roll Continuous Process

A. Nagasawa, T. Eguchi, Y. Sanai^{*}, K. Fujisawa^{**} TRADIM, Japan ^{*}Toagosei, Japan ^{**}Kuraray, Japan

A slim and bendable backlight system has been developed by a roll-toroll continuous manufacturing process. This backlight system which was composed of a light guide film and an optical-patterned film was less than 0.3 mm in total thickness, although it was too slim to radiate sufficiently. Then radiations of this backlight system could be accomplished by using a new developed light guide component to induce lights from a light source to a light guide film.

FMCp - 14 Optimized Optical Reflection Sheet as a Component in LCD Backlight with Special Lighting Condition for Luminance Enhancement

Y. Chen, D. K. Yoon, S. J. Lee, F. Huang, S. K. Lee Beijing BOE OptoElect. Tech., China

A kind of new reflector with some special structure for LCD back light of large size are capable of enhancing the luminance outcome up to 11.4% in comparison with the existed one.

FMCp - 15 Enhancement of Luminance and View Angle by Optimizing the Structure of Prism Sheet and the Diffusivity of Reflective Polarizer Film

G. J. Park, T. S. Aum, D. H.Lee, J. H. Kwon, M. H. Lee^{*}, B. K. Jung^{*}, H. S. Soh^{*} Yeungnam Univ., Korea ^{*}LG.Philips LCD, Korea

The normal luminance and the view angle of the LCD backlight were enhanced by optimizing the apex angle of the prism sheet and the diffusivity of the reflective polarizing sheet. The angular luminance profile of the backlight unit with a changed apex angle of prism sheet showed that the strong sidelobes lights from normal were almost disappeared when the apex angle of the prism sheet was changed to more than 96 degrees and also the view angle was broadened.

FMCp - 16 Color Filterless 32-in. OCB-TFT LCD

W. C. Tai, C. N. Mo, M. T. Ho, C. J. Lin, C. L. Liu Chunghwa Picture Tubes, Taiwan

In this study, the LED was used as a backlight system for its convenient of field sequential control and 3 times frame rate of 180 Hz/sec. Based on this structure, a good full color display is obtained in 32 inch the Optical Compensated Birefringent (OCB) TFT LCD with NTSC 100%. This proto type has verified its basic function in June and it has demonstrated at Taipei FPD'06.

FMCp - 17 Thin Backlight Unit with Integrated Light-Guide Film

Y. Y. Chang, P. H. Yao, Y. N. Pao, C. W. Yu ITRI, Taiwan

Edge-lit backlight modules are applied in liquid crystal displays (LCDs) of portable devices. A traditional backlight module, whose total thickness is greater than 0.65 mm, uses optical sheets to increase onaxis brightness and uniformity. We have designed a new coupling element as well as an integrated light guide film (LGF) without using optical sheets. The total thickness of LGF can be lowered to 0.36 mm. The slim LGF could be applied in LCDs of portable devices and future flexible displays.

FMCp - 18 State of Polarization of Polarized-Light Backlights

H. J. Cornelissen, D. K. G. de Boer, E. Souchier^{*} Philips Res. Europe, The Netherlands *Université Montpellier II, France

Polarized-light backlights have been made by creating micro-prisms in uniaxially stretched polymeric foils. The state of polarization of the emitted light is measured for all polar angles between 0° and 80° and azimuthal angles between 0° and 360°. The polarization vector can be rotated to a desired value using a half-wave retardation foil. A new polarized-light backlight is presented using micro-wedges instead of micro-prisms. A first prototype already shows an efficiency gain of 1.47x compared to an unpolarized-light backlight.

FMCp - 19 Development of Photosensitive Insulating Materials as a Planarizing and Passivated Layer on TFT-LCDs

Y. Kusaka, S. Nakamura, K. Azuma, T. Sasaki, T. Unate, Y. Nakatani, A. Nakasuga, K. Matsukawa^{*}, S. Murakami^{**}, K. Ohkura^{***}, T. Kikkawa^{***} Sekisui Chem., Japan ^{*}Osaka Municipal Tech. Res. Inst., Japan ^{**}Tech. Res. Inst. of Osaka Pref., Japan ^{***}Hiroshima Univ., Japan

Novel photosensitive insulating materials comprised of organic silsesquioxane (OSQ) have been developed. The OSQ had high photosensitivity, insulating performance, transparency, and heat resistance required as a passivation layer on TFT LCDs. In this paper, we report about the improvement of OSQ film thickness. Our photosensitive insulating materials could be formed thicker than 3 μ m without the independent planarization process. In addition, we could conduct the improvement of developing rate in an aqueous solution of TMAH.

FMCp - 20 Low-Temperature Synthesis of SiO₂ Insulator by ICP-CVD Using Tetramethylsilane

H. Furuta, M. Furuta, T. Matsuda, T. Hiramatsu^{*}, T. Hirao Kochi Univ. of Tech., Japan ^{*}Kochi Casio, Japan

 $\rm SiO_2$ insulator films were deposited at low temperature below 150°C using organic silicon source of tetramethylsilane (4MS) and N₂O precursor by ICP-CVD method. FT-IR absorption peaks of O-H stretch, Si-H stretch, Si-CH₃ stretch were not observed in these SiO₂ films. Refractive index of SiO₂ films at 100°C was 1.480. These results indicate that SiO₂ insulator films can be obtained by high-density plasma ICP-CVD using 4MS and N₂O by increasing substrate temperature to 100°C.

FMCp - 21 Negative Type Photoresist for Dome-Shaped Protrusion in Transflective MVA Mode

Y. K. Kim, S. Y. Choi, J. H. Chang, S. H. Kim, H. J. Kim, J. S. Jeong, K. C. Kim, H. C. Shin, J. H. Yoon Sekisui Fine Chem Korea, Korea

We developed the negative type photoresist which had the domeshaped protrusion in the TMVA(Transflective multi-domain vertical alignment) mode. When using the negative type photoresist, transmittance and pattern uniformity are excellent. But it was not used well, because there is difficult to controlled pattern shape, CD size in proximity type exposure system. But, we developed the new material which formed a dome-shaped protrusion such as mask size in proximity type exposure system.

FMCp - 22 Withdrawn

FMCp - 23 Influence of Deposition Pressure on Thermal Stability of ZnO Films Deposited by rf Magnetron Sputtering

T. Hiramatsu^{*,***}, M. Furuta^{**,***}, T. Matsuda^{**,***}, H. Furuta^{**,***}, T. Hirao^{**,***} ^{*}Kochi Casio, Japan ^{**}Kochi Univ. of Tech., Japan ^{***}Kochi Ind. Promotion Center, Japan

Thermal stability of ZnO film deposited by rf magnetron sputtering was investigated. Sheet resistance of the ZnO after post-deposition annealing strongly depends on the deposition pressure. The OES and TDS results revealed that desorption of Zn and O_2 from ZnO film deeply related to the ion species in the deposition plasma.

FMCp - 24 Applications of Self-Assembled Monolayers (SAMs) as the Mold Lubricant

T. Takahashi, N. Nakamoto, Y. Fujita, K. Kumazawa, D. Asanuma, M. Shimada, T. Hidaka, H. Suzuki, H. Saso Nippon Soda, Japan

We have already reported on the novel chemisorption method using a toluene solution of octadecyltrimethoxysilane (ODS), water and titanium alkoxide to form highly-ordered self-assembled monolayers (SAMs). Using our solution-based process, we could form the ODS-SAMs quickly and with uniform thickness on a wide area under ambient conditions. When we applied the ODS-SAMs as lubricants for nanoscale structured molds, they showed high durability under 200 °C and low peeling stress. And we confirmed that the ODS-SAMs could maintain nanopatterns on substrates.

FMCp - 25 Optimization of Surface Morphology of Indium Tin Oxide (ITO) Films Using New Sputtering Process

K. Ogawa, M. Yoshikawa, Y. G. Han^{*}, Y. W. Beag^{*}, S. K. Koh^{*} MICRO Tech., Japan ^{*}P&I, Korea

We prepared ITO films by combining two sputtering methods, i.e., ion beam sputtering and DC magnetron sputtering. The crystallinity of the ITO films showed highly preferential orientation into (111) direction, resulting in uniform and small pyramid-shaped surface morphology. Optical and electrical properties of the developed films were closely related to and showed very interesting characters by each preparation parameters. We are going to suggest potential applications of the films to new devices.

FMCp - 26 Preparation of AI Doped ZnO (AZO) Thin Films on PC and PES Substrates

B. J. Cho, M. J. Keum, K. H. Kim Kyungwon, Korea

We prepared the Al doped ZnO (AZO) thin film on polycarbonate (PC) and polyethersulfon (PES). The AZO thin films were prepared by Facing Targets Sputtering (FTS) apparatus and deposited with various O₂ gas flow rate without any substrate heating. We compared the AZO thin film deposited on PC substrate with PES substrate and the properties of thin films were investigated. In results, we obtained the AZO thin film as a resistivity of about 8.8 \times 10⁻⁴ ∞ -cm, transmittance of over 80%.

Thursday

FMCp - 27 Comparative Study on Reflective Polarizers: On-axis Properties

W. J. Jeong^{*}, H. Pak^{*}, K. C. Yoon^{*,**}, S. T. Kim^{*}, J. C. Jung^{*}, H. D. Park^{*}, J. R. Park^{***} ^{*}Samsung Fine Chems., Korea ^{**}KAIST, Korea ^{**}Chosun Univ., Korea

Comparative study on reflective polarizers, operations of which are based on either linear or circular polarization states of light, was performed. It was found that the reflective polarizer based on cholesteric liquid crystals showed superior optical performances in terms of reflectance and spectral bandwidth. It was shown that, however, the dispersion properties of quarter-wave films (QWFs) could limit the brightness enhancement performance of the polarizer and careful consideration should be given to the selection of proper QWFs.

FMCp - 28 Compensation of Color Shift in a Cholesteric LC Polarizer by Using Stacks of a Quarter-Wave Film with a Low n_z Value

H. Pak^{*}, W. J. Jeong^{*}, K. C. Yoon^{*,**}, S. T. Kim^{*}, J. C. Jung^{*}, H. D. Park^{*}, J. R. Park^{***} ^{*}Samsung Fine Chems., Korea ^{**}KAIST, Korea ^{***}Chosun Univ., Korea

Color shift in a cholesteric liquid crystal (CLC) polarizer, *i.e.*, abrupt change of color coordinates as a function of the viewing angle was compensated by using stacks of a quarter-wave film (QWF) with a low n_z value. It was found that while maintaining the in-plane retardation value unchanged, one could increase the optical path length along the depth of the retardation film by stacking a number of QWFs in a proper orientation.

FMCp - 29 Finite Difference Time Domain Analysis of 3-D Subwavelength Structured Array for Antireflective Application

C. J. Ting, H. Y. Tsai, C. J. Hsu, Y. Y. Nieh, C. P. Chou ITRI, Taiwan

Low reflectance can be obtained by both the pyramidal and conical shapes over a broadband range. Comparing the reflectance of different structure shapes and aspect ratios by the finite difference time domain (FDTD) method, it shows that the antireflective efficiency of the pyramidal structures is better than that of the conical structures. The polymer film of conical structured array was fabricated by holographic lithography and following replicating process. The experimental results show highly consistent with the simulation results.

FMCp - 30 New Type of Anti-glare Film and Manufacturing Process

C.-H. Yeh, C.-F. Huang, W.-Y. Lin Far Eastern Textile, Taiwan

The new antiglare film includes a transparent substrate and at least one resin layer. The resin layer contains particles and has surface concave hole configuration. The surface particles will be removed by appropriate solvent, allowing concave holes formed on the surface. The antiglare film has high light transmittance and high clarity of transmitted images.

FMCp - 31 One-Shot Mapping System of Birefringence Dispersion for Retardation Films

Y. Otani^{*}, T. Wakayama^{*,**}, N. Umeda^{*}, K. Takashi^{*} ^{*}Tokyo Univ. of A&T, Japan ^{**}Saitama Medical Univ., Japan

An one shot mapping system of birefringence dispersion is developed to measure both a retardation and an azimuthal angle with wavelength dependence. Spectroscopic polarization modulation by two polarizers and two reterders is a key technique to modulate sinusoidally the intenstity distribution along wavenumber. Only the image of spectroscopic intensity is sufficient to determine the retardation and the azimuthal angle, respectively. In the experiment, the retardation map of a retardation film is shown as demonstrations.

FMCp - 32 Polarization Mapping System of Viewing Angle for Optical Films

T. Wakayama^{*,**}, N. Asato^{**}, Y. Otani^{**}, N. Umeda^{**} ^{*}Saitama Medical Univ., Japan ^{**}Tokyo Univ. of A&T, Japan

A novel polarization mapping system is proposed for viewing angle of LCD's films. It is consisted of a compensator and an analyzer in rotating ratio of one to three. The maps of an ellipticity and an azimuth of ellipsoid are obtained with high precision. In the experiment, a commercial circular polarizer is measured at full visual spectrum from 450nm to 750nm. The maps of ellipticity in 450, 550 and 650nm have distinctive shapes, respectively.

FMCp - 33L The Electrical and Optical Characteristics of TCO Thin Films with Processing Parameters

C. H. Jeong, Y. J. Hong, H. J. Kim, K. M. Lee Korea Univ. of Tech. & Education, Korea

Al-doped ZnO thin films were deposited on glass substrates by RF magnetron sputtering. The Sheet resistance, roughness and optical transmittances were systematically investigated with various deposition time and working pressure. As the Ar flow rate increases, the deposition rate decreased monotonically. But, the sheet resistance does not increase in proportional to the film thickness. When the film thickness was fixed to 200nm regardless of Ar flow rate, as the Ar flow rate increases, the sheet resistance was decreased.

FMCp - 34L New Coating Method of Metallic Layer of Conductive Ball for Anisotropic Conductive Film (ACF) Using Ni Nanoparticle

S. J. Hong, C. J. Han, W. G. Kim, G. W. Jeong^{*}, J. I. Han Korea Elect. Tech. Inst., Korea ^{*}Jeong Eui, Korea

In this work, new simple method to make a conductive ball was developed. 5 nm sized Ni nanoparticle was uniformly coated onto PMMA ball with highly adhesive force leading to successful electroless-plating of Au onto it. The surface roughness is smooth, and such a good surface leads to good electrical properties with low resistance of 6 ω / ball, and uniformity is also good. So, high performance conductive ball was fabricated by using the coating of Ni nanoparticle followed by Au electroless-plating.

FMCp - 35L Discharge Characeteristics of a Mercury-Free Flat Fluorescent Lamp for LCD Backlight Unit

S. M. Lee, K. G. Jeong, Y. C. Jeong^{*}, M. G. Kwak^{**}, S. H. Sohn Kyungpook Nat. Univ., Korea ^{*}Hee-Sung Elect., Korea ^{**}KETI. Korea

We developed a Flat Fluorescent Lamp with a high luminance by using the same discharge mode as PDP. Our FFL has a simple and unigue structure where the glass substrates are used as dielectric layers. The panel has a striped line shape of 10 inch diagonal size. The gas discharge characteristics under both total gas pressure and partial gas pressure were investigated. The panel showed a maximum high luminance 8,690cd/m² under bias of 20kHz pulse of 2.9kV.

FMCp - 36L High-Luminance and High-Efficacy Flat Xe Discharge Lamp for LCD Backlights

D. I. Kang, H. S. Kim^{*}, Ko. J. J.^{**}, Lee. K.-W. Myongji Univ., Korea ^{*}LuxOn, Korea ^{**}FTLAB, Korea

In this work, highly efficient flat Xe discharge lamp with very simple structure is presented. The emission efficacy of 82 lm/W at 9500cd/m² was obtained, which is due to porous anodic alumina (PAA) dielectric layer and high Xe pressure. This XeFFL lamp, which has very fast response time and strip patterned plane parallel electrode discharge structure, was found to be very suitable for fast blinking and areal dimming control.

FMCp - 37L Micro-Holographic Light Guide Plates in LED BLUs

S. R. Park, O. J. Kwon, S.-H. Song, H.-S. Lee^{*}, H. Y. Choi^{*} Hanyang Univ., Korea *Samsung Advanced Inst. of Tech., Korea

We suggest a micro-holographic light guide plate (μ -LGP) structure for LED backlight units. Optimization in orientation of the micro-holographic gratings is performed, leading to a characteristic function for deriving optimal conical-angle distribution of grating direction. Micro-holographic lithography and UV embossing are used to fabricate the micro-gratings with different conical angles. Hot-spot and light-propagation line-patterns which were seriously occurred in LED BLUs are successfully eliminated in our μ -HLGP, when a LED is placed at a corner of the light guide plate.

Friday, December 8

9:00 - 10:	20	Ohmi 3
	FMC7: Backlight Systems (1)	
Chair: Co-Chair:	S. Bierhuizen, Philips Lumileds Lighting, USA M. Shinohara, Omron, Japan	
EMO7 1.	Invited Devfermence of Link Dever LEDe in	Diamlay

FMC7 - 1: Invited Performance of High Power LEDs in Display 9:00 Illumination Applications

S. Bierhuizen, G. Harbers, M. Krames Philips Lumileds Lighting, USA

We will discuss the performance, progress and trend of High Power Light Emitting Diodes (HP-LEDs) for backlighting and micro-display projection applications. Main parameters for backlights are efficiency and cost while luminance is the most important parameter for projection, but they are driven by similar LED parameters such as drive current, operating temperature and optical coupling efficiency. Prospects for improving these parameters to meet the demands for the various illumination applications will be discussed.

FMC7 - 2: Invited Thin RGB LED Light Source for LCD Monitor 9:20 and TV Backlighting

T. L. Mok Avago Techs., Malaysia

The use of RGB LED to backlight LCD panels is a must to achieving a superior color gamut. The tradeoffs in using RGB LED backlighting include the efficiency and cost of assemblies. A novel chip-on-board (COB) package has been developed which combines compact and low profile package outline with good color mixing and efficient thermal management. This package demonstrates that COB technology is an attractive option because of its cost effectiveness and its ability to incorporate simple electrical connections.

FMC7 - 3 Expanded Funnel-Shaped Light Guide for a Pseudo-9:40 White/RGB LEDs Display Illumination System

K. Käläntär Nippon Leiz, Japan

An expanded optical funnel-shaped light guide for illumination of the automotive display panel system has been developed. The light guide has a tubular portion with a circular light introduction surface at one end and has a flat section for illumination of the display panel at the other end. A diffuser film and three pseudo-white LEDs are combined with the micro-structured light guide to form a display for use in the automotive instrument panel.

FMC7 - 4 10:00 G. Kurata, K. Sakurai, M. Ohira, Y. Kawabata, A. Funamoto, S. Aoyama OMRON, Japan

The conventional light-guide requires two prism sheets and a diffusive sheet to improve the brightness and visual quality, respectively. In this paper, a novel pattern, grating-prism hybrid pattern, fabricated on the light-guide to realize a sheetless backlight system is proposed. With this proposal, the brightness and visual quality that nearly equal conventional systems without the use of sheets were realized and the reduction of the thickness of backlight system by 20% has been achieved.

----- Break -----

Ohmi 3

10:40 - 11:40

FMC8: Backlight Systems (2)

Chair: A. A. S. Sluyterman, Philips Lighting, The Nertherlands Co-Chair: K. Käläntär, Nippon Leiz, Japan

FMC8 - 1 Microplasma Unit with Nano-Tip Enhanced Electrode 10:40 Operated in Ar and Ne Gases for Integrated Flat Light Source

Z.-Y. Wu, S.-O. Kim Nat. Chiao Tung Univ., Taiwan

Microplasma devices with nano-tip electrodes have been fabricated and operated successfully in Ar and Ne gases. The nano-tip locally enhances the electronic field. Current-voltage characteristics of microplasma devices have been examined by direct current bipolar pulsed waveform with different frequencies from 2 to 20 kHz in 300 - 800 Torr of Ar, Ne and Ne+Ar(2%). With all the advantages, the nano-tip enhanced microplasma technology provides possible opportunity to integrate to flat plasma light source.

FMC8 - 2 Effect of Electrode Structure on Efficiency of Flat 11:00 Plasma Backlight

Y. Wu, Q. Li, Y. Xue Southeast Univ., China

The electrode structure has great effect on the luminous efficiency and firing voltage in flat plasma backlight. To optimize the electrode structure, a way of macro-cell for investigation was proposed, this method had been validated and optimum electrode structure is designed in experiments. Luminous efficiency is improved by applying this electrode structure.

FMC8 - 3:InvitedPhysical Properties of Nano Silicon and Its11:20Application to Functional Image Devices

N. Koshida^{*,**} ^{*}Tokyo Univ. of A&T, Japan ^{**}Quantum14, Japan

In nanocrystalline silicon (nc-Si), the original physical properties of bulk silicon are totally modified due to a strong quantum confinement effect. A significant band-gap widening induced in nc-Si leads to efficient visible luminescence at room temperature and related photonic phenomena. In addition to the optical effects, some useful functions have been found out in various manners: ballistic electron emission, thermally-induced ultrasonic emission, and bioactivity. Some topics on these characteristics and device application studies are presented.

----- Lunch -----

14:00 - 14	:40 Ohmi 3
	FMC9: Backlight Systems (3)
Chair:	K. Käläntär, Nippon Leiz, Japan
Co-Chair:	D. den Engelsen, Southeast Univ., China
FMC9 - 1	Expression of 11-Bit-Equivalent Gray Levels by
14:00	Adaptive Dimming of LCD Backlights

S. Shimizukawa, T. Shirai, H. Kamano, T. Shiga, S. Mikoshiba Univ. of Electro-Commun., Japan

Output luminance of an LED backlight unit for an LCD-TV was adaptively dimmed along with input video signal in order to improve the gray scale expression capability. When the technique is adopted to an LCD-TV having an 8-bit capability, the luminance range corresponding to 0-31 gray levels of the original signal can be expressed with 256 gray levels. Namely, 11-bit-equivalent resolution gray scale can be obtained for this range where a precise gray scale expression is needed.

FMC9 - 2 Properties of a Scanning Field Emission Backlight 14:20 for LC-TV

D. Den Engelsen, X. H. Li, Y. K. Qi Southeast Univ., China

The power consumption of a scanning and 2D dimming Field Emission Backlight Unit (FE-BLU) for LC-TV is about a factor of 1.5 larger than that of a conventional, stationary BLU based on Cold Cathode Fluorescent Lamps (CCFLs). It was found that scanning of an FE-BLU suppresses the motion blurring of TV-images satisfactorily. The scan frequency of the FE-BLU should be higher than 60Hz to reduce phosphor saturation at high luminance.

Author Interviews

17:00 - 18:00

Supporting Organizations:

The Japan Society for Printing Science and Technology Japan Society of Color Material The Technical Association of Photopolymers, Japan Society of Photographic Science and Technology, Japan The Society of Radtech, Japan The Society of Polymer Science, Japan The Japanese Research Association of Organic Electronics Materials Japan Printed Circuit Association

Workshop on CRTs

Thursday, December 7

9:00 - 12:00

Ohmi 5-7

Poster CRTp: CRTs

CRTp - 1 Optimized Curvature Design for Improving Local and Overall Doming in Real Flat AK Mask CRT

K. M. Kok, C. C. Chao, C. T. Lau Chunghwa Picture Tubes, Malaysia

In AK mask development for flat CRT, especially in larger screen size and slim tube type, both local doming and overall doming need to be solved simultaneously. A study on mask curvature design, with various of radius of curvature, and certain range of ratio for the radius of curvature, we take these designs into mask displacement simulation for local doming. Finally an experiment result which have achieved this target were recorded.

14:00 - 15:00

Ohmi 8

CRT1: Future CRT Technology & Market

Chair: M. Maeda, Consultant, Japan Co-Chair: H. Y. Chen, Chunghwa Picture Tube, Taiwan

CRT1 - 1: Invited The Digital, Orthogonal Scan Ultra Slim HDTV 14:00 CRT System

R. L. Barbin, E. E. Doerschuk, I. Gorog^{*}, J. Kleppinger, R. H. Miller, A. S. Poulos, P. M. Ritt^{*} Thomson, USA ^{*}CAPA Tech., USA

Thomson Engineers in Lancaster conceived and demonstrated new DOS/SLIM[™] high deflection angle CRT systems with superb HDTV picture performance competitive with flat panel products and allowing improved styling options. This integrated system offers significant advantages in Defection Yoke stored energy and manufacturability relative to standard SLIM products. Evolving Digital Technologies are used to integrate the rotated scan, geometry, and convergence video corrections, and a quadrupole augmented convergence system into a complete electronics package. Figure 1 shows progressive form factor improvements.

CRT1 - 2 The Future Trend of CRT Market 14:40

Y. Min, Y. Z. Zhen IRICO Group Elect., China

CRT still have fairish competitive power. One side, it have very excellent display quality, on the other side, it's price is much lower than other. CRT still has wide market content because the differences between zones make the requirements different. The digital TV is a huge opportunity for CRT. There is a new competition situation in CRT industry. Some factory quitted and the rest still take active part in technical improvement and cost control.

----- Break -----

15:40	-	17:10
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Ohmi 8

CRT2: Cathode & Mask

Chair: E. E. Doerschuk, Thomson, USA Co-Chair: T. Saito, Tokyo Cathode Lab., Japan

CRT2 - 1: Invited Oxide Cathodes for Today and Tomorrow 15:40

S. Yamamoto Nat. Inst. of Advanced Ind. S&T, Japan

The historical background as well as the present and future prospects of oxide cathodes is reviewed. Oxide cathodes will still play a major role as thermionic electron sources because of their high reliability and low production cost. A deeper understanding of the electron emission mechanism still remained unclear may be able to further enhance the capability of oxide cathodes in the future.

CRT2 - 2 Anti-Doming Design Improvement Based on 16:10 Computer Simulation

K.-D. Ha, J.-H. Lim, H.-S. Yoon, S.-H. Ji Samsung SDI, Korea

In this research, a system of CRT heat transfer simulation has been developed and applied to anti-doming design of each component. The glass envelope, magnetic shield, mask-frame assembly and suspension system are all included in radiation dominant heat-transfer simulation. Some examples of detailed effects of design components on antidoming performance are introduced. A unique formed mask design is devised and successfully applied into the development of one of value engineering models.

CRT2 - 3 Optimized Design of Mask Curvature to Improve 16:30 Mechanical Properties of CRT

W. Lin, G. Xu, W. Liu CPTF Optronics, China

In this study, by using computer simulation and fitting, we optimize the curvature design of CRT's Mask-Flame (MF) assembly to improve its shock-resistance and other quality. With this method, the MF's corner structure is strengthened and spring-back degree is lessened. And the result of tube's shock and drop test prove that the new design is effective, compared with conventional design.

CRT2 - 4L A New Architecture for Super Slim Tubes 16:50

J. Meijer, S. Dorel^{*} LG.Philips Displays, The Netherlands *FEI, The Netherlands

Motivated by ever more stringent performance requirements, a new architecture for SuperSlim CRT was developed. Characteristic for this architecture is the short length of the electron gun, and the small distance between gun and DY. The deflection angle can be kept to a minimum. Interestingly, both deflection-related and gun-related performance properties benefit from the new architecture.

----- Break -----

17:20 - 18:40

Ohmi 8

CRT3: Electron Gun

Chair: D. den Engelsen, South East Univ., China Co-Chair: S. Shirai, Hitachi Displays, Japan

CRT3 - 1 A New Concept Electron Gun for Large Screen Super 17:20 Slim Tube

> M. C. Bae, C. R. Byon, S. J. An, Y. H. Jeong, N. Arimoto Samsung SDI, Korea

No abstract was submitted.

CRT3 - 2 Short Gun Design for 21-in. Ultra-Slim CRT 17:40

S.-H. Jo, J.-H. Kwon, Y.-S. Nam, J.-Y. Choi, K.-B. Son LG.Philips Displays, Korea

A trend in display market has been rapidly moving toward flat display devices that occupy less space. In this point of view, CRT has several disadvantages such as bulky volumes and heavy weights. To cope with these issues, 21" Ultra-slim project has been initiated. Consequently, The short electric gun has been developed to minimize the overall tube length of 21" Ultra-Slim. However, 30% focus deterioration is expected by wide deflection angle, low anode voltage for decreasing deflection current and gun length reduction. To improve the focus performance, we have designed a new electron gun with large equivalent main lens diameter in horizontal direction and flat beam triode in vertical direction. As a result, we could achieve equal focus performance to 21" Superslim.

CRT3 - 3 Electron Gun Design for Super Slim CRTs 18:00

C. T. Chan, P. H. Chong, C. C. Chao Chunghwa Picture Tubes, Malaysia

With the trend of CRT TV market, Super Slim CRT has become one of the mainstreams. In order to keep pace with consumer preference, we start to develop with the size at 21-inch and 29-inch. Due to DY wide deflection magnetic field, the spot performance at the screen peripheral region will be much deteriorated. So we need to improve the electron gun design to meet the requirements for uniform spot performance.

CRT3 - 4 Halo Reduction in 17-in. Super Real Flat Low Power 18:20 CRT

J. Yang, S. Lin, Y.-K. Ma CPTF Optronics, China

Low power consumption color display tubes (CDT) are the trend of the current CRT market. However, using lower anode voltage to reduce power consumption causes halo and deterioration of the tube performance. This paper describes the newly designed electron gun of a 17-inch SRF low power CRT which has improved electron optics design, optimized gun assembly-precision control and mount sealing process. The result is a much reduced halo problem distribution in mass tube production below 1000PPM.

Author Interviews

18:40 - 19:40

Supporting Organizations:

Technical Group on Information Display, ITE Technical Committee on Electronics Information Displays, Electronics Society, IEICE

Workshop on Plasma Displays

Wednesday, December 6

13:20 - 14:40

Ohmi 8

PDP1: Protective Layer (1)

Chair: G. Oversluizen, Philips Res. Labs., The Netherlands Co-Chair: H. Kajiyama, Univ. of Tokyo, Japan

PDP1 - 1: Invited The Physics and Processing of the PDP 13:20 Protective Layer

H. Tolner South East Univ., China

In order to timely trigger the addressing discharge, and reduce the addressing jitter, sufficient exoelectrons must be emitted from the MgO surface. Metastable ions are long dead at the moment of the addressing pulse, and therefore cannot be a source of priming electrons.

PDP1 - 2 Destruction and Recrystallization Dynamics of MgO 13:40 Layer in PDP by Quantum Chemical Molecular Dynamics Methods

M. Kubo^{*,**}, H. Kikuchi^{*}, H. Tsuboi^{*}, M. Koyama^{*}, A. Endou^{*}, H. Takaba^{*}, C. A. Del Carpio^{*}, H. Kajiyama^{***}, T. Shinoda^{***}, A. Miyamoto^{*} ^{*}Tohoku Univ., Japan ^{**}JST-PRESTO, Japan ^{***}Univ. of Tokyo, Japan

Our original molecular dynamics and quantum chemical molecular dynamics codes were applied to the destruction dynamics of the MgO protecting layer in the plasma display panel. Our results suggest that the recrystallization process of the MgO protecting layer is very important to discuss the stability of the MgO protecting layer in addition to the destruction process. Moreover, the self-organized formation of the nano-dot structure was observed on the MgO(011) and MgO(111), which was not detected on the MgO(001).

PDP1 - 3A Theoretical Analysis of Mid-Gap States of MgO14:00Protecting Layer in PDP

A. Endou^{*}, H. Kikuchi^{*}, H. Tsuboi^{*}, M. Koyama^{*}, H. Takaba^{*}, M. Kubo^{*,**}, C. A. Del Carpio^{*}, H. Kajiyama^{***}, T. Shinoda^{***}, P. Selvam^{*}, A. Miyamoto^{*} ^{*}Tohoku Univ., Japan ^{**}JST-PRESTO, Japan ^{***}Univ. of Tokyo, Japan

Our original tight-binding quantum chemical molecular dynamics (QCMD) simulator was applied to the analysis of the mid-gap states of the undoped MgO with and without the oxygen defects and of doped MgO protecting layer in PDP. Our method successfully re-produced the experiment regarding dopant levels as well as the mid-gap level in MgO model with the oxygen defects. This indicates that our method is a very effective tool for the detail analysis of the electronic structures of MgO protecting layer.

PDP1 - 4L Ion-Induced Secondary Electron Emission from 14:20 12CaO · 7Al₂O₃ Electride

S. Webster, M. Ono-Kuwahara, S. Ito, K. Tsutsumi^{*}, G. Uchida^{*}, H. Kajiyama^{*}, T. Shinoda^{*} Asahi Glass, Japan ^{*}Univ. of Tokyo, Japan

A significant secondary electron emission, SEE, by Xe⁺ was observed for 12CaO \cdot 7Al₂O₃ crystals with 'F⁺-like center' concentration, N, of 10¹⁹ to 10²¹ cm⁻³ (so-called C12A7 electride) prepared using aluminum or carbon as reducing reagents. The SEE yield by Xe⁺ was increased with increasing N and reached -0.2 at N=10²¹ cm⁻³, which may be attributed to F⁺-like center inherent to C12A7 electride, that gives a small work function of 0.6-2.1 eV to the present material.

----- Break -----

15:00 - 16:	20	Ohmi 8
	PDP2: Protective Layer (2)	
Chair: Co-Chair:	H. Tolner, Southeast Univ., China M. Uchidoi, Pioneer, Japan	
PDP2 - 1 15:00	Evaluation of Discharge Voltage in AC PDP Manufactured under Vacuum after MgO De	position.

K. Uchida^{*,**}, G. Uchida^{**}, T. Kurauchi^{*}, T. Terasawa^{*}, H. Kajiyama^{**}, T. Shinoda^{**} ^{*}ULVAC, Japan ^{**}Univ. of Tokyo, Japan

A new PDP manufacturing method in which processes, such as deposition of MgO, and sealing of front and rear plate, are carried out in succession under the vacuum condition is proposed. We have evaluated the firing voltage by using a 4-inch PDP test panel. The measured result shows that the firing voltage is stabilized in a brief time from the beginning of the measurement. The developed method is considerably effective for decreasing the aging process time.

PDP2 - 2 Characteristics of Doped MgO Layer Deposited 15:20 under Hydrogen Atmosphere

K. H. Park, Y. S. Kim Hongik Univ., Korea

Characteristics of MgO layer deposited under hydrogen atmosphere and doped impurities were investigated. Hydrogen gas was introduced during e-beam evaporation coating process of MgO layer and its effects on microstructure, cathode luminescence spectra, discharge voltages and effective yield of secondary electron emission were measured. The results indicated that a combination of hydrogen atmosphere for coating with doped elements enhanced the luminance efficiency and discharge delays of the panels more significantly.

PDP2 - 3 Discharge Characteristics of MgO Layer Formed by 15:40 Aqueous Solution Process

H. N. Choi, Y. S. Kim Hongik Univ., Korea

In this study, magnesium oxide thin film was prepared via aqueous solution route of salt precipitation process. Flake type film was formed from the process. In addition, doping elements were added during the film forming process in order to enhance the secondary electron emission characteristics of the film. The films formed were characterized using SEM, XRD, and cathode luminescence measurement. The results indicate that MgO film can be formed via the aqueous solution process successfully, of which characteristics are comparable to those of MgO film formed by e-beam evaporation process.

PDP2 - 4 Analysis of Priming Source for Addressing 16:00 Discharge of AC PDP

Q. Yan, N. Kosugi^{*}, Y. Oe^{*}, H. Tachibana^{*}, L. Weber^{**} PPDLA, USA ^{*}Matsushita Elec. Ind., Japan ^{**}Consult., USA

Exo-electron emission from MgO is a key priming source for addressing discharge of AC plasma display panel. We have investigated the exoelectron emission from MgO protective layer in AC plasma display panel. A technique of directly measuring the exo-electron emission was developed on AC PDP. The measured exo-electron emission is proved to be proportional to the reciprocal of the statistical delay of addressing discharge.

Author Interviews

18:00 - 19:00

Thursday, December 7

9:00 - 12:00		Ohmi 5-7
	Poster PDPp1: PDP(1)	

PDPp1 - 1 A New Sustain Driving Method with High Impedance State for AC PDP

> Z.-H. Liang, Y.-D. Li, C.-L. Liu Xi'an Jiaotong Univ., China

A new sustain driving method with high impedance state for AC PDP is developed. In this method, the voltage between X and Y electrodes of AC PDP has three states during one sustain cycle, positive voltage state, high impedance state and negative voltage state. The high impedance state occurs between the positive voltage state and the negative voltage state. The experimental results show that the minimum sustain voltage can be decreased and the sustain voltage margin can be increased.

PDPp1 - 2 Equivalent Circuit Model and Characteristic Parameters for AC PDP Cells

Z.-H. Liang, C.-L. Liu, Z.-J. Liu Xi'an Jiaotong Univ., China

In this paper, an equivalent circuit model for discharge cells of alternating current plasma display panel is developed. Three internal discharge characteristic parameters, breakdown voltage of discharge gap, minimum sustain voltage of discharge gap and discharge cell capacitance ratio, are proposed. The formulas for expressing external discharge characteristic parameters by internal discharge characteristic parameters are derived. The experimental method for measuring internal characteristic parameters is developed and the measurement results for a "macroscopic" cell are presented.

PDPp1 - 3 Reset Waveform for Large-Sustain-Gap Structure in AC PDPs

S. Kim, T. Y. Song, J. Y. Kim, S. H. Lee, J. H. Seo^{*}, B. J. Shin^{**} Inha Univ., Korea ^{*}Univ. of Incheon, Korea ^{**}Sejong Univ., Korea

In this paper, we present a new reset waveform for a large-sustain-gap structure in ac PDPs. With this scheme, we obtained 60V minimum address voltage and 145V maximum address voltage in 250μ m and 350μ m gap structures. By using the square reset pulse instead of the conventional ramp pulse reset, it is expected low contrast ratio. To improve contrast ratio, the reset waveforms in each subfield are replaced by the selective erase waveforms except the 1st subfield.

PDPp1 - 4 Reset Waveform with Negative Ramp Pulse in AC PDP for Improving Addressing Characteristic

H. R. Choi, S. W. Jung, M. H. Oh, J. W. Kang Dankook Univ., Korea

Conventional reset waveform applied to the commercial PDP uses a positive ramp pulse. This paper proposes a new reset waveform with negative ramp pulse. The reset waveforms, especially focused on ramp area, were examined with 2 dimensional fluid simulation code. The proposed negative reset waveform showed much lower ignition voltage (- 70V) as compared with the conventional reset waveform.

PDPp1 - 5 Driving Waveform for Improvement of Gray Scale Capability in Low Luminance Levels in AC PDP

E. Y. Park, S. B. Lee, Y. G. Han, S. H. Jeong, C. G. Son, N. L. Yoo, Y. J. Hong, S. J. Jung, J. H. Kim, M. W. Moon, P. Y. Oh, K. B. Song, B. H. Hong, E. H. Choi Kwangwoon Univ., Korea

The gray scale is controlled by the number of discharge pulse at sustain period in alternating current plasma display panel. At the low gray scale, the IR intensity at each sustain pulse is important in AC-PDP. But the IR intensities of the first and second sustain pulse are usually smaller than those of the other sustain pulses. Thus, we could obtain the driving waveform by which the first IR intensity is similar to those of the other sustain pulses.
PDPp1 - 6 Modified Ramp-Reset Waveform Robust for Ambient Temperature in PDP

S.-K. Jang, H.-S. Tae, E.-Y. Jung^{*}, K.-J. Suh^{*}, E.-G. Heo^{*}, B.-H. Lee^{*} Kyungpook Nat. Univ., Korea ^{*}Samsung SDI, Korea

The changes in the discharge characteristics such as a firing voltage and IR emission among the three electrodes are examined relative to the ambient temperature and working gas pressure based on the Vt close-curve analysis method. The reset discharge does not occur sufficiently at high temperature due to the increase in the firing voltage, thereby resulting in accumulating the sufficient wall charges on the address electrode. As a result, a misfiring discharge often occurs at high temperature. To reduce the misfiring at high temperature, modified reset waveform that can maximize the plate gap discharge to accumulate the sufficient wall charges on the address electrode is proposed. As a result of adopting the proposed reset waveform, it is observed that stable address discharge is produced irrespective of the ambient temperature variation.

PDPp1 - 7 New Reset Waveform with Dual-Slope Falling Ramp for Reduction of Reset Period and Low Address Voltage in AC PDP

J. K. Lim, K.-H. Park, B.-T. Choi, H.-S. Tae Kyungpook Nat. Univ., Korea

The new reset waveform with dual-slope falling ramp is proposed to reduce a reset-period without deteriorating the address discharge characteristics for the full HD AC-PDPs. The proposed reset waveform has two different voltage slopes during a falling reset-period. The higher X-bias voltage is additionally applied to the X-electrode so as to adjust the reset discharge during a part of the first voltage-slope period. As a result, the proposed dual-slope reset waveform can reduce the falling reset period by 50 %, compared to the conventional falling reset-period.

PDPp1 - 8 Bipolar Sustain Waveforms for Improving Luminance and Luminous Efficiency in AC PDPs

B.-T. Choi, J. K. Lim, K.-H. Park, H.-S. Tae, J.-H. Seo^{*}, S.-H. Lee^{**} Kyungpook Nat. Univ., Korea ^{*}Incheon Univ., Korea ^{**}Inha Univ., Korea

To improve the luminance and luminous efficiency in AC-PDPs, the bipolar sustain waveforms, which had the positive and negative pulse, were proposed and their discharge characteristics were examined. By using the bipolar sustain waveform that could control the ions effectively during a sustain discharge, the ratio of the MgO cathode condition was increased, compared with the conventional sustain waveform. As a result of adopting the bipolar sustain waveforms, the luminance and luminous efficacy were improved by 12% and 5.3%, respectively.

PDPp1 - 9 Relationship between Address Power and Address Data in Color PDP

X.-N. Zhang, C.-L. Liu, Z.-T. Tu, J. Zhang, Y.-D. Li Xi'an Jiaotong Univ., China

Address equivalent circuit model and address power expression are developed to detect and calculate address power exactly. It considers that address power is mostly caused by switch of MOSFET in address IC, which causes difference voltage variety on address equivalent capacitors. The experiment results show that average picture level has no influence on address power. Address power is proportional to the change rate of subfield data between adjacent lines in vertical direction and between adjacent columns in succeeding lines.

PDPp1 - 10 Relationship between IR Emission of Reset Discharge and Image Retention in AC PDP

Y. S. Do, K. C. Choi KAIST, Korea

The temporal image sticking and image retention time were investigated in accordance with the slopes of the ramp pulse during a reset ramp-up and down period. For the measurement of luminance, IR peak time, and CIEXYZ stimulus value, the image retention time was increased with an increase of the slopes of ramp pulse. According to the results, the temporal measurement of luminance, IR peak time, and CIEXYZ stimulus value is suitable in the investigation of the dark image retention time.

PDPp1 - 11 Optimization of Geometries and Study of Optical Properties in PDP Cells

S. W. Jung, H. R. Choi, M. H. Oh, J. W. Kang Dankook Univ., Korea

The detailed studies regarding to the front and rear panel geometries and optical properties of composed layers were needed to improve the luminance and efficiency. 3-dimensional optical code was used to analyze the variation of geometries and the changing of optical properties. The visible light distributions and illuminance results were simulated depending on the bus electrode position, ITO geometries, optical properties of dielectric layer and slope of barrier rib. Simulation results will benefit designing of new cell structure and quantification of visible right out of cell.

PDPp1 - 12 Discharge Characteristics in Accordance with Spatial Location on Sustaining Electrode in AC PDP

S. B. Lee, E. Y. Park, P. Y. Oh, C. G. Son, Y. G. Han, S. H. Jeong, N. L. Yoo, S. J. Jeoung, J. H. Kim, Y. J. Hong, K. B. Song, M. W. Moon, B. H. Hong, E. H. Choi Kwangwoon Univ., Korea

We have investigated the discharge characteristics in accordance with spatial location on sustaining electrode in AC-PDPs. With Xe contents of 4 %, the luminance and efficacy of midbus and inbus structures are lower than outbus's one. And the difference of luminance and efficacy among the outbus, midbus and inbus structure is getting small with high sustaining voltage, because of effect of blocking the IR emission by bus electrode in a cell. However, with Xe contents of 15 %, the efficacy of midbus structure is higher than the others. And it is noted that the static voltage margin is also higher than other structures. Td of the inbus structure showed 7 and 30 % shorter delay than the outbus structure with Xe contents of 4 and 15 %, respectively.

PDPp1 - 13 Withdrawn

PDPp1 - 14 Spatiotemporal Analysis of Excited Xe^{*} (1s₅) Atoms in Counter Sustain Structure Cells with Twin Auxiliary Electrodes by Laser Absorption Spectroscopy

M. Hashimoto, J. S. Oh, K. Tachibana, H. Asai^{*}, K. Kikuchi^{*}, S. Sakamoto^{*} Kyoto Univ., Japan ^{*}Noritake, Japan

Spatiotemporal behaviors of the excited Xe^{*}(1s₅) atoms in a counter sustain structure microdischarge cell with a twin auxiliary electrode were investigated by laser-absorption spectroscopic technique. As the previous results of the near-IR emission, it was improved the emission intensity with a proposed driving method for the auxiliary electrodes which connected to neighboring sustain one. With this driving condition, we investigated the spatiotemporal behavior of the Xe^{*} atoms and estimated the efficiency of the related vacuum-ultraviolet photon emissions in this paper.

PDPp1 - 15 Estimation of Efficient Sustain Frequency Using Decay Rate Constant of Xe Metastable Atoms for Xe-Ne Gas Mixtures

J.-S. Oh, M. Hashimoto, K. Tachibana Kyoto Univ., Japan

An efficient sustain frequency was estimated by the decay characteristics of the excited Xe^{*}(1s₅) atoms with Xe-Ne binary mixtures for PDPs. The collisional decay rate constant was investigated using by μ LAS. They are 3.64 μ s for the Xe(5%), 1.95 μ s for the Xe(10%), and 1.41 μ s for the Xe(15%) with the Xe-Ne binary at the total pressure of 450 Torr. With the measured values and previous frequency study, we proposed efficient sustaining frequency for different gas condition.

PDPp1 - 16 Temporal Evolution of Optical Emission Spectra from AC PDP

G. Uchida, H. Kajiyama, T. Shinoda Univ. of Tokyo, Japan

Here is presented experiment on temporal evolution and spatial distribution of optical emission spectra from AC-PDP. Measurement shows that the relative emission intensity $I_{Ne(585nm)}/I_{Xe(623nm)}$, which is induced from Ne and Xe atom, drastically changes in each discharge stage and each spatial region. There is also considerable effect of discharge voltage and gas pressure on $I_{Ne(585nm)}/I_{Xe(623nm)}$. The time-resolved measurement of optical emission spectra is useful to investigate the electron temperature in PDP.

$\begin{array}{lll} \text{PDPp1-17} & \text{Measurement of Spatiotemporal Behavior Excited Xe} \\ \text{Atom Density in $1s_5$ in Accordance with Various} \\ \text{Barrier Ribs in AC PDP} \end{array}$

S. H. Jeong, P. Y. Oh, M. W. Moon, K. B. Song, Y. G. Han, C. G. Son, S. B. Lee, N. L. Yoo, Y. J. Hong, S. J. Jung, J. H. Kim, E. Y. Park, B. C. Park, B. H. Hong, E. H. Choi Kwangwoon Univ., Korea

In this study, we have measured the spatiotemporal behavior excited Xe atoms density in the 1s₅ metastable states by laser absorption spectroscopy in accordance with various barrier ribs. The maximum density of excited Xe atoms in the 1s5 in discharge cell with stripe type and closed type barrier rib have been measured to be 1.28 x 10¹³ cm⁻³ and 1.45 x 10¹³ cm⁻³, respectively. Through this experiment, we could understand influence of barrier rib in micro discharge cell.

PDPp1 - 18 Time Dependence of VUV Emission Characteristics of PDP Cells

N. L. Yoo, J. H. Kim, P. Y. Oh, M. W. Moon, K. B. Song, H. J. Lee, S. H. Jeong, C. G. Son, Y. G. Han, S. B. Lee, S. J. Jung, E. Y. Park, Y. J. Hong, B. H. Hong, G. S. Cho, H. S. Uhm^{*}, E. H. Choi Kwangwoon Univ., Korea *Aiou Univ., Korea

We have observed the time variation of vacuum ultraviolet(VUV) lights for 147 nm from the resonant atoms and 173 nm from the excited molecular dimers versus the filling gas pressures 200, 300, 400 and 500 Torr for the several xenon mole fractions in the binary gas mixture of Ne-Xe. From the time variation, the decay time of 147 nm and 173 nm emission is obtained.

PDPp1 - 19L Priming Effect of Excelectrons during 10 Hours in PDPs

T. Sakashita, T. Shiga, S. Mikoshiba Univ. of Electro-Commun., Japan

A phenomenon of an exoelectron emission is attracting attention because its priming effect on discharges plays an important role in driving of PDP-TVs. In order to detect an extremely weak priming effect of the exoelectrons, a measurement method has been developed with which an exoelectron emission can be detected even at 10 hours after the excitation of the exoelectron emitter. The phosphor prolongs the persistence of the priming effect. The persistence is reduced with higher Xe partical pressure, but the emission intensity does not depend on the Xe pressure.

14:00 - 17:	00 Ohmi 5-7
	Poster PDPp2: PDP(2)
PDPp2 - 1	Measurement of Sputtering Yield of RF-Plasma Treated MgO Films
	W. H. Jeong, K. W. Jeong, Y. C. Lim, H. J. Oh, C. W. Park [*] , E. H. Choi, Y. H. Seo, Y. K. Kim, S. O. Kang Kwangwoon Univ., Korea [*] Korea Polytech. Univ., Korea
We have me treated and PDP(plasma	easured sputtering yield of radio frequency(RF) Ar-plasma $I_{\rm O_2}$ -plasma treated MgO protective layer for AC display panel) using a Focused Ion Beam System(FIB). A

10 kV acceleration voltage has been applied. The sputtering yields of the untreated, the Ar-plasma treated and O_2 -plasma treated samples have been 0.32 atoms/ion, 0.21 atoms/ion and 0.20 atoms/ion, respectively. The influence of the plasma treatment on MgO thin film has been characterized by XPS analysis.

PDPp2 - 2 Degradation Characteristics of MgO Protective Layer in AC PDP

J. H. Kim, H. J. Lee, C. G. Son, Y. G. Han, S. H. Jeong, N. L. Yoo, S. B. Lee, S. J. Jung, E. Y. Park, Y. J. Hong, M. W. Moon, P. Y. Oh, K. B. Song, B. H. Hong, G. S. Cho, E. H. Choi Kwangwoon Univ., Korea

One of important issues in recent AC-PDP technology is image sticking. In this research, we have investigated the correlation with image sticking and discharge-degraded MgO protective layer in AC-PDP. MgO protective layer is exposed during the discharge in PDP cell. And during the discharge MgO protective layer is bombarded and changed in characteristics. We have measured Paschen curves, firing voltage (Vfmin), sustain voltage (Vsmax) and memory coefficient, brightness, secondary electron emission coefficient γ , crystal orientation, component of phosphor for the discharge-degraded MgO protective layer, and Surface of MgO layer using Scanning Electron Microscopy (SEM).

PDPp2 - 3 Characteristics of MgO Thick Film Protective Layer

M.-S. Ko, D.-H. Kang^{*}, J.-S. Choi^{*}, Y.-S. Kim Hongik Univ., Korea ^{*}SAMSUNG SDI, Korea

MgO electron emission layer of AC-PDP was formed in a form of thick film using nano-sized MgO powders. Effects of chemical purities of such nano-sized MgO powders on glow discharge voltage, and luminance efficiency were investigated. The results indicated that impurities in the powders determine defect energy levels in band gap of MgO and that eventually affect the discharge voltage and luminance efficiency of AC-PDP, demonstrating a possibility of dramatic improvements in performance of AC-PDP.

PDPp2 - 4 Wall Charge and Wall Voltage Characteristics of MgO Layer after O₂ Plasma Treatment

C. G. Son, S, J., Jung, J. H. Kim, E. Y. Park, Y. G. Han, S. H. Jeong, N. L. Yoo, S. B. Lee, Y. J. Hong, M. W. Moon, P. Y. Oh, W. B. Park^{*}, B. H. Hong, E. H. Choi Kwangwoon Univ., Korea ^{*}LG Elect., Korea

We investigated electro-optical characteristics of MgO protective layer after radio frequency (RF) O₂ plasma treatment. In recent study, O₂ plasma treatment MgO layer have better characteristics, such as secondary electron emission coefficient (γ), efficiency, and degradation characteristic. The wall charge and wall voltage characteristics have been studied for the O₂ plasma treated and as-deposited MgO layer. For optimization of driving technology, we measured the wall charge and the wall voltage by using the charge-voltage (Q-V) method.

PDPp2 - 5 Characteristics of MgO Protective Layer Deposited by O⁺ IBAD Method in AC PDP

S. J. Kwon, Z. H. Li, Y. J. Kim, K. H. Kim Kyungwon Univ., Korea

We deposited the MgO films using O⁺ IBAD method and found that the assisting oxygen ion beam energy plays a significant role in the structural and the discharging characteristics for MgO. The lowest firing inception voltage, the highest brightness and the highest luminous efficiency were obtained when oxygen ion beam energy was 300eV. Crystallization and surface quality of MgO were also measured by XRD and AFM.

PDPp2 - 6 Secondary Electron Emission, Brightness and Luminous Efficiency Characteristics of MgO/Al/MgO Protective Layer

S. J. Jung, H. J. Lee, C. G. Son, Y. J. Hong, J. H. Kim, E. Y. Park, Y. G. Han, S. H. Jeong, S. B. Lee, N. L. Yoo, K. B. Song, M. W. Moon, P. Y. Oh, B. H. Hong, E. H. Choi Kwangwoon Univ., Korea

MgO protective layer have many characteristics and the secondary electron emission coefficient is the most important one. So we have designed various samples (MgO/Al/MgO) which have different gamma value(secondary electron coefficient). In order to increase the secondary electron emission coefficient, we have investigated the MgO/ Al/MgO layer according to the various thickness of Al layer. We have measured the secondary electron emission coefficient, brightness, and work function for them. We have been known for the thickness of 50 Å and 80 Å in Al layer the secondary electron emission coefficient are higher than for a reference MgO layer without Al. As the result, the firing voltage is lower. Although very thin Al layer does not disturb the brightness, the brightness is not good as the Al layer increases.

PDPp2 - 7 Electron Emission Effect of 12CaO · 7Al₂O₃ Electride on Glow Discharge of PDP

M. Y. Lee, Y. S. Kim Hongik Univ., Korea

A possibility of using $12CaO \cdot 7Al_2O_3$ electride as electron emission layer of PDP discharge cells was explored. The synthesized compound was converted to electride via reduction method and its electron emission behavior during the glow discharge was measured. The results indicated that the electride is effective in reducing firing voltage of discharge gases of high Xe content. Its thermal stability, however, was not adequate for an actual application of the material. A possibility of enhanced thermal stability of the electride was demonstrated by alloying the compound with Mg.

PDPp2 - 8 Study on Properties of Si Doped MgO Layer in SMPDP

Q. Li, Z. Fan, Y. Tang, X. Zhang, L. Yang, Y. Jiang, Q. Lin^{*}, Q. Zhang, B. Wang Southeast Univ., China ^{*}Nanjing Huaxian High Tech., China

The Si-doped MgO layer has been introduced into SMPDP. XRD results showed that (111) peak intensity enhances with increasing the O_2 . The fluorescence spectrum analysis has detected two peaks, which are near 360nm and 630nm respectively. The result shows that oxygen and magnesium vacancies are formed on the Si-doped MgO layer. After studying the influence on firing voltage and delay time, we can conclude that Si-doped MgO deposited under suitable condition can improve V_f and delay time in SMPDP.

PDPp2 - 9 Measurement of Work Function of MgO, MgAl₂O₄/ MgO, and MgAl₂O₄ Protective Layers in AC PDPs

K.-W. Jung, H. J. Lee, W. H. Jeong, S. J. Jeong, H. J. Oh, C. W. Park^{*}, Y. H. Seo, S. O. Kang, E. H. Choi Kwangwoon Univ., Korea ^{*}Korea Polytech. Univ., Korea

The MgAl₂O₄/MgO protective layer has been found to have lower work function values of 4.25 eV than those for MgO protective layers whose are of 4.54 eV, and MgAl₂O₄ layer the highest work function values of 4.7 eV. It is also found that MgAl2O4/MgO and MgO protective layers have been found to have the similar secondary electron emission coefficient (γ) to each other from 0.05 up to 0.08 for Ne+ ion energies ranged from 80 eV to 200 eV.

PDPp2 - 10 A New DIDE Cell Structure for High Luminous Efficacy and Low Voltage Driving of PDP

H. Y. Jung, T. J. Kim, J. K. Lim, K. W. Whang Seoul Nat. Univ., Korea

A new DIDE structure was suggested to realize a high luminous efficacy with low driving voltage. Additional works for optimization of DIDE structure brought more improved voltage and efficacy characteristics. The intrinsic long gap effect and low driving voltage due to the auxiliary electrodes made it possible to achieve a very high luminous efficacy of 7.9 lm/W at the sustain voltage of 230V.

PDPp2 - 11 Ultra Bright Plasma Synthetic Scene Generator with 1000 levels of Gray and 1000 Hz Frame Rate

C. A. Wedding, E. F. Peters, J. W. Guy, T. J. Pavliscak, O. M. Strbik III, J. C. Rutherford, D. K. Wedding, V. W. Kurtz, D. K. Wedding^{*} Imaging Syss. Tech., USA ^{*}Univ. of Toledo, USA

Imaging Systems Technology (IST), is developing Plasma-sphere[™] synthetic scene generators with 1,000 levels of gray and a 1,000 Hz frame rate and a brightness between 5,000cd/m² and 15,000cd/m². This is accomplished with a novel high frequency sustain drive. The enclosed pixel structure of the Plasma-sphere[™] makes a high-frequency drive scheme possible while still maintaining good memory margin. Plasma-sphere[™] is a trademark of IST.

PDPp2 - 12 Influence of Cell Uniformity on Voltage Margins of SMPDP

Y. M. Tang, L. S. Tong, B. P. Wang Southeast Univ., China

A novel equivalent circuit model of SMPDP had been developed and certified, which can describe the working characteristics precisely because of its well representation ability of the detailed SMPDP cell structure and the gas-discharge property. Abnormal discharge phenomenon can be found when the applied voltage beyond its limitations by checking the wall voltage variation during the addressing or sustain period in circuit behavior simulation. With this method, the influence of cell uniformity on the voltage margins of SMPDP is studied.

PDPp2 - 13 UV Curable Barrier Rib Paste for Micro Injection Molding Process

Y.-S. Kim, T.-G. Koh, Y.-S. Kim Hongik Univ., Korea

UV curable paste for barrier ribs of plasma display panel was developed for micro injection molding processing route. The rheological parameters that may cause defects during the process were identified, which viscosity at rest, pseu-doplasticity, and dilatancy. Considering such parameters, UV curable paste was developed and barrier ribs of PDPs were successfully processed via the process. This work demonstrated the possibility of build-up route in manufacturing barrier ribs of PDP.

Friday, December 8

10:40 - 12:00 Or		mi 8
	PDP3: Driving Method	
Chair: Co-Chair:	R. L. Johnson, Information Tech., USA Y. Murakami, NHK, Japan	
PDP3 - 1 10:40	A New Multi-Level Scan Method for Improving Address Discharge Characteristics in Subsidiary Subfields	

B.-G. Cho, H.-S. Tae Kyungpook Nat. Univ., Korea

New multi-level scan driving method with different scan low voltages under the same ramp falling voltage is proposed to improve address discharge characteristics in subsidiary subfields. When adopting singlelevel scan method with the same scan low voltage, address discharge time lag in subsidiary subfield is lengthened over 200ns compared with the first subfield using main ramp reset waveform. By adopting multilevel scan method, address discharge in the second subfield can be reduced as much as that in the first subfield.

PDP3 - 2 Modified Reset Waveform to Widen Driving Margin 11:00 under Low Address Voltage in AC PDPs

H. D. Park, K.-H. Park, H.-S. Tae, J.-R. Kim^{*}, S.-H. Park^{*}, M. Hur^{*}, M. Yoo^{*}, K. S. Lee^{*} Kyungpook Nat. Univ., Korea ^{*}Samsung SDI, Korea

In this paper, a new reset driving waveform is proposed to widen a driving margin under the low address voltage in AC-PDPs. The proposed reset waveform can alter the wall charge distribution between the X-Y electrodes by applying the X-ramp bias(ΔVx) prior to an address-period, thus resulting in lowering the minimum level of the scan pulse(ΔVy) during an address- period without a misfiring discharge in off-cells. As a result of adopting the proposed reset waveform, the address discharge time delay is reduced about by 200 ns at an address voltage of 35 V and the related dynamic driving margin is observed to be wide under a low address voltage condition, and its related phenomenon is examined by the Vt close-curve method.

PDP3 - 3 Efficacy Improvement of Positive Column PDPs by 11:20 an Introduction of Field Perturbation

T. Sato, N. Kobayashi, T. Shiga, S. Mikoshiba, H. Asai^{*}, N. Kikuchi^{*} Univ. of Electro-Commun., Japan ^{*}Noritake, Japan

Luminous efficacy of the positive column discharge PDPs has been improved by introducing "delayed data pulses" which are applied to the data electrodes after the sustain discharges are self-terminated. The wall charges on the data electrodes perturb the electric field distribution in the discharge space, slowing the build-up of the sustain discharge, limiting the peak discharge current, lowering the electron temperature, and also diffusing the sustain discharge path. The efficacy and luminance are improved by 35% and 38%, respectively.

PDP3 - 4 Effect of Full-White Aging on Boundary Image 11:40 Sticking in AC PDP

C.-S. Park, H.-S. Tae, Y.-K. Kwon^{*}, J. M. Jeoung^{*}, S. B. Seo^{*} Kyungpook Nat. Univ., Korea ^{*}Samsung SDI, Korea

When displaying the square-type image with peak luminance for a long time in 42-in. PDP-TV, the permanent image sticking and boundary image sticking appeared. This image sticking phenomenon is deeply related to the Mg species sputtered from the MgO surface of the discharge cell due to the iterant strong sustain discharge. In particular, the boundary image sticking is due to the re-deposition of the Mg species on both the MgO and phosphor layers in the non-discharge region adjacent to the discharge region. To reduce the boundary image sticking, the effects of full-white aging discharge on the boundary image sticking were observed. The full-white aging experiment showed that the MgO morphology in the boundary region was changed due to the 100 hours full-white aging discharge, which was almost similar to that in the non-discharge region. Furthermore, the changes in the discharge and luminance characteristics in the boundary image sticking region were observed after the 100 hours full-white aging discharge. As a result, it is observed that the full-white aging discharge can contribute to reducing the boundary image sticking considerably.

----- Lunch -----

Ohmi 8

14:00 - 15:20

PDP4: Fabrication

Chair:	K. W. Whang, Seoul Nat. Univ., Korea
Co-Chair:	R. Murai, Matsushita Elec, Ind., Japan

PDP4 - 1: Invited Replication Process for High Resolution 14:00 Barrier Ribs

H. Kikuchi, A. Yoda, J. C. Cha, P. S. McGuire^{*} Sumitomo 3M, Japan ^{*}3M, USA

3M has developed a Precision Replication Process for the production of PDP Barrier Ribs and other display devices. This additive, and intrinsically simple process, is fast, clean and capable of producing very high resolution, aperture ratio and fine cell structures. The 3M system utilizes: a flexible sheet mold, a light curable paste and a lamination molding process to produce a glass microstructure in registration with PDP panel electrodes. This process offers PDP manufacturer's design flexibility, productivity and reduced manufacturing costs.

PDP4 - 2 14:20 *Z. W. Fan^{*,**}, X. Zhang^{*,**}, L. L. Yang^{*,**}, Y. Y. Jiang^{*}, Q. Li^{*,**}, Y. Tu^{*}, B. P. Wang^{*,**}, Q. Y. Lin^{**} Southeast Univ., China ^{**}Nanjing Huaxian High Tech., China*

One kind of Shadow Mask PDP(SMPDP) with unsymmetrical structure discharge cell is discussed in this article. It consists of a front plate, a rear plate, and a conductive shadow mask sandwiched between the front plate and rear plate. Each cell on the shadow mask has an unsymmetrical structure. A 4-inch size unsymmetrical SMPDP was fabricated and analyzed. Compared with the present symmetrical SMPDP, the unsymmetrical SMPDP has higher brightness and luminous efficacy.

PDP4 - 3 Withdrawn 14:40

PDP4 - 4 Plasma Characteristics of Line-Shaped Plasma for 15:00 PDP Manufacturing

G. Shanmugavelayutham^{*,**}, T. Fukasawa^{*,**}, H. Kajiyama^{*}, T. Shinoda^{*} ^{*}Univ. of Tokyo, Japan ^{**}ADTEC Plasma Tech., Japan

High density microwave plasmas based on electrodeless discharge have been studied and developed for large area plasma processing in manufacturing industries, such as large area PDP and LCD. The present paper describes the development of novel line-shaped plasma under Long Wavelength Evanescent Microwave (LWEM) and its characteristics. Uniform plasma density is observed employing a twin power supply system. The line-shaped plasma has uniformity of about 7 % for 40 cm length at 4 Torr He plasma with total input power of 1.4 kW in the twin power mode and the same is 7.6%, 3.6% at pressure of 20mTorr Ar plasma. We developed a system for processing of 10×10 mm² PDP samples.

----- Break -----

15:40 - 17:00

Ohmi 8

PDP5: PDP TV

Chair: L. F. Weber, Consultant, USA Co-Chair: T. Shinoda, Fujitsu Labs., Japan

PDP5 - 1: Invited Image Quality Evaluation and Analysis of LCD 15:40 and PDP

K. Hirai, T. Nakaguchi, N. Tsumura, Y. Miyake Chiba Univ., Japan

In this paper, an image quality of movies displayed on the LCD and the PDP is compared and analyzed on the basis of subjective and objective evaluation experiments. Nineteen kinds of movies with different dynamic range, contrast, colorfulness and motion blur are evaluated by observers. Physical values such as luminance and chromaticity of each movie and MPRT displayed on the displays were also measured and analyzed. Moreover the relationship between observer rating values and those obtained physical values was discussed.

PDP5 - 2 High Luminous Efficiency and Low Black Luminance 16:00 AC PDP with Address Space Separation Cell Structure Structure

H. Ajiki, Y. Negoro, S. Kitazawa, K. Mogi, Y. Shiozaki, K. Yahagi, E. Otani, H. Taniguchi, S. Iwaoka, N. Saegusa, K. Amemiya Pioneer, Japan

The issue of high luminous efficient PDPs with high Xe content gas are high driving voltage, and high black luminance caused by the increased luminance of reset and address discharges. Address Space Separation cell structure, where each cell is divided to a display sub-cell and a control sub-cell, is examined. 50-inch diagonal test panel shows following performance: luminous efficacy; 2.8 lm/W, peak luminance; 1200cd/m2, black luminance; 0.04 cd/m2, and dark-room contrast ratio; 30,000:1.

PDP5 - 3 16:20 42-in. Wide XGA Shadow Mask PDP without ITO X. Zhang^{*,**}, Y. Tu^{*}, Q. Li^{*,**}, Y. Tang^{*,**}, Z. Fan^{*,**}, Z. Wu^{*,**}, Y. Zheng^{*,**}, L. Yang^{*,**}, Q. Lin^{**}, B. Wang^{*,**} ^{*}Southeast Univ., China ^{**}Hua Xian High Tech., China

A 42-inch wide XGA Shadow Mask PDP is introduced in this paper. A diamond shape discharge cell on the shadow mask is designed with delta type RGB arrangement. The panel structure is optimized to reduce the capacitance and increase the discharge efficiency. A twisted opposite discharge process is captured by ICCD camera. The discharge current shows equivalence for the negative and positive sustain pulse which increase the efficacy effectively.

PDP5 - 4L: Invited World Largest 103-in. 1080p PDP 16:40 R. Murai, K. Ueda, S. Masuda, K. Ogawa, H. Yasui, S. Ikeda

Matushita Elec. Ind., Japan

The 103-in. 1080p(full HD PDP,1920x1080 pro-gressive) has been developed and introduced into the market as the world largest product since last September. In this report, we describe the concept of the 103-in. 1080p(full HD PDP) and the panel structure. We also discuss the best viewing angle for picture quality in a living room.

Author Interviews

17:00 - 18:00

Sponsor:

Plasma Display Technical Meeting

Workshop on EL Displays, LEDs and Phosphors

Wednesday, December 6

13:20 - 1	6:20	Ohmi 5-7
	Poster PHp: Phosphors	
РНр - 1	XANES Study of Eu Centers in $CaAl_2O_4$:E Thin-Films Prepared by Pulsed Laser Dep	u Phosphor position

T. Kunimoto, T. Honma^{*}, A. Yamane^{**}, Y. Shao^{**}, K. Ohmi^{**}, H. Kobayashi Tokushima Bunri Univ., Japan ^{*}JASRI/SPring-8, Japan ^{**}Tottori Univ., Japan

XAFS studies of CaAl₂O₄:Eu phosphor thin films prepared by PLD were carried out. The ratio of Eu²⁺/Eu³⁺ is estimated by Eu-L_{III} edge XANES spectra. It has been found that the Eu²⁺ has a majority for the asdeposited film. The ratio of Eu²⁺ is further increased to 95% by annealing only for the films deposited under almost stoichiometric condition in the laser-induced plasma. For the film deposited under non-stoichiometric condition, Eu³⁺ is rather increased by annealing even in a reducing atmosphere.

PHp - 2 Temperature Dependence of the Exciton Emission from BaMgAl₁₀O₁₇

H. Kajiyama^{*}, H. Tanno^{*,**}, S. Zhang^{*,**}, G. Uchida^{*}, T. Kono^{**}, T. Yasaka^{**}, T. Shinoda^{*} ^{*}Univ. of Tokyo, Japan ^{**}Daiden, Japan

Temperature dependence of photoluminescence and thermoluminescence are measured on $BaMgAl_{10}O_{17}$ (BAM) between 50 and 500 K. The emission peak shifts from 270 to 242 nm and its intensity increases significantly, as the sample temperature decreases. The thermoluminescence measurement supports the idea that oxygen vacancies in BAM affect the exciton emission. Based on the results, the electron transport mechanism before exciton formation is proposed, in which electrons have undergone a non-radiative transition and this frequent is depending on the temperature.

Wednesday

PHp - 3 Large-Scale Electronic Structure Calculation of Eu-Doped BaMgAl₁₀O₁₇ - Effects of Defects on Its Luminescence Properties-

H. Onuma^{*}, H. Tanno^{**}, H. Tsuboi^{*}, M. Koyama^{*}, A. Endou^{*}, H. Takaba^{*}, M. Kubo^{*****}, C. A. Del Carpio^{*}, H. Kajiyama^{**}, T. Shinoda^{**}, A. Miyamoto^{**} ^{*}Tohoku Univ., Japan ^{**}Univ. of Tokyo, Japan ^{***}JST-PRESTO, Japan

We have employed tight-binding quantum chemistry method involving a new calculation method for rare earth elements to calculate the electronic structure of $BaMgAI_{10}O_{17}$:Eu²⁺ (BAM). The new method considers the particular nature of the 4f orbitals which is specified by their location respect the nuclei and their degeneration properties. Our calculation results indicate that the oxygen vacancy in BAM cause the red-shift of luminescence color and the degradation of brightness.

PHp - 4 Phosphors with High Chromatic Purity for Cold Cathode Fluorescent Lamps Utilized for Wide-Color-Gamut LCDs

R. Ohtsuka Kasei Optonix, Japan

To enhance the chromatic purity of pixels and expand the color gamut of LCDs, the spectral distribution of a CCFL was investigated together with the spectral transmittances of related color filters. As new green and red phosphors with high chromatic purity, BaMgAl₁₀O₁₇:Eu²⁺,Mn²⁺ and YVO₄:Eu³⁺ were developed and improved and applied to the CCFL. The CCFL with these new phosphors used as an LCD backlight had an expanded LCD color gamut without any sacrifice in image brightness.

PHp - 5 Oxide Coating on Sulfide Phosphors for Improved Luminescent Properties

E. J. Kim, S. H. Hong Seoul Nat. Univ., Korea

Sulfide phosphors have become useful for blue LED phosphors. The prevention of the degradation of sulfide phosphors from light source is important for white LED technology. In this study, the red emitting SrS:Eu phosphor was coated with a uniform SiO₂ layer to enhance luminescent properties. The surface morphologies of coated and uncoated phosphors were characterized using FE-SEM, analyzed the coating image by TEM, and measured relative intensity under PL excitation.

PHp - 6 Luminescent Properties of Co-Doped ZnAl₂O₄:Mn,Gd Phosphors

Y. Kato, H. Kominami, K. Hara, Y. Nakanishi, Y. Hatanaka^{*} Shizuoka Univ., Japan ^{*}Aichi Univ. of Tech., Japan

ZnAl₂O₄:Mn green emitting phosphor synthesized by citric acid gel method was studied for wider gamut displays. $ZnAl_2O_4$:Mn shows green emission peaked at 512 nm with FWHM of 24.3 nm, and high-chroma than the ZnS:Cu,Al and SrGa₂S₄:Eu under excitation with electron beam. However, the luminance should be improved for commercialization. It was expected that improvement of luminescent properties of the several ions co-doping with ZnAl₂O₄:Mn, however, from the results, Mn emission was quenched by co-doping.

PHp - 7 Synthesis and Size Control of Monodisperse Spherical Y₂O₃:Eu³⁺ Phosphor and Its Photoluminescence Properties

H. S. Yoo, H. S. Jang, W. B. Im, J. H. Kang, D. Y. Jeon KAIST, Korea

A monodisperse spherical Y_2O_3 :Eu³⁺ phosphor was prepared by a homogeneous precipitation method. Mean size of the phosphor particles was successfully controlled from 276 nm to 103 nm with maintaining a high yield more than 95 %. Crystallinity and PL intensity of the phosphor increased with decrease of particle size. Because the numbers of Eu³⁺ ions at no-inversion symmetry sites increased with decrease of particle size, PL intensity ratio between two types of transition (I_{5D0-7F2}/I_{5D0-7F1}) increased from 10.8 to 12.7.

PHp - 8 Cathodoluminescent and Structural Properties of Y₂O₃:Eu Thin-Film Phosphors Deposited by a RF-Magnetron Sputtering Process

K. Y. Ko, K.-N. Lee, S.-U. Kim, Y. R. Do, Y.-D. Huh^{*} Kookmin Univ., Korea ^{*}Dankook Univ., Korea

 $Y_2O_3:Eu^{3+}$ thin-film phosphors have been deposited on quartz substrates using a simple RF-magnetron sputtering process. The crystal structure of the $Y_2O_3:Eu^{3+}$ target was crystalline with a cubic phase. The films were deposited at 200 °C in Ar plasma. The asdeposited $Y_2O_3:Eu^{3+}$ thin-film phosphors on quartz substrates were crystalline with mixed Y_2O_3 cubic and monoclinic phases. $Y_2O_3:Eu^{3+}$ films annealed at temperature above 900 °C were cubic structures. The cathodoluminescent properties, morphologies and crystallographic structures of the as-sputtered and annealed $Y_2O_3:Eu^{3+}$ thin-films are characterized and discussed.

PHp - 9 Cathodoluminescence Properties of Sol-Gel Derived Y₂O₃:Re (Re=Eu, Tb and Tm) Thick-Film Phosphors for Display Applications

J. Y. Cho, J. R. Oh, C. R. Park, Y. R. Do Kookmin Univ., Korea

Rare earth doped yttrium oxide thick film phosphors (Y_2O_3 ;Re, Re=Eu³⁺, Tb³⁺, and Tm³⁺) were grown on sapphire substrates employing a simple sol-gel technique. Structural and optical properties were investigated by using XRD, AFM, SEM, and CL. The film annealed at elevated temperature shows an increase in crystallinity of Y_2O_3 and cathodoluminescence brightness of Y_2O_3 :Re thin-films. Films containing Eu³⁺, Tb³⁺, and Tm³⁺ emitted red, green, and blue colors, respectively.

PHp - 10 Excitation Mechanism of Luminescence Centers in Nanostructured ZnS:Tb Thin-Film Electroluminescent Devices

D. Adachi, K. Takei, T. Toyama, H. Okamoto Osaka Univ., Japan

Excitation mechanism of luminescence centers in low-operation-voltage nanostructured thin-film electroluminescent (NS-TFEL) device, of which emission layer is a multilayer composed with 4-nm-thick activator-ion-doped ZnS nanocrystal (NC) layers and 0.7-nm-thick insulating interlayers, has been studied. The voltage-dependence of EL intensity ratio originated from the 5D_3 and 5D_4 level of Tb $^{3+}$ has revealed that the dominant mechanism is attributed to the direct-impact excitation by hotelectrons.

PHp - 11 Elecroluminescent and Aging Characteristics of TFEL Devices Employing Spin-Coated (Ba,Sr)TiO₃ Insulating Layers

M. Yamasaki, Y. Ouchi, K. Tsuji, K. Ohmi, M. Niboshi^{**}, H. Kobayashi^{*} Tottori Univ., Japan ^{*}Tokushima Bunri Univ., Japan ^{**}Sharp, Japan

Spin-coated (Ba,Sr)TiO₃ (BST) thin films have been firstly employed as both first and second insulating layers in thin film electroluminescent (TFEL) devices. A luminance is improved by replacing the EB-evaporated Y_2O_3 film by the BST film. For the devices having the 2nd BST insulating layer, no luminance degradation is found after accelerated aging at 1 kHz for 256 h.

PHp - 12 Electroluminescence from Zn₂(Si_{1-x}Ge_x)O₄ Phosphor Thin-Films

H. Fukada, S. Matsui, T. Miyata, T. Minami Kanazawa Inst. of Tech., Japan

Two types of thin-film electroluminescent (TFEL) devices, one driven under ac voltage and the other under dc voltage, have been fabricated using $Zn_2(Si_{1-X}Ge_X)O_4$ phosphors as the emitting layer. A high luminance for green emission was obtained in the dc-type TFEL devices with a $Zn_2Si_{0.6}Ge_{0.4}O_4$:Mn thin-film layer. Blue emission was obtained in ac-type TFEL devices fabricated by combining a $Zn_2Si_{0.6}Ge_{0.4}O_4$ phosphor thin-film emitting layer with a thick BaTiO₃ ceramic sheet as the insulating layer.

PHp - 13 Thin-Film EL Devices Using Eu-Activated SnO₂-Based Multicomponent Oxide Phosphors

H. Fukada, T. Miyata, T. Minami Kanazawa Inst. of Tech., Japan

Red-emitting thin-film electroluminescent (TFEL) devices have been developed using various Eu-activated SnO₂-based multi-component oxide-phosphor thin films deposited on thick BaTiO₃ ceramic sheets. The phosphor thin films were prepared by conventional and combinatorial r.f. magnetron sputtering deposition and pulsed laser deposition methods and then post-annealed in air. A high luminance was obtained in TFEL devices with a post-annealed (Y_2O_3)_{0.33}-(SnO₂)_{0.67}:Eu or (GeO₂)_{0.2}-(SnO₂)_{0.8}:Eu thin-film emitting layer.

PHp - 14 Schottky Barrier Measurements on Oxidized Au/Ni/p-GaN by Photoelectron Spectroscopy

T.-C. Tien, W.-H. Kuo, L.-S. Fang, C.-S. Huang, M. Siddheswar, B.-J. Hsu, L.-J. Lin ITRI, Taiwan

In this study, we report the relation between Shottky Barrier Height (SBH) and compositional ratio on oxidized Au/Ni/p-GaN by photoelectron spectroscopy. After annealing, the nickel oxide formed at top side of gold layer due to diffusion effect. In the top NiO layer, we found that higher N/Ga and lower O/Ni atomic ratio will reduce Valence Band Maximum (VBM) and SBH. Beside, the contact resistances of oxidized Au/Ni/p-GaN are also proportional to SBH.

PHp - 15L Correlating the ACEL Performance of Phosphor Powders ZnS:Cu,X (X = CI, Br) with their Charge Trap Characteristics

J. Silver, R. Withnall, G. R. Fern, P. J. Marsh, T. G. Ireland, A. Salimian Brunel Univ., UK

In this work we describe how the thermal annealing history of ACEL phosphor powders ZnS:Cu,X (X = Cl, Br) critically affects their electroluminescence performance. This is shown to be due to the dependence of the characteristics of the electron traps on the firing conditions, as is made evident from their thermally stimulated luminescence curves.

PHp - 16L Optical Properties of the (Y,Gd)BO₃:Eu³⁺Phosphor Coated with SiO₂ Nano Particles via a Sol-Gel Process

J. H. Lee, S. M. Lee, S. H. Sohn Kyungpook Nat. Univ., Korea

In order to improve the luminance of red emission of the PDP europiumdoped (Y,Gd)BO₃ phosphors were coated on the surface with SiO₂ via sol-gel process. It was revealed that the surface coating of phosphors with SiO₂ leads to an increase in luminance intensity. This seems to be due to the increase of the excitation light which is transmitted into the phosphor, i.e., an effective vacuum ultraviolet absorption of the phosphor via SiO₂. The experimental results suggest that the surface coating of the phosphor with SiO₂ is a way to improve the luminance of the PDP.

PHp - 17L Luminescence Characteristics of ZnGa₂O₄: Mn⁺², Cr⁺³ Phosphor Thick Film Deposited by Screen-Printing Method

H, W. Choi, Y. S. Park, S. K. Lee, J. H. Cha Kyungwon Univ., Korea

The Mn²⁺, Cr³⁺ doped ZnGa₂O₄ phosphor powder was synthesized by solid-state reaction and thick films were made by screen-printing method. The XRD patterns of ZnGa₂O₄ phosphor thick films show a (311) main peak and a spinel phase. The CL spectrum of Mn²⁺ doped ZnGa₂O₄ show the main peak of 512nm green emission, and the CL spectrum of Cr³⁺ doped ZnGa₂O₄ is the main peak of 716nm red emission.

PHp - 18L Effect on the Characterization of SrGa₂S₄:Eu Green Emitting Thin Film Phosphor of KrF Laser Annealing

T. Harakawa, T. Seino^{*}, K. Kominami, K. Hara, Y. Nakanishi, Y. Hatanaka^{**} Shizuoka Univ., Japan ^{*}Japan Steel Works, Japan ^{**}Aichi Univ. of Tech., Japan

SrGa₂S₄:Eu green emitting thin films prepared by lower temperature process blow 600 °C were investigated. It was obtained that the films were crystallized by thermal annealing above 550 °C, and showed green emission of SrGa₂S₄:Eu. Besides, the films annealed below 500 °C showed poor emittion. On the other hand, the films annealed 500 °C showed the highest luminance after laser annealing than that of 550 °C. It indicates that the process of laser annealing was assisted not only the crystallization of SrGa₂S₄ phase at lower temperature but also improvement of luminescent properties.

PHp - 19L Ceramic-Sheet Phosphor for Phosphor-on-Top Package of White LED

J. S. K. Park, K. W. Park, S. M. Son, J. S. Kim, G. C. Kim^{*}, H. L. Park^{**} Pukyong Nat. Univ., Korea ^{*}Korea Univ. of Tech. & Education, Korea ^{**}Yonsei Univ., Korea

Yellow ceramic-sheet phosphor for phosphor-on-top package of whitelight-emitting diode (WLED) is presented. It is made of green-to-yellow emissive (Ba,Sr)₂SiO₄:Eu²⁺ phosphor, and wide-band gap metal oxide to control the transmittance of blue light of InGaN LED. As an increase of the metal oxide ratio to the phosphor in the ceramic-sheet phosphors, WLEDs show more blue-dominant white lights.

PHp - 20L Measurements of Luminous Efficiencies of Conversion Phosphors for Blue Emitting LEDs

R. Withnall, J. Silver, A. L. Lipman Brunel Univ., UK

In this work we describe luminous efficiency measurements carried out on both in-house and commercial samples of YAG:Ce (P46). We show herein that the luminous efficiency of the phosphor depends on a number of variables; these include the Ce activator concentration, the firing temperature, the exciting wavelength and the operating temperature of the phosphor.

PHp - 21L White Two-Phosphor Blend of CaMgSi₂O₆: Eu²⁺, Mn²⁺ and (Ba, Sr)₂SiO₄: Eu²⁺ for UV-Based White LED

J. S. Kim Pukyong Nat. Univ., Korea

Diopside CaMgSi₂O₆: Eu²⁺, Mn²⁺ phosphor shows yellow-poor three emission bands. Two-phosphor blends of CaMgSi₂O₆: Eu²⁺, Mn²⁺ and green-to-yellow emissive (Ba, Sr)₂SiO₄: Eu²⁺ phosphors excited by the near-ultraviolet show the correlated color temperatures from 4845 K to 9180 K, and the color rendering indexes from 71 % to 88 %.

Thursday, December 7

9:00 - 10:15		Ohmi 9
	PH1: ELDs	
Chair: Co-Chair:	P. H. Holloway, Univ. of Florida, USA K. Ohmi, Tottori Univ., Japan	
PH1 - 1 9:00	High Luminance Powder-Type Inorganic Electroluminescent Devices	
	S. Yamashita, T. Satou, M. Shirata, T. Noguch	ii,

S. Yamashita, T. Satou, M. Shirata, T. Noguchi, K. Kawato, K. Ogawa Fuji Film, Japan

The Dispersion-type electroluminescence (EL) device was studied to achieve higher brightness, longer lifetime, and higher color rendering property in order to obtain ideal flexible film light source for transparent materials. In the conventional powder type inorganic EL film, the high brightness over 300 cd/m² was not obtained with long life and high color rendering property (red illuminant). Phosphor particles, optical and electrical design of layer structures, color-changing materials were studied and reported in this paper.

PH1 - 2 Zinc Gallate Based Multicomponent Oxide Thin-Film 9:20 EL Phosphors Developed with Combinatorial Sputtering Deposition

T. Miyata, H. Fukada, T. Minami Kanazawa Inst. of Tech., Japan

Zinc gallate based multicomponent oxide phosphor thin films have been developed for applications as the emitting ayer of thin-film electroluminescent (TFEL) devices using a combinatorial r.f. magnetron sputtering deposition method. Al content (X) as well as the Mn content of $Zn(Ga_{1-X}Al_X)_2O_4$:Mn thin films were optimized; consequently, a high luminance of 2200 cd/m² for green emission was obtained in 1 kHz-driven TFEL devices using $Zn(Ga_{0.7}Al_{0.3})_2O_4$:Mn thin films with an Mn content of 2.2 at.%.

Ohmi 9

PH1 - 3 Hot Carrier Behavior and Excitation Process in Blue 9:40 Electroluminescent BaAl₂S₄:Eu Thin-Films

K. Tanaka, S. Okamoto NHK, Japan

We have investigated hot carrier behavior and electroluminescent (EL) excitation process in oxygen-free BaAl₂S₄:Eu thin-film having high crystallinity. EL waveform clarifies firstly that blue EL in BaAl₂S₄:Eu thin-film is caused by hot hole excitation. X-ray photoelectron spectroscopy spectra and first principles calculation revealed the unique excitation process in which hot holes excite the Eu²⁺ centers effectively in BaAl₂S₄ host.

PH1 - 4L Oxygen Effect on Microstructure and Stability of 10:00 BaAl₂S₄:Eu Phosphor in TDEL Display Devices

S. Yu, J. Acchione iFire Tech., Canada

The oxygen effect on BaAl₂S₄:Eu phosphor microstructure has been revealed by Transmission Electron Microscopy (TEM) analyses. Oxidation driven aluminum segregation caused the inhomogeneous phosphor film microstructure and stacking faults in the phosphor. Stable and high efficient BaAl₂S₄:Eu phosphor in TDEL deices have been achieved by optimizing oxidation during phosphor process which reduces the defects level and eliminate the segregation of aluminum at the lower interface between phosphor and lower dielectric.

----- Break -----

10:40 - 12	2:55
	PH2: LEDs
Chair: Co-Chair:	M. Shiiki, Hitachi, Japan Y. Nakanishi, Shizuoka Univ., Japan

PH2 - 1: Invited Phosphors for Solid-State Lighting 10:40 N. Kijima Mitsubishi Chem. Group S&T Res. Ctr., Japan

High-luminous green phosphors and a red phosphor have been newly developed for a white light emitting diode using a blue LED as an excitation source. The developed green phosphors are $Ca_3(Sc, Mg)_2Si_3O_{12}$:Ce made by replacing with Mg a part of Sc of green phosphor $Ca_3Sc_2Si_3O_{12}$:Ce, and a new phosphor $CaSc_2O_4$:Ce. The new red phosphor is (Sr, Ca)AlSiN₃:Eu made by replacing a part of Ca of CaAlSiN₃:Eu with Sr.

 $\left(\right)$

PH2 - 2 A New Red LED Phosphor, $Ba_2R_3Li_3M_8O_{32}$:Eu (R = 11:10 Rare Earths, M = Mo and W)

K. Toda, S. Seki, Y. Ito, K. Uematsu, M. Sato Niigata Univ., Japan

 $Ba_2R_3Li_3M_8O_{32}$:Eu³⁺ (R = Rare earths, M = Mo and W) was prepared by a conventional solid-state reaction. These molybdate and tungstate phosphors can be efficiently excited by near UV light, yielding an intense red emission. The emission intensity of the phosphor is about 5 times higher than that of a commercial YAG:Ce³⁺ phosphor.

PH2 - 3Efficiency Investigations of Blue Light Excitation11:30Type for White LEDs

K. Sakuma, N. Hirosaki^{*}, R.-J. Xie^{*}, N. Kimura, S. Hirafune Fujikura, Japan ^{*}NIMS, Japan

The luminous efficiencies and the theoretical limits of the luminous efficacies of the white LED lamps consisting of a blue LED die and phosphors were investigated by calculations. Various phosphors including novel nitride and oxynitride phosphors are adopted to be investigated.

PH2 - 4L: *Invited* Luminescence of Novel Rare-Earth Doped 11:50 Nitride-Based Phosphors for White LEDs

Y. Q. Li^{*,**}, G. De With^{*}, H. T. Hintzen^{*} ^{*}Eindhoven Univ. of Tech., The Netherlands ^{**}Nat. Inst. for Materials Sci., Japan

Novel rare-earth doped green, yellow and red-emitting nitride based phosphors have been developed for white-LEDs applications. The luminescence properties of nitride phosphors are described according to the host lattices from nitride, oxynitride to nitride-carbide. Eu²⁺, Ce³⁺ and Tb³⁺ activated nitride materials show high conversion efficiency in the blue region with high thermal stability. In this overview presentation, the focus is on revelation of the relationship between the luminescence roperties and the crystal structure/composition.

PH2 - 5L: Invited A Correlation between Thermal Stability of 12:15 PDP Phosphors and Their Crystal Structures

D. Y. Jeon, W. B. Im KAIST, Korea

To understand the thermal stability of PDP phosphors during the baking process, we have evaluated the thermal stability of BaAl₂Si₂O₈:Eu²⁺, (Sr_{1-x},Ba_x)₃MgSi₂O₈:Eu²⁺, LaMgAl₁₁O₁₉:Eu²⁺ and a few others. Through this study, it was found that both the openness around Eu²⁺ ion and the average inter-atomic distances (d_{Eu-O}) between Eu²⁺ ion and oxygen play a key role of shield for Eu²⁺ ions against oxidation atmosphere.

PH2 - 6L Synthesis of (Ca,Sr)MgSi₂O₆:Eu Phosphors and 12:40 Their Luminescent Characteristics under VUV Excitation

T. Kunimoto, K. Ohmi^{*}, H. Kobayashi, S. Kuze^{**}, T. Isobe^{**}, S. Miyazaki^{**} Tokushima Bunri Univ., Japan ^{*}Tottori Univ., Japan ^{**}Sumitomo Chem., Japan

CaMgSi₂O₆:Eu is recently expected to be a promising material for new blue PDP phosphor because of its longevity for Xe discharge plasma. To improve the luminescent efficiency and thermal quenching of CaMgSi₂O₆:Eu, (Ca,Sr)MgSi₂O₆:Eu phosphor has been developed. It is found that the toral stimuli (L/y) of (Ca,Sr)MgSi₂O₆:Eu is better than that of BAM under Kr₂ excimer excitation and the (Ca,Sr)MgSi₂O₆:Eu shows better maintenance ratio of PL intensity at 373K in comparison to CaMgSi₂O₆:Eu (75% vs. 50%).

----- Lunch -----

15:40 - 16:4	40 Ohmi 9
	PH3: Phosphors for PDPs
Chair: Co-Chair:	D. Y. Jeon, KAIST, Korea T. Miyata, Kanazawa Inst. of Tech, Japan
PH3 - 1 15:40	A Molecular Dynamics Study on Eu Doped BaMgAl ₁₀ O ₁₇ -Influence of Defects, Humidity, and Surface on Geometrical Structure-
	H. Onuma [*] , H. Tanno ^{**} , H. Tsuboi [*] , M. Koyama [*] , A. Endou [*] , H. Takaba [*] , M. Kubo ^{*,***} , C. A. Del Carpio [*] , H. Kajiyama ^{**} , T. Shinoda ^{**} , A. Miyamoto [*] [*] Tohoku Univ., Japan ^{**} Univ. of Tokyo, Japan ^{***} JST-PRESTO, Japan

We carried out molecular dynamics simulation to study the structural characteristics of BaMgAl₁₀O₁₇:Eu²⁺ (BAM). Our results suggested that Beevers-Ross site is the dominant Eu site in the bulk of BAM. We found structural disorder in BAM near the surface when the BAM crystal surface was clean. We employed Monte Carlo methods to investigate the water sorption on BAM. The water molecules did not intercalate with the bulk of BAM and were dominantly adsorbed to the Eu atoms on the surface.

PH3 - 2Baking and Plasma-Irradiating Induced Degradations16:00in BaMgAl10017

H. Tanno^{*,**}, S. Zhang^{*,**}, T. Fukasawa^{*}, G. Uchida^{*}, H. Kajiyama^{*}, T. Kono^{**}, T. Yasaka^{**}, T. Shinoda^{*} ^{*}Univ. of Tokyo, Japan ^{**}Daiden, Japan

The degradation processes induced by baking and plasma irradiation in undoped and Eu-doped BAM (BaMgAl₁₀O₁₇) are investigated by photoluminescence (PL) and thermoluminescence (TL) spectroscopy. The TL spectra of Eu-doped BAM indicate that the baking process shakes down the number density of original electron traps, whereas a deep electron trap is newly formed. As for a plasma irradiation, it has severe effect on the original electron traps in BAM host but only a slight effect on Eu-doped BAM.

PH3 - 3 Study of Local Structure of Luminescent Centers in 16:20 MeLn₄Si₃O₁₃:Tb (Me = Ca, Sr, Ln = La, Gd) Green-Emitting VUV Phosphors by XAFS

T. Honma, T. Kunimoto^{*}, A. Yamane^{**}, S. Orita^{**}, Y. Nakashima^{**}, K. Ohmi^{**}, H. Kobayashi^{*} JASRI/SPring-8, Japan ^{*}Tokushima Bunri Univ., Japan ^{**}Tottori Univ., Japan

Local structure around luminescent centers has been investigated by X-ray absorption fine structure (XAFS) measurement for Tb-doped MeLn₄Si₃O₁₃ (Me=Ca,Sr, Ln=La,Gd) phosphors. It has been found that the local structure around Tb³⁺ centers is similar for all phosphors, resulting in the similar spectral shape of photoluminescence excitation spectra in UV-VUV region except for the excitation band due to intra-shell transition of Gd³⁺.

----- Break -----

16:55 - 18:15

Ohmi 9

PH4: Phosphors

Chair:	Y. Nakanishi, Shizuoka Univ., Japan
Co-Chair:	N. Miura, Meiji Univ., Japan

PH4 - 1: *Invited* Preparation of Fine Phosphor Particle by 16:55 Spray-Based Methods

W. Lenggoro, K. Okuyama Hiroshima Univ., Japan

Spray method (e.g. spray pyrolysis, spray drying) is a droplet-to-particle conversion method for aerosol processing. Several synthesis routes based on spray method (e.g. salt-assisted spray pyrolysis) were designed to prepare doped-type oxide and sulfide phosphor particles. The newly developed methods have considerable potential for preparing a variety of nano- and submicron phosphor particles without the need for post-treatment processing.

PH4 - 2The Use of Polymeric Additives in a Low-17:30Temperature Flame Spray Pyrolysis

R. Kubrin, W. Bauhofer, A. Ivankov^{*} Tech. Univ. Hamburg-Harburg, Germany ^{*}Helling GmbH, Germany

Fine powder of cubic Y2O3:Eu phosphor was synthesized by lowtemperature flame spray pyrolysis in premixed propane/air flames. The new method of simultaneous synthesis and screening is reported, where the use of binding agents is entirely avoided. In this method, hot particles of phosphor settle onto the surface of the substrate fixed directly above the flame. The article focuses on discussion of the influence of polymeric additives (ethylene glycol and citric acid) on morphology of phosphor particles.

PH4 - 3: *Invited* Nanophosphors – PL, EL, and Biological 17:50 Markers –

P. H. Holloway, H.-S. Yang^{*}, H.-J. Lee, S.-Y. Seo, S. Santra^{**}, L. Qian, D. Bera Univ. of Florida, USA ^{*}Hongik Univ., Korea ^{**}Univ. of Central Florida, USA

Phosphors whose particle size is about 2 to 3 nm (called Quantum dots or Qdots) have very unusual properties. Quantum states and confinement of their excitons may shift their absorption and emission energies. Such effects are important for tuning their luminescence stimulated by photons (photoluminescence-PL) or electric fields (electroluminescence-EL). CdS:Mn/ZnS Qdots were synthesized using a microemulsion process. Procedures for functionalizing Qdots and their use as markers in biological systems were described.

Author Interviews

18:40 – 19:40

Friday, December 8

10:30 - 11:40

Ohmi 9

FED2/PH5: Phosphors for FED and FEA Backlight Unit

Chair: N. Egami, NHK, Japan Co-Chair: T. Hisamune, KASEI OPTONIX, Japan

FED2/PH5 - 1: Invited Development of FEDs 10:30 S. Itoh, M. Tanaka, T. Tonegawa, M. Taniguchi, K. Tamura, Y. Marushima, Y. Eujimura, M. Nam

K. Tamura, Y. Marushima, Y. Fujimura, M. Namikawa, Y. Naito, F. Kataoka, K. Nawamaki, Y. Kubo, T. Niiyama, Y. Takeya, K. Deguchi, S. Kawata, Y. Sato, T. Yamaura Futaba, Japan

Spindt-type color Field Emission displays (FEDs) are supplied as commercial products. The carbon nanotube(CNT) FED panel is under development as for information board. FEDs are self-emissive display, and have the potential not only to realize high contrast ratio, high response speed and superior grayscale expression for video picture image, but also to get a low power consumption. The present status of FEDs with Spindt-type and nano-carbon emitters are reported in this paper.

FED2/PH5 - 2 White Light Emission from a Carbon Naotube Field 11:00 Emitter Backlight Unit Using Two Phosphors System

H. S. Jang, J. H. Kang, S. Lee^{*}, D. Y. Jeon KAIST, Korea ^{*}Samsung SDI, Korea

Cathodoluminescence property of $Y_3Al_5O_{12}:Ce^{3+}$ (YAG:Ce) and ZnS:Ag,Cl phosphor mixture was investigated. Although YAG:Ce showed weak yellow emission under irradiation of electron beam, YAG:Ce mixed with ZnS:Ag,Cl showed stronger yellow emission. Stronger yellow emission ascribed to blue light absorption of YAG:Ce phosphor as well as electron irradiation. A carbon nanotube (CNT) field emitter backlight unit (FE-BLU) was fabricated by using CNT cathode and phosphor (YAG:Ce + ZnS:Ag,Cl) anode and two band white light was generated from the CNT FE-BLU.

FED2/PH5 - 3 A Study on Bank-Wised Driving Schemes for a 20-in. 11:20 CNT Backlight Unit

C.-C. Liang, C.-N. Huang, Y.-S. Kuo, B.-N. Lin, C.-H. Fu, T.-H. Tsou, W.-Y. Lin, M.-H. Lin ITRI, Taiwan

Using PWM scheme to drive Carbon Nanotube Backlight Units (CNT-BLUs) can well utilize the persistence of their phosphors and hence increase the illuminating efficiency. Divide a CNT-BLU into several banks and drive them separately can gain more advantages than the illuminating efficiency. This paper proposed bank-wised driving schemes for CNT-BLUs developed by DTC/ITRI. Their illuminating efficiencies are experimentally evaluated. From these evaluations, several interesting properties of the CNT-BLUs and the proposed driving methods can be obtained.

Author Interviews

17:00 - 18:00

Sponsors:

The 126th Research Committee on Mutual Convention between Light and Electricity, JSPS

Phosphor Research Society, The Electrochemical Society of Japan

AD '07

Asia Display 2007 March 12–16, 2007 Shanghai, China

http://ad07.ecnu.edu.cn/

Workshop on Field Emission Display

Friday, December 8

9:00 - 9:10

Ohmi 9

Opening

Opening Remarks 9:00

M. Takai, Workshop Chair

9:10 - 10:15

Ohmi 9

FED1: FEDs and Novel Devices

Chair: H. Mimura, Shizuoka Univ., Japan Co-Chair: S. Itoh, Futaba, Japan

FED1 - 1 Development of High Resolution Spindt-Type FED

9:10

K. Sakurada, M. Kitada, T. Niiyama, M. Namikawa, Y. Takeya, M. Tanaka Futaba, Japan

We evaluated the possibility of high-resolution FED by the Spint type cathode. Since high electron emission of a single emitter is one of the characteristics of the Spindt cathode, the number of emitters per pixel reduced by improving stability of each emitter. In this report, the properties of the newly developed 1.4-inch high resolution FEDs and evaluation results of emission performance under low emitter density with Spindt-type emitter were described.

FED1 - 2 High-Luminance CNT-FED for Half-Meter-Size 9:25 Character-Displays

J. Yotani, S. Uemura, T. Nagasako, H. Kurachi, H. Yamada, T. Ezaki, T. Maesoba, T. Nakao, M. Ito, A. Sakurai, H. Shimoda, Y. Saito^{*} Noritake., Japan ^{*}Nagoya Univ., Japan

A prototype of high-luminance CNT-FED character display was performed for half-meter-size character-displays. The display-panel had 48x480dots. The color-pixel pitch was 3mm. In order to realize highluminance and high manufacturing -yield, the new structure using a flexible gate substrate was developed. The configuration of the displaypanel was a metal-backed color-phosphor screen with 1mm-tall spacers, a metal gate-substrate with 1mm-tall ribs on anode-side and shallow ribs on cathode side of the gate substrate and a cathode substrate with CNT-deposited metal electrodes.

FED1 - 3 Development of CNT Cathodes for Triode Type FEDs 9:40 by Liquid-Phase Fabrication

Y. Z. Chen, C. C. Kuo, J. S. Fang, S. H. Lee, J. T. Hsu, S. C. Hsiao, F. Yang, W. S. Hsu, C. H. Hsiao, W. C. Yao, S. H. Chen^{*}, C. Y. Hsiao^{*}, K. Cheng, B. Gao^{**}, O. Zhou^{**}, T. F. Chan^{*} TECO Elec. & Machinery, Taiwan ^{*}TECO Nanotech, Taiwan ^{**}Xintek. USA

The liquid-phase CNTs deposition process has been successfully applied to fabricate triode FED structures. We manufactured the prototype CNT-FED panels of 8-in. in diagonal and 160x3x120 subpixels through vacuum sealing of the normal gate cathode and color anode. The switching voltage of the normal gate structures can be lower than 80 V and the color video images are obtained.

FED1 - 4: Invited 640x480 Pixel HARP Image Sensor with 9:55 Active-Matrix Spindt-Type FEA

M. Nanba, Y. Hirano, Y. Honda, K. Miyakawa, Y. Ookawa, T. Watabe, S. Okazaki, N. Egami, K. Miya, K. Nakamura^{*}, M. Taniguchi^{*}, S. Itoh^{*} NHK, Japan ^{*}Futaba, Japan

A new Spindt-type FEA equipped with an active drive circuit was developed for ultra-high sensitivity compact HARP image sensors. The FEA has 640 \times 480 pixels, which is equal to the VGA format, and the pixel size is 20 \times 20 μ m. Our experiments on a fabricated 1-inch HARP image sensor with the FEA revealed that the prototype sensor could obtain sufficient resolution as a VGA image sensor, high sensitivity, and a wide dynamic range by convenient operation.

----- Break -----

10:30

10:30 - 11:40

Ohmi 9

FED2/PH5: Phosphors for FED and FEA Backlight Unit

Chair:	N. Egami, NHK, Japan
Co-Chair:	T. Hisamune, KASEI OPTONIX, Japan

FED2/PH5 - 1: Invited Development of FEDs

S. Itoh, M. Tanaka, T. Tonegawa, M. Taniguchi, K. Tamura, Y. Marushima, Y. Fujimura, M. Namikawa, Y. Naito, F. Kataoka, K. Nawamaki, Y. Kubo, T. Niiyama, Y. Takeya, K. Deguchi, S. Kawata, Y. Sato, T. Yamaura Futaba, Japan

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FED2/PH5 - 2 White Light Emission from a Carbon Naotube Field 11:00 Emitter Backlight Unit Using Two Phosphors System

H. S. Jang, J. H. Kang, S. Lee^{*}, D. Y. Jeon KAIST, Korea ^{*}Samsung SDI, Korea

Cathodoluminescence property of $Y_3Al_5O_{12}$:Ce³⁺ (YAG:Ce) and ZnS:Ag,Cl phosphor mixture was investigated. Although YAG:Ce showed weak yellow emission under irradiation of electron beam, YAG:Ce mixed with ZnS:Ag,Cl showed stronger yellow emission. Stronger yellow emission ascribed to blue light absorption of YAG:Ce phosphor as well as electron irradiation. A carbon nanotube (CNT) field emitter backlight unit (FE-BLU) was fabricated by using CNT cathode and phosphor (YAG:Ce + ZnS:Ag,Cl) anode and two band white light was generated from the CNT FE-BLU.

FED2/PH5-3 A Study on Bank-Wised Driving Schemes for a 20-in. 11:20 CNT Backlight Unit

C.-C. Liang, C.-N. Huang, Y.-S. Kuo, B.-N. Lin, C.-H. Fu, T.-H. Tsou, W.-Y. Lin, M.-H. Lin ITRI, Taiwan

Using PWM scheme to drive Carbon Nanotube Backlight Units (CNT-BLUs) can well utilize the persistence of their phosphors and hence increase the illuminating efficiency. Divide a CNT-BLU into several banks and drive them separately can gain more advantages than the illuminating efficiency. This paper proposed bank-wised driving schemes for CNT-BLUs developed by DTC/ITRI. Their illuminating efficiencies are experimentally evaluated. From these evaluations, several interesting properties of the CNT-BLUs and the proposed driving methods can be obtained.

----- Lunch -----

13:15 - 15:15	
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Ohmi 9

FED3: CNT-FEs for FEDs

Chair: S. Uemura, Noritake, Japan Co-Chair: S. Nakata, Mitsubishi, Japan

FED3 - 8LDevelopment of Key Technologies for CNT-FED13:15S. Nakata, T. Takahashi, S. Okuda, A. Hosono

S. Nakata, T. Takahashi, S. Okuda, A. Hosono MITSUBISHI Elec., Japan

We have developed the key-technologies for fabricating spacer-free FEDs. The developed cathode plate has showed the performance of the driving voltage less than 40V. The black-matrix and phosphor of the front panel have been successfully patterned with the position error less than 20μ m without any degradation of the phosphor properties.

FED3 - 1A Particle Blasting Method to Improve the CNT-FED13:30Manufacturing

M. Liu, C. N. Mo, M. C. Chiang, C. Y. Hsu Chunghwa Picture Tubes, Taiwan

We have fabricated a 25 mm x 25 mm CNT-FED with a space of less than 400 μ m by printing technology. The particle blasting method was utilized to improve the CNT emission characters when the particles hit the cathode surface, which of the materials is removed. Then the CNT fiber would slowly protrude on the cathode surface after the particle blasting. This novel method provides a low cost and easy way for large size CNT-FED manufacturing in the future.

FED3 - 2 Influence of Reactive Ion Etching on KrF Laser 13:45 Surface Treatment of CNT Cathodes

K. Ohsumi, T. Honda, W. S. Kim, C. B. Oh, K. Murakami, S. Abo, F. Wakaya, M. Takai, S. Nakata^{*} Osaka Univ., Japan ^{*}Mitsubishi Elec., Japan

The emission characteristics of carbon nanotube (CNT) cathodes with and without reactive ion etching (RIE) process followed by KrF laser irradiation were investigated. The emission characteristics of CNT cathodes without RIE process strongly depend on laser power density. The emission characteristics of CNT cathodes with RIE process, however, are almost uniform with laser power density.

FED3 - 3 Field Emission Characteristics of CNT Cathode 14:00 Treated by Plasma and Laser Irradiation

W. S. Kim, T. Honda, C. B. Oh, K. Ohsumi, K. Murakami, S. Abo, F. Wakaya, M. Takai Osaka Univ., Japan

An effect of Ar plasma treatment of carbon nanotube cathodes followed by krypton fluoride laser irradiation on field emission (FE) characteristics was investigated. With an Ar plasma treatment of 100W, the FE current density was increased after laser irradiation. The emission site density of the sample with 100W plasma treatment was also increased by 25 times than that without plasma treatment. However, the further increase in plasma power beyond 100W deteriorated both FE characteristics due to the excess plasma damage.

FED3 - 4 Novel Positioning Technology of CNTs for Electron 14:15 Emitter Array

K. C. Park, J. H. Ryu, K. S. Kim, Y. Y. Yu, J. H. Moon, J. Jang Kyung Hee Univ., Korea

We have developed novel growth technique for carbon nanotubes (CNTs) by using resist assisted patterned growth. The CNTs can be grown directly on the patterned catalyst surface without diffusion barrier. The novel positioning technique for CNTs growth could be applicable to electron emitter array for nano-electronic device.

FED3 - 5 Improvement of Emission Characteristics by SiO₂ 14:30 Containing Catalyst for GNF-FED

M. Ushirozawa, K. Hagiwara, T. Sakai NHK, Japan

Catalyst geometry is an essential factor for controlling the growth of graphite nanofiber by thermal CVD. A new catalyst containing silicon dioxide was developed. This catalyst is effective for two aspects of the field emitter for FEDs: one is that the nanometer-sized catalyst particles separated by SiO₂ result in a fine fiber, and the other is that the fiber diameter becomes almost uniform, suggesting that emission uniformity can be improved.

FED3 - 6 Controlling of E-Beam Trajectory by Tapered Macro-14:45 Gate for Various Field Emission Applications

J. -W. Jeong, D. -J. Kim, J. -S. Oh, Y. -H. Song ETRI, Korea

We report the controlling of e-beam trajectory by TMG proposed for CNT field emitters in the last year. The TMG has relatively tall and tapered holes, showing a high e-beam focusing and perfect shielding of CNT emitters from the anode voltage for FED. For FE lamp(FEL) application, we modified the TMG to have two separate gate electrodes against gate holes. The alternating driving of the two gate electrodes of the modified TMG showed a wide e-beam spreading suitable for FEL.

FED3 - 7 Electron Emission Properties of CNTs Grown with 15:00 Selective Positioning Technique

J. H. Ryu, Y. Y. Yu, K. S. Kim, J. H. Moon, K. C. Park, J. Jang Kyung Hee Univ., Korea

The electron emission properties of carbon nanotubes (CNTs), grown with selective positioning technique, were studied with various number of emitters. Various numbers of island-emitters were grown and measure the electron emission properties by using diode structure. The total electron emission characteristic shows very linear properties with number of island emitters.

----- Break -----

15:30 - 17:00

- 17:00 Ohmi 9 FED4: FED Driving Methods and FE Materials

Chair:	J. Ishikawa, Kyoto Univ., Japan
Co-Chair:	Y. Iguchi, Sony EMCS, Japan

FED4 - 1 An Amplitude-Modulated Driving System with Multi-15:30 Scaled Clocks for Linear Gamma Correction of an 8in. CNT FED

C.-N. Huang, C.-C. Liang, P.-S. Wu, T.-A. Chen, Y.-S. Kuo, W.-C. Yao^{*}, K.-S. Chen^{*}, C.-C. Kuo^{*}, J.-S. Fang^{*} ITRI, Taiwan ^{*}TECO Elec. & Machinery, Taiwan

An amplitude-modulated driving system is developed for exhibiting fullcolor images on an 8" carbon nanotube field emission display (CNT-FED). For solving the nonlinear gamma problem associating with the highly nonlinear I-V curve of CNT-FEDs, a multi-scaled clock scheme is proposed to conduct linear gamma correction. Experiments show that the driving system can successfully display full-color images on the CNT-FED, and after applying the proposed scheme, RGB gray levels are substantially increased by the linearized gamma curves of the CNT-FED.

FED4 - 2 A New Driving Method for Active-Matrix FED 15:45 D. -J. Kim, J. -W. Jeong, J. -S. Oh, Y. -H. Song ETRI, Korea

We present a new driving method of current scanning for active-matrix field emission display (AMFED) to improve image quality. The currentscan driving is to use current sources for scan signals instead of conventional voltage pulses, and the current sources are addressed to the source electrode of a-Si TFT used as a switching device of AMFED. The developed currentscan driving showed a better image quality than conventional voltage driving for the AMFED with carbon nano-tube emitters.

FED4 - 3 A Macro-Modeling Approach to Integrate CNT Field 16:00 Emission Triode Devices into Circuit Simulations

X. Guo, S. R. P. Silva Univ. of Surrey, UK

The advances of using carbon nanotube (CNT) triode structure field emission (FE) devices for display applications require an accurate and efficient SPICE compatible device model for evaluating their electrical behaviors in the early circuit and system design stage. This paper presents a macro-modeling approach, which can accurately and efficiently model the CNT triode FE devices independent of the device process and physical structures for circuit simulations.
FED4 - 4 Electron Emission from Metal-Oxide-Semiconductor 16:15 Cathodes Based on Nanocrystalline Silicon

H. Shimawaki, Y. Neo^{*}, H. Mimura^{*} Hachinohe Inst. of Tech., Japan ^{*}Shizuoka Univ., Japan

We have fabricated planar cathodes based on nanocrystalline Si covered with a thin oxide film deposited by using a pulsed laser ablation technique and examined their emission characteristics. The electron emission occurred at the gate voltage higher than the work function of the gate metal, and the emission efficiency about 4% was achieved.

FED4 - 5 Work Function Measurement by Use of 16:30 Photoemission Electron Microscope

Y. Nakano, K. Yamane, H. Nakane, H. Adachi Muroran Inst. of Tech., Japan

Work function of ZrO/W(100) surface has been successfully measured by the use of Photoelectron emission microscope (PEEM) to be 2.7eV with the Fowler plot[1]. This value fairly coincide to the widely accepted values of 2.7-2.9eV determind by use of Fowler-Nordheim plot for field emission current [2]. We have expected photo-emission current gives more directly the work function as a physical constant[3] than field emission current to which Fowler Nordheim plot can be applied.

FED4 - 6LEED and XPS Analyses on W(100) Surface Modified16:45with Yttrium Oxide

T. Kawakubo, N. Miyamoto, H. Nakane, H. Adachi Muroran Inst. of Tech., Japan

The work function determined by use of the Fowler Nordheim plot on a modified surface of W(100) with yttrium oxide, which is denoted by YO/W(100), has been reported 2.0 eV, which is much smaller than the values of 2.7. 2.9 eV for ZrO/W(100) conventional thermal field emitters. In situ analyses of XPS and LEED on the YO/W(100) are going on. Tentative results of LEED show a smeared periodic pattern, depending on depositing conditions of yttrium.

Author Interviews

17:00 - 18:00

Sponsor:

159th Committee on Vacuum Nanoelectronics, JSPS

Workshop on Organic LED Displays

Wednesday, December 6

13:20 - 14:50

Ohmi 10

OLED1: OLED Technology

Chair: J. J. Brown, Universal Display, USA Co-Chair: C. Adachi, Kyushu Univ., Japan

OLED1 - 1: Invited Twenty Years of Research and Development 13:20 on Organic Electroluminescent Devices

T. Tsutsui Kyushu Univ., Japan

Pre-history of research and development on organic electroluminescent devices before the appearance of "Kodak break-through" in 1987, is examined based on early studies on organic electroluminescence. Next, we try to pick out some important key messages from Kodak break- through. Then, the impacts of the Kodak break-through on the research and development of organic electroluminescent devices during ten years after 1987 is discussed. Finally, discussions on the future of organic electroluminescent devices will be added.

OLED1 - 2 Development of New Materials in Polymer Light 13:50 Emitting Diodes

N. Akino, C. Sekine, J. Pillow Sumation, Japan

Improvement of the efficiency and lifetime is crucial in light emitting diodes. In this presentation, computational modeling as one of our approaches will be introduced, and also device performance with our solution processable red phosphorescent materials will be presented, where we have achieved CIE=(0.67,0.32) with the lifetime of LT50 - 95khrs at 400cd/m² and an efficiency of 11cd/A. Some other data including fluorescent materials will also be presented.

OLED1 - 3 Evaluation of RGB OLED Stacks on CMOS 14:10 Microdisplay Substrates

U. Vogel, D. Kreye, M. Töerker, J. Amelung Fraunhofer Inst. for Photonic Microsystems, Germany

Highly efficient, low-voltage organic light emit-ting diodes (OLEDs) are well suitable for the inte-gration into a CMOS-process. Different RGB-OLED-stacks with doped charge transport layers were prepared on different two metal layer CMOS test substrates without active transistor area. Afterwards, the different test displays were measured and compared with respect to their per-formance (current, luminance, voltage, luminance dependence on viewing angle, optical outcoupling etc.).

OLED1 - 4Development of High Performance OLED Included14:30Wet Coating Film in Organic Layer Structure

I. Kashima, K. Harada, K. Monzen, T. Wakimoto, A. Yoshihara Optrex, Japan

We study the RGB fluorescent OLED using wet coating film in hole injection layer(Sp-OLED) to get low driving voltage, high current efficiency and high external quantum efficiency. And the efficiency of the Sp-OLED could be improved by optimizing the interference effects and the device structure. As a result the green Sp-OLED index perform at a current efficiency of 30.5cd/A, external quantum efficiency of 7.5% and driving voltage of 3.5V at 10mA/cm².

----- Break -----

15:05 - 16:35		Ohmi 10
	OLED2: Device Technology	

Chair: T. Tsutsui, Kyushu Univ., Japan Co-Chair: S. Tokito, NHK, Japan

OLED2 - 1: Invited Low Power Consumption Technologies for a 15:05 Full-Color AMOLED Display

G. Harada, H. Kanno, T. Kinoshita, Y. Nishio, K. Shibata SANYO Elec., Japan

A couple of technologies for realizing a high-performance and lowpower consumption AMOLED using white emitter with color-filter array are presented. One is new OLED structure, which can reduce a driving voltage. The other is an RGBW pixel format, which can decrease the power consumption down to a half value in comparison with that of conventional RGB pixel format. By combining two technologies, we can reduce power consumption to 1/3, and improve the lifetime by three times compared with conventional AMOLED.

OLED2 - 2 Operating Physics and Newly Developed 15:35 Technologies of AM-Full Color OLEDs Based on Advanced Color Conversion Method

Y. Terao, H. Kimura, Y. Kawamura, K. Kawaguchi, Y. Nakamata, C. Li, N. Kanai, R. Teramoto, K. Sakurai Fuji Elec. Advanced Tech., Japan

A simple ray-optical analysis shows that the improved coupling between CCM and EL accounts for the conversion-efficiency enhancement in advanced-CCM. The top-emitting configuration with advanced-CCM is promising. Then the inverted top-emitting OLEDs are studied so that n-type a-Si TFT can be used. The simple bilayer device is proposed to see the electron-injection nature of inverted OLEDs. Finally AM-OLED display with advanced-CCM is first demonstrated.

OLED2 - 3 Effects and Mechanism Aspect of Organic-Metal 15:55 Oxide Composites

Y. Iwaki, H. Ikeda, J. Sakata, S. Seo, T. Aoyama, T. Kawakami, R. Nomura, S. Yamazaki Semiconductor Energy Lab., Japan

OMOx, a composite consisting of an organic hole-transporting material and molybdenum oxide, acts as a very useful buffer layer for organic light emitting diodes (OLEDs) because of its high conductivity. We will discuss the band structure of OMO_x and the mechanism of the electron transfer process between molybdenum oxide and organic compounds based on computational calculations.

OLED2 - 4 Nickel Oxide Buffer Layers on Amorphous ITO 16:15 Anodes for Flexible Organic Light-Emitting Diodes with Extended Driving Lifetimes

K. Akedo, A. Miura, K. Noda, H. Fujikawa TOYOTA Central R&D Labs., Japan

We have investigated several metal-oxide buffer layers on amorphous ITO anodes for flexible OLEDs in order to extend their driving lifetimes, and have found that the 3-nm-thick NiOx buffer layer was the most appropriate one. The half-decay driving lifetime of the OLED with the NiOx buffer layer showed six times longer than that without the NiOx buffer layer. This is because the NiOx buffer layer prevented the organic layer from oxidation by unstable amorphous ITO.

----- Break -----

16:50 - 18:00

Ohmi 10

OLED3: Phosphorescent OLED

Chair: G. Harada, SANYO Elec., Japan Co-Chair: J. Kido, Yamagata Univ., Japan

OLED3 - 1: Invited Full-Color Phosphorescent OLEDs 16:50

J. J. Brown Universal Display, USA

A phosphorescent white organic light-emitting device exhibits an external quantum efficiency of 14% (or 25% with outcoupling enhancements) at 1,000 cd/m², has CIE coordinates that vary between (0.47, 0.45) at 1,000 cd/m² and (0.46, 0.46) at 5,000 nits; 97% of the emission power is between 470 nm and 750 nm. The operational lifetimes 500 cd/m² from an initial luminance of 1,000 cd/m² is -21,000 hours. These results demonstrate the great promise of phosphorescent white devices for both displays and lighting.

OLED3 - 2 Withdrawn 17:20

OLED3 - 3 Flexible Color OLED Display Based on 17:40 Phosphorescent Materials Fabricated by Ink-Jet Printing

M. Suzuki, T. Tsuzuki, T. Koyama^{*}, T. Yamaguchi^{*}, T. Furukawa^{**}, S. Tokito NHK, Japan ^{*}Showa Denko, Japan ^{**}Kyodo Printing, Japan

We have demonstrated a flexible phosphorescent organic light-emitting diode (OLED) display fabricated by using ink-jet printing. We used iridium complexes and non-conjugated polymer as the guest and host system for the RGB emitting layers. The ink-jet inks were optimized for jetting reliability and film uniformity. ITO anode and bank structures were precisely formed on a plastic film by using a transfer technique. An example video image generated with the passive-matrix driving method was clearly observed.

OLED3 - 4L High-Conductive PEDOT/PSS for ITO-Substitution in 0LEDs

A. Elschner, F. Jonas, S. Kirchmeyer, W. Lövenich, N. Koch^{*}, K. Fehse^{**}, M. Pfeiffer^{**}, K. Walzer^{**}, K. Leo^{**} H.C. Starck GmbH, Germany ^{*}Humboldt-Univ., Germany ^{**}Tech. Univ. Dresden, Germany

Waterborne dispersions of PEDOT/PSS are exploited as hole-injection layers in OLEDs to planarize the ITO surface and to improve hole-injection. With BAYTRON[®]PH 500, a new product has been designed with good film forming properties and a conductivity of 500 S/cm to replace ITO on flexible substrates and to be used as transparent anode for OLED lighting. Due to its relative small refractive index of n = 1.41 at 550 nm, this polymer gives rise to better light out-coupling as compared to ITO.

Author Interviews

18:00 - 19:00

Thursday, December 7

9:00 - 10:25

Ohmi 2

AMD4/OLED4: AM-OLED

Chair: R. Hattori, Kyushu Univ., Japan Co-Chair: M. Inoue, TPO Displays Japan, Japan

AMD4/0LED4 · 1: Invited Current Status of, Challenges to, and 9:00 Perspective View of AM-OLED

H. N. Lee, J. W. Kyung, S. K. Kang, D. Y. Kim, M. C. Sung, S. J. Kim, C. N. Kim, H. G. Kim, S. T. Kim LG Elect., Korea

ZnO and IGZO TFTs were fabricated by conventional photo-lithography and wet-etching process. ZnO and IGZO TFTs showed high mobility of $66 \text{ cm}^2/\text{Vs}$ and 157 cm²/Vs, and high on/off ratios of 7.6 x 10⁶ and 1.1 x 10⁷, respectively. In addition, the IGZO TFT array was successfully fabricated to drive the OLED device on it. Therefore, it can be suggested that the oxide TFT be one of the promising candidates as a backplane for OLED device.

AMD4/0LED4-2: Invited Novel Active-Matrix Panel with Organic Light-9:25 Emitting Field-Effect Transistor

Y. Oku, N. Shimoji, T. Tanabe^{*}, S. Akiyama^{**}, T. Oyamada^{***}, H. Uchiuzou^{***}, C. Adachi^{*****}, K. Matsushige^{*****} Rohm, Japan ^{*}Pioneer, Japan ^{**}Mitsubishi Chem., Japan ^{**}Chitose Inst. of S&T, Japan ^{***}Kyushu Univ., Japan ^{****}Kyoto Univ., Japan

We successfully demonstrated a novel active-matrix panel having an organic light-emitting field-effect transistor (OLEFET) on a Si substrate. An OLEFET, a switching transistor, and a capacitor were integrated into each pixel. As an OLEFET material, tetraphenylpyrene (TPPy) doped with rubrene at 1wt% was employed. The switching transistor was fabricated with pentacene. All organic transistors are bottom-contact-type, using conventional photolithography. An 8x8 display panel clearly showed moving characters.

AMD4/0LED4-3 Pulse-Width Modulation with Current 9:50 Uniformalization for TFT-OLEDs

M. Kimura, M. Kato, Y. Hara, S. Sawamura, H. Hara^{*}, T. Okuyama^{*}, S. Inoue^{*}, T. Shimoda^{*} Ryukoku Univ., Japan ^{*}Seiko Epson, Japan

A novel driving concept, "pulse-width modulation with current uniformization", is proposed for TFT-OLEDs. An example of this driving concept is a combination of "pulse-width modulation with self-biased inverter" and "time-ratio grayscale with current uniformization". Its driving operation is confirmed using circuit simulation. It is found that this driving method can compensate characteristic deviations and degradations of both TFTs and OLEDs and exceedingly improve luminance uniformity. Moreover, it does not need high-speed scanning even for high-resolution and many-grayscale displays.

AMD4/OLED4-4L A New Pixel Circuit Employing Data Reflected 10:10 Negative Bias Annealing to Improve the Current Stability of a-Si:H TFT AMOLED

S.-M. Han, H.-S. Park, J.-H. Lee, M.-K. Han Seoul Nat. Univ., Korea

We proposed a new pixel circuit employing data reflected negative bias annealing to improve the current stability of a-Si:H TFT AMOLED. The proposed 5 TFTs pixel is can apply the negative V_{GS}, which is proportional to the previous emitting V_{GS} of the TFT, to the driving a-Si:H TFT by using its own data signal so that suppress its degradation induced by positive gate bias effectively. The data reflected negative bias annealing of pixel was proved by a SPICE simulations.

Author Interviews 18:40 - 19:40

Ohmi 5-7

9:00 - 12:00

Poster OLEDp: OLED Poster

OLEDp - 1 Pyrolysis Behavior of Blue Alq₃ Derivatives in Thermal Process

J.-A. Cheng, Y. Yang^{*}, C. H. Chen, H.-P. D. Shieh, T. Negishi^{*} Nat. Chiao Tung Univ., Taiwan ^{*}ULVAC, Japan

In order to study the blue and soluble Alq₃.based derivates that fail to sublimate, a series of developable solutions and thermally stable aluminum quinolates with different sulfon reactants were synthesized. The physical and chemical attributes of these chelates were investigated and thoroughly characterized by using the X-ray diffraction method, ¹H NMR and thermal gravity analysis. In this study we also explored the mechanisms involved in the thermal decomposition that occurs during the sublimation process.

OLEDp - 2 The Effects of the Bidentate Ligand on the Cyclometalated Iridium Complexes

W. Ding, C. Liu, X. Hou, M. Yu^{*} Xiian Jiaotong Univ., China ^{*}Irico Group Tech. Ctr., China

Iridium based complexes with same cyclometalated ligand (2phenpyridine) and different bidentate ligand (acetylacetone, 2, 2'bipyridine, phenanthroline) were synthesized and investigated. The emission λ max has a shift from 510nm to λ = 570nm, indicated that the emission color is not only dependent on the cyclometalating ligand, but also can be changed by the bidentate ligand. Farther theoretically calculated results in quantum chemistry indicated that the emission color can be affected by the bidentate ligand's conjugate degree.

OLEDp - 3 Highly Stable Electron Transporters and Electron Injectors for the Enhancement of Life-Time, Efficiency and Reduction in Operating Voltage

P. Kathirgamanathan, S. Ganeshamurugan, S. Surendrakumar, M. Kumaraverl, G. Paramaswara, A. Partheepan, S. Ravichandran OLED-T, UK

OLEDs are becoming established as a commercially viable flat panel display technology of choice. For OLEDs to function effectively, highly thermally stable materials, which offer high efficiency and long operational lifetimes are required. This paper reports a unique patented electron transporter (E246) that increases the lifetime and efficiency and reduces operating voltage. Further, an electron injector, EEI-101, which evaporates at a very low temperature of 300°C as opposed to the conventional LiF, which requires 580°C, is also presented.

OLEDp - 4 High Efficiency Green-Light-Emitting Phosphorescent Organic Devices Having a Carrier Transporting Polymer Layer

Y. Nishita, Y. Mizuno, A. Imamura, A. Mikami Kanazawa Inst. of Tech., Japan

Phosphorescent organic devices consisting of carrier transporting polymer and light-emitting small molecule layers have been characterized from electrical and optical viewpoints. It was found that very thin polymer layer significantly enhances the performance such as luminance and emission efficiency. The optimized device showed an external quantum efficiency of 23 % (87 cd/A) and a power efficiency of 55-lm/W.

OLEDp - 5 Color-Variable Organic Light-Emitting Device by External Light Irradiation -Approach to High -Efficient Device-

K. Sakaguchi, M. Chikamatsu, Y. Yoshida, R. Azumi, K. Yase AIST, Japan

We have developed an organic light-emitting device whose emission color is controllable by external light. Photoirradiation to a titanyl phthalocyanine layer inserted between blue- and green- emission layers controls the charge recombination site from one layer to the other, resulting in the different emission color with and without external light. By tuning a hole blocking layer and a cathode, the device efficiency was optimized. Ca and LiF/Al cathodes provided more effective device compared with Mg:Ag.

OLEDp - 6 Enhanced Hole-Injection in Organic Light-Emitting Devices by Utilizing F4-TCNQ and the Interface Analysis by Ultraviolet Photoelectron Spectroscopy

K.-Y. Peng, C.-C. Lee, C.-T. Lee^{*}, C.-I. Wu^{*} AU Optronics, Taiwan ^{*}Nat. Taiwan Univ., Taiwan

An thin F4-TCNQ layer on ITO substrate can enhance hole injection in organic light-emitting devices, as the uniformly p-doped hole-transport layer. The F4-TCNQ layer between ITO and hole-transport layer reduces the operation voltage and raises the current efficiency. Such results are evidenced by ultraviolet photoelectron spectroscopy analysis, which reveals that both the thin F4-TCNQ layer and the p-doped hole-transport layer can decrease hole injection barrier from 1.05 eV to 0.35 eV.

OLEDp - 7 Fabrication of Organic Light Emitting Device on the Spray-CVD Derived Tin-Doped Indium Oxide Anode

S. Seki, M. Wakana, Y. Kasahara, T. Kondo, M. Wang, T. Uchida, M. Ohtsuka, Y. Sawada Tokyo Polytech. Univ., Japan

Tin-doped In₂O₃ films are mainly manufactured by physical vapor deposition (PVD). The present authors reported ITO films deposited by a unique system of spray-CVD with lower production costs. The lowest value of resistivity (7.9 × 10⁻⁵ Ω · cm) was compatible with the lowest values obtained by the PVD process. We report the organic light emitting device (OLED), *L*-*V* and *J*-*V* curves of which were almost equal to the OLED on commercial ITO, fabricated on the ITO anode deposited by the unique spray-CVD.

OLEDP - 8 The Characterization of the Gas Barrier Comprising Parylene-C Thin Films for Flexible OLED Application

J.-Y. Liao, P.-C. Liu, C.-H. Hsiao^{*}, C.-L. Huang^{*}, J.-H. Lee^{*}, C.-S. Chang, M.-R. Tseng ITRI, Taiwan ^{*}Nat. Taiwan Univ., Taiwan

In order to provide OLED devices with a water-resistive protection in the flexible application, the multilayer barrier comprising Parylene-C and ICP-CVD fabricated SiNx or SiOx is studied. The surface roughness of the Parylene-C film and the optical as well as barrier properties of SiNx and SiOx films are characterized individually. In addition, the transparent Ca test method is proposed to evaluate the WVTR of the multilayer barrier.

OLEDp - 9 Optical Simulation and Characterization of Full Color Organic Light Emitting Diodes with Color Filter on Array Structure

C. K. Tseng, H. L. Hsu, L. C. Wei, W. F. Chien, H. C. Wu, R. Nishikawa, Y. M. Tsai TPO Displays, Taiwan

A simulation method of OLED with color filter on array (COA) was introduced. In the RGB side-by-side OLED with COA structure it can get high transmittance in red, green and blue lights and very high NTSC ratio. A previous simulation method was revised to predict the OLED with COA processes results. In the simulation method, by combining the captured OLED spectrum with the characteristics of color filter, the experimental results can thus be predicted.

OLEDp - 10 Investigation of O₂ Plasma Treatment Conditions of ITO for High Efficiency of Organic Light Emitting Diodes

W.-J. Shin, J.-H. Kim, M.-C. Oh, J.-C. Kim, T.-H. Yoon Pusan Nat. Univ., Korea

To increase the hole injection efficiency of OLED, surface potential modification by the O_2 plasma treatment on ITO surfaces was examined systematically. The operating voltage was decreased from 11.8 V to 9.0 V and the power efficiency was increased from 1.5 lm/watt to 2.0 lm/ watt at 100 mA/cm². Based on the Schottky emission current model, it was confirmed that the energy barrier for the hole injection was reduced to 0.5 eV from 1.1 eV by O_2 plasma treatment.

OLEDp - 11 Highly Efficient Polarized Polymer Light-Emitting Diodes Prepared by Friction-Transfer Technique

M. Misaki, S. Nagamatsu, M. Chikamatsu, Y. Yoshida, N. Tanigaki, R. Azumi, Y. Ueda^{*}, K. Yase AIST, Japan ^{*}Kobe Univ., Japan

We demonstrate highly efficient polarized polymer light-emitting diodes (p-PLEDs) for liquid crystal display (LCD) backlights application. The optimization of the device structure drastically improves the performance of p-PLEDs: the devices turn on at 4 V and reach a brightness of 1793 cd/m² at 12.5 V with an efficiency of 1.23 cd/A. The electroluminescent (EL) dichroic ratio (integrated intensity) is estimated to be 45.

OLEDp - 12 Organic Light Emitting Display with a Single Isolation Structure Using a Half-Tone Mask

Y. H. Lee, S. W. Youn, K. S. Kim, K. H. Choi, S. J. Yi, D. H. Choi Daewoo Elect., Korea

We have developed a single isolation structure using a half-tone mask for PMOLEDs. In the single isolation structure, three exposure processes were reduced to two exposure processes using a half-tone mask. The half-tone composed of multiple slits in the half-tone mask caused a problem of the insulator thickness deviation, but it was settled by designing the half-tone pattern and modifying the separator mask design. Compared with the conventional double layered isolation structure, the fabrication processes could be reduced to 64%.

Thursday

December 7

OLEDp - 13 Gas Permeability Measurement Method by Electrical Analysis of Calcium Degradation for Organic Electronics

J. H. Choi^{*}, Y. M. Kim^{*,**}, Y. W. Park^{*}, J. H. Seo^{*}, J. W. Lee^{**}, S. J. Bae^{*,**}, B. K. Ju^{*} ^{*}Korea Univ., Korea ^{**}Korea Inst. of S&T, Korea

The measurement method to characterize barrier coated plastic film relative to water and oxygen permeation for organic electronics has been demonstrated. We derive the permeation rate by amount of oxidative degradation in thin calcium by resistance measurements. As a result, this method can achieve accurate determination of the permeation rate with high sensitivity, also has application to various fabrication technique of passivation layers for OLED stability.

OLEDp - 14 Large-Area White Polymer Light-Emitting Diode Made by Selective Spin Coating

S. H. Jeong, S. K. Kwon, Y. K. Lee, T. J. Park, W. S. Jeon, J. H. Kwon, J. Jang Kyung Hee Univ., Korea

We developed a selective coating technique by spin coating for white polymer light-emitting diode (WPLED). This is a new polymer patterning technology for large area lighting application of WPLED. Teflon can be used to make a hydrophobic surface for the selective polymer coating without increasing contact resistance significantly.

OLEDp - 15 Admittance Spectroscopy of the Electric Properties of 1,4-*bis*[*N*-(1-naphthyl) -*N*'-phenylamino]-4,4' Diamine Doped with Tungsten Oxide

M. T. Hsieh, C. C. Chang, C. A. Hu, Y. T. Huang, S. L. Yang, J. F. Chen, S. W. Hwang, C. H. Chen Nat. Chiao Tung Univ., Taiwan

We report an efficient p-type doping of NPB layer using WO_3 as a pdopant.. We find that increasing the WO_3 volume percentage can reduce the activation energy of the NPB layer and increase the hole concentration in NPB layer. As a result, the hole-injection can be improved via tunneling through a narrow depletion region due to the increasing band bending which corresponds to the difference of Fermi level position between the ITO and the NPB layer.

OLEDp - 16 The Study of Power Consumption of Individual Organic Semiconductor Device: From Panel Point of View

H. Yang, T. Y. Su Nat. Taipei Univ. of Tech., Taiwan

The quantification of total power consumption of the organic lightemitting diode (OLED) from display panel point of view was investigated by macro impedance model. The OLED device in our macro impedance model is regarded as a net power consuming device in which the electrical power will dissipate through its internal resistance as well as complex power during panel operation. Our preliminary results revealed that a relatively large phase shift may cause ineffective power consumption from panel point of view.

OLEDp - 17 Impedance Spectroscopy and Equivalent Circuits of Polymer Light-Emitting Diodes

T. Okachi, H. Azuma, T. Nagase, T. Kobayashi, H. Naito Osaka Pref. Univ., Japan

Impedance spectroscopy (IS) of poly(9,9-dioctylfluorene) (F8) polymer light-emitting diodes (PLEDs) with anode buffer layers has been studied to determine their equivalent circuits. The equivalent circuits of the PLEDs below and above the threshold voltage for electroluminescence (EL) and their physical interpretation are shown. A significant difference in equivalent circuits is observed between below and above the threshold for EL. Above EL threshold, two R-L series branches due to charge carrier recombination appear in the equivalent circuit.

OLEDp - 18 Analysis of the Hole-Mobility in PLEDs Using Transient-Electroluminescence Method

J. H. Youn, Y. I. Lee, Y. K. Lee^{*}, T. J. Park^{*}, H. T. Moon, J. Jang^{*} KAIST, Korea ^{*}Kyung Hee Univ., Korea

We have studied the behavior of hole mobility of the PLEDs having a hole transport layer such as PEDOT:PSS. Using the transientelectroluminescence technique, we measured the mobility of the emitting layer in the PLED which is at an order of 10^{-5} cm²/Vs at room temperature. The mobility increases significantly with PEDOT:PSS, but has no dependence of the thickness of LiF in the range of 1 to 3 nm.

OLEDp - 19 Liquid Light-Emitting Display Based on Electrochemiluminescence with Interdigitated Microelectrodes

S. Enomoto, Y. Mizuno, N. Saito, Y. Kizaki, I. Amemiya, S. Uchikoga Toshiba, Japan

We proposed a novel liquid light-emitting display (LLED) consisting of an electrochemical cell with interdigitated microelectrodes and liquid electrolyte containing light-emitting material. The emitting phenomenon is electrochemiluminescence (ECL) based on electro-chemical reaction. The cell with fast response time of 3 ms has been successfully operated by AC voltage application. LLED could avoid image-sticking problem of OLED caused by DC voltage application and solid-state component.

OLEDp - 20L The Synthesis New Dendrimer and High Quantum Efficiency Iridium Complex Properties of Solution Processable Phosphorescent

H.-W. Hong, I.-R. Laskar, T.-M. Chen Nat. Chiao Tung Univ., Taiwan

We demonstrate that the Ir complexes used as dopants in organic electrophosphorescent diodes exhibit high PL quantum efficiency (η_{PL}) in the solid-state. We have pursued the development of highly luminescent solution-processible electrophosphorescent dendrimers. We observed that the PLQY of the (G1-bt_3Ir) compound dendrimer was approximately 1.5 times higher than the pristine complex Ir(bt)_3 in solution. The external quantum efficiency of OLEDs using the film containing a mixture of the first-generation dendrimer and an electron-transporting material was as high as 4.14%.

OLEDp - 21L Low Voltage and Long Lifetime Organic EL Devices with New Electron Transport Materials

T. Koike, Y. Ono, M. Uchida Chisso PetroChem., Japan

In this paper, we report new highly effective Electron Transport Materials (ETMs) for Organic Light Emitting Diode (OLED). The ETMs showed good performances, such as high efficiency, low operating voltage, and long lifetime in blue OLEDs.

OLEDp - 22L Multilayer White Organic Light-Emitting Diode with a Alq₃ Doped Blue Layer

S. I. Park^{*}, Y. G. Lee^{*,**}, S. Lee^{*}, K. H. Koh^{*} ^{*}Ajou Univ., Korea ^{**}Samsung Advanced Inst. of Tech., Korea

We fabricated white organic light-emitting devices which had composite emission layers based on blue emitting MADN and DSA-Ph, greenemitting Alq₃, and red-emitting DCJTB. The co-doping of MADN layer with DSA-Ph and Alq₃ resulted in substantial improvement of device performance. The maximum luminance and efficiency of 29,420 cd/m² and 5.72 cd/A were achieved at 11 and 7 V. Moreover, stable white emission with the CIE_{xy} color coordinates of (0.357, 0.350) was observed for driving voltages between 6 and 11 V.

OLEDp - 23L Influence of Doping Concentration in the Emissive Layer of Organic Light Emitting Diodes

Y. W. Park^{*}, Y. M. Kim^{*,**}, J. H. Choi^{*}, B. K. Ju^{*} ^{*}Korea Univ., Korea ^{**}Korea Inst. of Sci. Tech., Korea

Currently, in the area of organic light emitting diodes, the way how to improving electroluminescence efficiency and other characteristics are investigated in world widely. In this paper, we've studied the influence of doping concentration in the emissive layer. With applying variations of doping concentration, we've added one more dopant. The emission layer was commonly used Alq3 and two dopants were C-545T and DMQA. Compared with single dopant based device, the EL characteristics were improved when the two dopants used simultaneously.

OLEDp - 24L Electric Field Distribution in Polyfluorene Based Light-emitting Diodes upon Insertion of Interfacial Layer

R. Jin, J. C. deMello, J. Huang, D. D. C. Bradley Imperial College London, UK

We present electroabsorption (EA) technique measurements of internal electric fields in poly(9,9'-dioctylfluorene)(PFO)-based multilayer polymer light emitting diodes (PLEDs) with and without an interfacial layer between the hole conducting layer and the emissive layer. There is a strong internal electric field screening effect for the interfacial material-based PLEDs, which can explain the significant improvement of the device efficiency caused by adding a 10nm layer of poly(9,9-dioctyl-fluorene-co-N-(4-butylphenyl)-diphenylamine) (TFB) between a poly(styrene sulphonate)-doped poly(3,4-ethylene dioxythiophene) (PEDOT:PSS) layer and a PFO emissive layer.

OLEDp - 25L Preparation of Nickel-Doped Indium Tin Oxide Anode for Organic Light-Emitting Diode Using a Single Target Sputter

C.-M. Hsu, H.-H. Lee Southern Taiwan Univ. of Tech., Taiwan

A nickel (Ni)-doped indium tin oxide (ITO) anode was prepared using a Ni-ITO single-target sputtering for organic light-emitting diodes (OLEDs). Devices with 3% and 5 wt% Ni-ITO anodes show a threshold voltage drop of 1.52 and 0.72 V, respectively, whereas the turn-on voltage was reduced by 4 V and 3.8 V. The successful development in preparing Ni-doped ITO films by a single target instead of a Ni-ITO co-sputter system allows this approach to be adopted for OLED manufacturing.

OLEDp - 26L Study of Moisture Permeation Properties of OLED Package and Device Lifetime

S. K. Ramadas, S. J. Chua, L. Ke, S. Z. Ma, M. Auch Inst. of Materials Res. & Eng., Singapore

A highly sensitive water vapor permeation measurement technique for organic light emitting display applications is demonstrated. Calcium is used as a sensor. The amount of the calcium degraded as hydroxide is detected by measuring the change in electrical properties of calcium. The sensitivity of this system for the measurement of water vapor transmission rates is better than 10⁻⁶g/m²/day. Water vapor transport rates and diffusion coefficients of glass based packaged OLED structures are quantified and related to the OLED operating lifetimes.

14:00 - 17:00

Ohmi 5-7

Poster AMD/OLEDp: AM-OLED

AMD/OLEDp - 1 2-in. QQCIF Top-Emission AMOLED Drived by Low Temperature Poly Silicon TFT on Flexible Metal Foil with BCB Planarization

> D. J. Park, Y. H. Kim, M. H. Lee, J. H. Moon, C. H. Chung, Y. H. Song ETRI, Korea

We have developed a 2 inch QQCIF LTPS-TFT AMOLED display with a top emission structure on a 50-µm-thick metal foil with BCB planarization. The p-channel poly-Si TFT on flexible metal foil exhibited the field-effect mobility of $54\text{cm}^2/\text{Vs}$, the on/off current ratio of 10^6 , the threshold voltage of -3V, and the subthreshold slope of 0.8V/dec. Finally, a images from prototype monochrome AMOLED displays are successfully presented, with 64×88 pixels and 56-ppi resolution.

AMD/OLEDp - 2 A Novel Compensation Pixel Circuit of AMOLED Display for Stable OLED Current

M. H. Kang, J. W. Choi, J. H. Koo, Y. S. Kim, K. W. Ahn, J. H. Hur, S. W. Lee, J. Jang Kyung Hee Univ., Korea

We propose a new pixel circuit for a-Si:H AM-OLED display. The voltage-programming method is used in the pixel circuit for compensating the threshold voltage shifts of a-Si:H TFTs. One of the switching TFTs takes a role of preventing the peak current flowing to OLED during reset and compensation periods. We have designed an Emission Control Pulse (ECP) generator based on gate signals to control the switching TFT. The operation and stability of proposed pixel circuit are proved by SPICE simulation.

AMD/OLEDp - 3 A Voltage Driver IC with Automatic Luminance Control for 256-Level Full Color Active-Matrix OLED Displays

J. H. Lee, D. C. Park, C. H. Park, S. H. Kim, H. K. Yun, G. N. Kim, I. S. Kang, B. N. Kim Samsung Elect., Korea

An AMOLED driver IC using voltage driving scheme, one of driving methods to drive AMOLED, is developed. The developed driver IC can automatically control the luminance and has 256 gray levels for LTPS QVGA full-color AMOLED Displays. To reduce the chip size, the developed driver IC also uses one source amplifier for RGB. As a result, it has 240 source outputs and the separated serial gamma circuits.

AMD/OLEDp - 4 New Pixel Circuit Employing Fast V_{TH} Detection Scheme for LTPS AMOLED

H.-S. Shin, W.-K. Lee, S.-G. Park, S.-H. Choi, M.-K. Han Seoul Nat. Univ., Korea

We propose a novel pixel design employing fast threshold voltage detection scheme for active matrix organic light emitting diode (AMOLED) displays using low temperature polycrystalline silicon thin film transistors (LTPS-TFTs). The proposed pixel circuit, which consists of 5 p-type TFTs and 2 capacitors, has a fast threshold voltage detection scheme using the clock signal. The simulation results show that the proposed pixel circuit exhibits a scan time less than 7 micron second and successfully compensates V_{th} variation of poly-Si TFT.

AMD/0LEDp-5 Capacitive Compensation to Suppress Sample-and-Hold Non-Idealities in Switched-Current AMOLED Pixel Circuits

X. Guo, S. R. P. Silva Univ. of Surrey, UK

A simple and effective capacitive compensation method is presented to suppress the sampling and hold (S/H) non-idealities in switched-current (S-I) AMOLED pixel circuits for inverting structure top-emitting OLEDs, and thus greatly improve the output linearity of the circuit. The method can also be used to design the p-TFT S-I pixel circuit for normal structure top-emission OLEDs, and some other configurations of S-I AMOLED pixel circuits, or even voltage-mode driven pixel circuits.

AMD/OLEDp-6 A Novel Threshold Voltage Compensation Pixel Circuit with High Immunity to the Supply Voltage Drop for AMOLED Displays

H.-Y. Lu, P.-T. Liu, T.-C. Chang^{*}, S. Chi Nat. Chiao Tung Univ., Taiwan ^{*}Nat. Sun Yat-Sen Univ., Taiwan

A new pixel circuit employing LTPS TFT for AMOLED is proposed. The proposed one can eliminate both the threshold voltage variation of the driving TFT and the supply voltage drop. The simulation results indicate that the proposed circuit significantly improves the non-uniformity of output current by the new compensation operation.

AMD/OLEDp - 7 A New Drive Method for Large Organic Light-Emitting Diode Displays

J. C. Rutherford, C. A. Wedding, D. K. Wedding^{*} Imaging Syss. Tech., USA ^{*}Univ. of Toledo, USA

This new drive method eliminates obstacles that affect the performance of very large organic light-emitting diode displays on plastic substrates. Increased component tolerances reduce problems caused by dimensional instability of plastic substrates. The enhanced performance enabled by using this drive method is not matched by other active matrix drive methods.

AMD/OLEDp+8L Polarity Inversion Driving Method to Reduce the Threshold Voltage Shift in a-Si:H TFT AMOLED

H.-S. Park, J.-H. Lee, J.-H. Jeon^{*}, M.-K. Han Seoul Nat. Univ., Korea ^{*}Hankuk Aviation Univ., Korea

We have proposed a new driving method to improve the current stability of a-Si:H TFT for AMOLED. The proposed scheme performs the negative bias annealing on a-Si:H TFTs during a certain period of a frame time. The amplitude of negative bias to cure the degradation of a-Si:H TFTs is determined by the previously applied positive voltage which displays the original image. Our simulation result shows that it can suppress the degradation of a-Si:H TFT and provide the good screen uniformity.

BANQUET

Wednesday, December 6 19:10–21:10 Prince Hall (3F) Otsu Prince Hotel

See page 9 for details

Workshop on 3D/Hyper-Realistic Displays and Systems

Thursday, December 7

14:00 - 14:05

Opening

Opening Remarks 14:00

I. Yuyama, Utsunomiya Univ., Japan

0

Ohmi 5-7

Ohmi 2

Poster 3Dp: 3D and Hyper Realistic Display

3Dp - 1 Adjustment of Depth of Field of Binocular Cameras to Reproducible Depth with Stereoscopic LED Display

M. Nitta, H. Yamamoto, Y. Hayasaki, N. Nishida Univ. of Tokushima, Japan

We have developed a stereoscopic display system with adjustment of depth of field of binocular cameras. It is necessary to adjust the binocular disparity that three-dimensional image contains to the allowable disparity range of the stereoscopic display. In this paper, we analyze the disparity distribution and the boundary of stereoscopic vision. Furthermore, we propose a method of adjustment of depth of field with binocular cameras in order to extract the objects in the allowable disparity range.

3Dp - 2 Limits of Disparity Angle for Perception of Depth Reproduced by a Stereoscopic Display by Use of a Large LED Panel

> K. Uchida, H. Yamamoto, Y. Hayasaki, N. Nishida Univ. of Tokushima, Japan

The viewing conditions of stereoscopic LED displays in the open air are changeable in brightness according to the weather and the surrounding lights. This paper reports the limits of disparity angle for perception of depth that is represented by a large stereoscopic LED display. Experiments about depth-perceptions have been conducted with and without lighting up the experimental room. Experimental results revealed that the limit of disparity angle depends on the lighting conditions.

3Dp - 3 Large Stereoscopic Display with a Parallax Barrier by Use of an Aperture Grille

H. Nishimura, T. Abe, H. Yamamoto, Y. Hayasaki, N. Nishida Univ. of Tokushima, Japan

We propose a large parallax barrier by use of aperture grille. Main advantages of using aperture grille include no reflection and no absorption in apertures. We have measured viewing areas around the main lobe and around side lobes. Experimental results show use of aperture grille in-creases contrast and enlarge the viewing areas compared to the conventional parallax barrier by use of a painted acrylic board. Furthermore, we have realized a large stereoscopic display by use of 140-inch LED panel.

3Dp - 4 Projection-Type Depth Fused 3-D (DFD) Display

M. Date, H. Takada, S. Suyama, K. Tanaka, K. Nakazawa NTT, Japan

A large-area see-through 3D display using a depth fused 3D (DFD) visual illusion is presented. The display consists of a stack of two transparent screens with projection from both the rear and front directions. Utilizing angular and polarization dependence of the scattering efficiency of the screens, cross talk between the images on the front and rear screens is suppressed. The display also provides a see-through effect, which can give a viewer the sense that the image is floating.

3Dp - 5 360 Degree Viewing Stereoscopic 3D Display System

K. Sakamoto, T. Nishida, K. Uchida Shimane Univ., Japan

We describe a 360 degree viewing display that can be viewed from any direction. The screen rotates at a uniform speed. Then an observer can view a monitor screen at any position surrounding the round table. But the solid of revolution is formed when an image screen is rotated. Hence the angle of view is controlled by slit in order that a screen faces an observer and he can view only 2D images on the screen without 3D solid images.

3Dp - 6L Virtual Display: Mirror Image for Extension of Display Area

A. Tanaka, K. Sakamoto Shimane Univ., Japan

A liquid crystal display recently comes into common use. It is possible for this display unit to provide the same size of displaying area as the image screen on the panel. The conventional display can show only one screen, but it is impossible to enlarge the size of a screen. In this report, we present an enlarging method of display area. Our extension method enables the observers to show the virtual image plane and to enlarge a screen area twice.

3Dp - 7L Field-lens 3D Display Using Linear and Circular Polarized Illuminations

H. Morimoto, K. Sakamoto Shimane Univ., Japan

This report describes the field-lens display for viewing the 2-views stereoscopic images. We have developed field-lens 3D displays using dual LCD panels for displaying full-screen left and right images. Our proposed method can ever modulate horizontally and vertically oriented linear polarized illuminations. However, each LCD panel can't display a left or right image directly. To solve this problem, this report proposes new modulation method using both linear and circular polarizations.

3Dp - 8L A Turn-Type High-Resolution 3-D Display Using LEDs

T. Yamaguchi, A. Ito, Y. Sakamoto, I. Fukuda Kanazawa Inst. of Tech., Japan

We developed a turn type depth sampling display using a vertical array of light emitting diodes (LEDs). By moving of LED array, two dimensional images are perceived by the effect of after image. By arrangement of 16 arrays, 3-D images can be display in real space. We successfully combined our previously developed display prototypes with a printer head LED array to develop a display unit capable of displaying an high-resolution image of $640 \times 750 \times 16$ boxels.

14:00 - 15:20		Ohmi 2
	3D1: 3D Display (1)	

Chair:	JY. Son, Hanyang Univ., Korea
Co-Chair:	T. Mishina, NICT, Japan

3D1 - 1: Invited Development of Multi-Focus 3D Display 14:05 Systems

S.-K. Kim KIST, Korea

Multi-focus 3D display systems are developed and possibility about satisfaction of eye accommodation is tested. The multi-focus means the ability of monocular depth cue to various depth levels. By achieving multi-focus function, we developed a 3D display system for one eye, which can satisfy accommodation to displayed virtual objects within defined depth. The accommodation of one eye is tested and a proof of the satisfaction of the accommodation is given as results by using the proposed 3D display systems.

3D1 - 2Simulation of a Novel High Brightness Technology of14:30Stereoscopic Display

C.-Y. Chen, Y.-M. Chen^{*}, C.-C. Lin^{*}, M.-C. Chang, H.-T. Chou Nat. Yunlin Univ. of S&T, Taiwan ^{*}Chunghwa Picture Tube, Taiwan

In this paper, we newly propose a light-reuse method for increasing the brightness of stereoscopic display. This method can effectively resolve the problem of traditional parallax barrier method that will produce much reflected light and cause the deficiency of the luminance. The idea is to evaporate a layer of metal thin film on the back of the grating of parallax barrier which can guide the reflected light to transparent region, and the reflected light can be reused again.

3D1 - 3A 3D/2D Convertible Display with Pinhole Array on a14:50LC Panel

H. Choi, Y. Kim, S.-W. Cho, B. Lee Seoul Nat. Univ., Korea

A 3D/2D convertible integral imaging system using a pinhole array on an LC panel is proposed. By generating and eliminating the pinhole array on the LC panel electrically, the system can be operated on the 3D and 2D modes. Some experimental results are also demonstrated to prove the proposed method.

3D1 - 5L Autostereoscopic Multi View 3D System Using 15:10 Square Subpixel

J. U. Park, B. J. Lee, H. K. Hong, H. H. Shin LG.Philips, Korea

Subpixel structure of 2D display is an important factor in designing optical configuration of viewing zone. Relation between view number and 3D image quality is estimated for LCD of RGBW quad subpixel structure. As view number increases, distances between subpixel in each zone tend to be uniform. Autostereoscopic multiview 3D system is developed using slanted barrier and evaluated.

----- Break -----

15:40 -16:55

Ohmi 2

3D2: Holographic and Advanced Displays

Chair: I. Yuyama, Utsunomiya Univ., Japan Co-Chair: S. Yano, NHK, Japan

CO-Chair. S. fano, NHK, Japan

3D2 - 1:InvitedA Broadcasting Technique for Holographic 3D15:40TV Using Internet System

K. Takano, K. Sato^{*} Tokyo Metropolitan College of Ind. Tech., Japan ^{*}Shonan Inst. of Tech., Japan

In this paper, a transmitting process of a sequence of holograms describing 3D moving objects over the communicating network system is presented. A sequence of holograms involves holographic information of 3D moving objects recorded as fringe patterns. In this process, holographic information recorded in the holograms is transformed into in a bit stream data, and then it is transmitted over the internet system.

3D2 - 2 Expansion of Reconstruction Image of 16:05 Electroholography Using LCD Panels in Parallel

A. Shiraki^{*}, T. Ito^{*,**}, N. Masuda^{*}, T. Shimobaba^{***} ^{*}Chiba Univ., Japan ^{**}JST, Japan ^{***}Yamagata Univ., Japan

In recent years, research of electroholography is studied in various fields. However, since there is not a sufficient device for displaying computer generated hologram, generally it is not put to practical use yet. Then, we put several liquid crystal display panels in order and made a large display area. Consequently, we were able to obtain the larger reconstruction image than the case that only one liquid crystal display panel was used.

3D2 - 3 Optic Waveguide Flexi Panel Electronic Display

16:25

D. Huang

Firstwave Advanced Mechanical Elect. Display, Australia

A visual display formed by picture elements, which are optically coupled to optical pathways through which light is supplied from light sources controlled by control hardware, transmit light to the optical pathways by scanning light to different optical pathways. The light sources and the pathways are mutually oriented. Light sources can be scanned into different optical pathways to form images. Light sources on a rotating mounting rotate past static pathways that transmit coupled light to the waveguide screen.

3D2 - 4L Real Time Rendering for a Full Parallax 3D Display 16:45 Using High-Density Directional Images

M. Tsuboi, M. Fujioka^{*}, Y. Takaki^{*}, T. Horikoshi NTT DoCoMo, Japan ^{*}Tokyo Univ. of A&T, Japan

We realize the real time interaction on the 3D display using high-density directional images. By tracking the face of the observer and changing the 3D image dynamically according to the position of the observer, a full parallax 3D display is achieved. In addition, the speed to generate the 3D image is 15 [fps]. Consequently, natural 3D interaction turns to reality and real time interaction with 3D image is achieved.

Author Interviews 18:40 – 19:40

Friday, December 8

9:00 - 10:30	Ohmi 1
3D3: Hyper Realistic Display and Human Fact	tor

Chair: S.-K. Kim, KIST, Korea Co-Chair: M. Hashimoto, NTT Data, Japan

3D3 - 1:InvitedThe Effects of the Additional Static Stimulus9:00in Perceiving Visually Induced Self-Motion

S. Nakamura Nihon Fukushi Univ., Japan

A larger moving stimulus can induce illusory self-motion perception to the opposite direction (vection). Psychophysical experiments revealed that an additional static foreground can facilitate vection, while it inhibits vection when the same stimulus is presented as a back-ground. Furthermore, the vection facilitation by the foreground is dominated by central, whereas the vection inhibition caused by the background is more salient with peripheral stimulation. These results can be applied for a visual display which can demonstrate self-motion perception more effectively.

3D3 - 2Analysis on the Effect of Diffraction and Human9:25Factors on the Integral Imaging System

J. Kim, Y. Kim, S.-W. Cho, H. Kim, B. Lee Seoul Nat. Univ., Korea

We analyze the effect of the diffraction of the lens array and the lens of the eye when the observer is watching three-dimensional image constructed by integral imaging. We simulate the retinal image of the observer through the wave optical calculation for the analysis. The optimum size for the lens array is investigated and the integration of the image in the sense of wave optics is tested.

3D3 - 3: Invited Multi-Dimensional Multipoint Measurement 9:45 System to Construct Large-Scale Real-World Database

T. Fujii, K. Mori, K. Takeda, K. Mase, M. Tanimoto, Y. Suenaga Nagoya Univ., Japan

We developed a novel multipoint measurement system capable of acquiring video and sound at more than 100 points in a "synchronized" manner. In this paper, we first describe the specification of the system and then report data acquisition results that include test sequences for MPEG (Moving Picture Experts Group) Multiview Video Coding, traffic surveillance, and multiview video for educational materials. We are planning to collect a large volume of real-world video and sound and release them to the public.

3D3 - 4Development of Hyper-Realistic Peripheral-Visual-10:10Fieald Image Processing Using Distortion PerceptionLimit of Peripheral Vision

T. Sasaki, A. Hotta, H. Okumura Toshiba, Japan

We propose a method to centralize image information for improving hyper-reality with wide visual field. This method produces distortion on images. We evaluated the profile of distortion perception limit at peripheral vision. The distortion perception was sensitive to less than 30 degrees of eccentricity. It became dull rapidly at over 40 degrees, and distortion was largely unperceived at 50 degrees. Simple enlargement of HD image on dome screen increases "hyper-reality". Transformation using this profile enhanced 0.6 points in subjective evaluation.

----- Break -----

10:30 - 11:40		
	3D4: 3D Display (2)	
Chair: Co-Chair:	T. Fujii, Nagoya Univ., Japan T. Mishina, NICT, Japan	
3D4 - 1 10:30	Three Dimensional Imaging Systems without Viewing Zone Forming Optical Plates	
	JY. Son, V. V. Saveljev, KT. Kim [*] , YJ. Choi, KH. Cha ^{**} Hanyang Univ., Korea [*] Hannam Univ., Korea	

A multiview 3-D image device based on LED array is introduced. This device is free from viewing zone forming optics in current multiview 3 dimensional imaging systems. This device has the same structure as current LCD panel but an LED light source array is used instead of the back light panel. 3 dimensional images displayed on this device provide a good depth sense, though it reveals many problems to be solved in future.

3D4 - 23D Images with Enhanced DOF Produced by 128-10:50Directional Display

Y. Takaki, K. Kikuta Tokyo Univ. of A&T, Japan

^{**}Samsung Elect., Korea

A high-density directional display has been developed to solve the accommodation-vergence conflict. The accommodation responses to the 128-directional display show that the high-density directional display technique has the effect of enhancing the depth of focus (DOF) of an eye imaging system. When 3D images are displayed within the enhanced DOF, the accommodation function works appropriately. We also report the development of a new 128-directional display having SVGA resolution.

3D4 - 3 A Novel 3D Double Screens Display

11:10 C. Lai, C. Chen, H. Shieh Nat. Chiao Tung Univ., Taiwan

A novel 3D double screens display system including a planar mirror and a micro-optical structure is proposed to yield dual full-sized 3D images. The lenticular-lenses-based micro-optical structure can generate 3D function and double screens function by rotating color filter's pixel layout with respect to the lenticular-lenses' positioning direction. Viewers can enjoy two image screens simultaneously with a planar mirror aligned. The proposed system has high potential on transforming the ordinary flat panel displays to 3D double screens displays.

3D4 - 4L Moire Reduction for Integral Videography 11:30

T. Koike^{*,**}, M. Oikawa^{**}, K. Utsugi^{**} ^{*}Univ. of Tokyo, Japan ^{**}Hitachi, Japan

We developed an integral videography display with an optimized color filter layout. The integral videography display consists of a highresolution LCD and a microlens array. There are two kinds of moire visible on the display: a color moire caused by the color filter layout and an intensity moire caused by a black matrix on the LCD. To reduce the moires, we have changed the layout of the color filter on the LCD and defocused autostereoscopic images through the microlens array.

Author Interviews 17:00 – 18:00

IDW '07

The 14th International Display Workshops

December 5-7, 2007 Sapporo, Japan

Outstanding Poster Paper Awards Ceremony

Friday, December 8

See page 9 for details

Workshop on Applied Vision and Human Factors

Wednesday, December 6

13:20 - 16:20	Ohmi 5-7
Poster VHEn: Human Factors and Imag	ve Quality

VHFp - 1 Skin Color Reproduction for Mobile Display

H. H. Cho, J. S. Kim, J. F. Zhan, M. H. Lee Samsung Elect., Korea

In this paper, preferred skin color reproduction for improving the image quality is designed. The proposed method consists of two blocks: color space conversion and skin transformation. The color discontinuity reduction algorithm is described to remove false contours caused by conventional skin color transformation methods. The visual test is performed to compare the processed image and original one. The proposed method has been verified by using FPGA and 2.4-inch LCD module (QVGA, 260k colors).

VHFp - 2 Accurate Color Reproduction Method for Displays

Y. Kawagoe, Y. Shimodaira Shizuoka Univ., Japan

There are color reproduction problems those are the color-tracking phenomenon that result in the shifts of chromaticity in the low luminance regions and the imperfectness of the additive color mixture in the display devices. In this study, we propose a real-time color reproduction method suppressing the color-tracking and correcting the imperfectness of the additive color mixture. When the method works in a display, it displays images with accurate color.

VHFp - 3 Visual Detection and Recognition of Objects under Low-Illuminance of Different Color Temperature

K. Inagaki, G. Ohashi, Y. Shimodaira Shizuoka Univ., Japan

Visual performance against changes of luminance, contrast and color temperature of objects was evaluated to reduce traffic accidents at nighttime driving. The best performance is obtained at white point of 6500K under the dark environment. There are large influences caused by contrast in all luminance levels, although no influence is caused by color temperature in the brighter one. Moreover, novel method to determine optimal luminance in dark environment is proposed by relations of luminance to ratios of detection and recognition.

VHFp - 4 Preferred Color Conversion Applied to Display Based on Hardware Design

C.-W. Ho, T.-L. Wu, C.-H. Cheng, C.-Y. Ke, Y.-W. Huang ITRI, Taiwan

The proposed method is to do color transform pixel by pixel firstly and then apply color gamut mapping and preferred color adjustment simultaneously or respectively in hue and chroma. The architecture has worked out with FPGA. It achieves real-time color processing by pipeline structure and has the I2C interface to connect hardware and software. The overall processing performance can reach to 100.5MHZ. The visual quality rate of color reproduction will be improved more than 20% by applying this method.

VHFp - 5 Adaptive Color Image Enhancement Applied to Display Based on Hardware Design

C.-Y. Ke, T.-L. Wu, C.-H. Cheng, C.-W. Ho, Y.-W. Huang ITRI, Taiwan

This paper proposes a kind of dynamic digital color adjustment that it can automatically calculate out the features of continuous frames and judge what kinds of these continuous frames should belong in and then do different strategies of color adjustment for these. It makes these frames perceptually optimal and high dynamic range for human vision. The proposed architecture achieves real-time color processing by FPGA. The visual quality rate of color reproduction will be improved more than 20% by this method.

VHFp - 6 A New Method for the Viewing Angle Image Color Shift Evaluation

C.-Y. Liu, L.-H. Chang Chung-Hwa Picture Tubes, Taiwan

The new method of viewing angle image quality evaluation for large screen TFT-LCD TV was proposed. The off-axis color shift has become more noticeable especially for the vertical alignment TFT-LCD. Due to the off-axis color shift level is highly related to the oblique gamma distortion. We develop OGD (oblique gamma difference) method to qualify the off-axis color shift of the TFT-LCD. It can truly evaluate the off-axis color shift level by using OGD method.

VHFp - 7 Visual Evaluation of New Pixel Arrangements for Matrix Displays

A. Tsunoya, M. Kimura Ryukoku Univ., Japan

New pixel arrangements have been visually evaluated for matrix displays. Visual resolution limits and natural picture quality of the conventional and new pixel arrangements are evaluated using physiological experiment. It is found that the visual resolution limit for the stripe arrangement is small. On the other hand, the visual resolution limits for the PenTile RGBW L6W and RGBCMY arrangements are large. Natural picture quality for the PenTile RGBW L6W is most superior.

VHFp - 8 Measurements of Time-Dependent Mura in LCD Manufacture

P-Y. Tang, K.-H. Yang, S.-L. Ho, C.-H. Kuo^{*}, Z.-J. Jhang^{*}, K.-C. Chang^{*} HannStar Display, Taiwan ^{*}Tainwan TFT LCD Assn., Taiwan

In this paper, we used novel methods to measure and analyze the phenomenon of COG (chip-on-glass) mura aging. Results revealed that the JND profile of muras decayed day by day. In addition, a subjective experiment was conducted to find the human eyes' contrast threshold of curtain mura. Finally, our methods can be used to reduce testing time to validate the robustness of the display, and establish accelerated measuring techniques to find the corrosion failure.

VHFp - 9 An Objective Sharpness Evaluation Method for Edge-Enhanced Digital Halftone Images Using Cooperative Human Vision Model

T. Matsui, H. Shioda Gunma Univ., Japan

A new objective sharpness evaluation method independent of tonereproducing methods was already developed using a cooperative human vision model. This research focuses on clarifying that the proposed method can also be successfully applied to sharpness evaluation for edge-enhanced images. Consequently, the correlation coefficients between the objective and subjective evaluation values were over 0.97 irrespective of tone-reproducing methods. This result suggests that the proposed method is also effective in reproducing human subjective judgments on sharpness for edge-enhanced images.

VHFp - 10 New Metrics Based on Visual Perception for Evaluating Image Quality

S. Ueki, T. Taguchi, K. Nakamura, Y. Itoh, K. Okamoto Sharp, Japan

We propose a new evaluation metrics for any surrounding environments. We confirm the evaluation metrics can be applied to the image evaluation under large range of light conditions. In our subjective experiments, the metrics strongly related to the image quality under the outdoor condition (20,000lux) as well as in the room light (200lux). We could compare "Brightness" and "Brightness Sense's Contrast Ratio" of the images under some different light conditions by using the metrics.

VHFp - 11 Detection of Uneven Area Defects on LCD Display by Using Variable-sized Directional Filter

T. Hatada, F. Saitoh Gifu Univ., Japan

Uneven areas are typical defect of LCD display. For now, the experts inspect unevenness on LCD display by visual in manufacturing line because of its location and sizes are unpredictable in advance. This paper proposes a method of image processing. The special filter is used in this method for changing its direction and length to improve in the detectability of the contour of a defect. The experimental results showed that the major parts of contours of defects are detected effectively.

VHFp - 12 Composition of Multiple Exposed Images Based on Weights Setting by Genetic Algorithm

F. Saitoh, Y. Narumiya Gifu Univ., Japan

This paper proposes a method to generate a single image with superior gradations from multiple exposed images. The genetic algorithm is applied for setting weights of all exposed images. In the algorithm, an individual chromosome is represented by the array of real numbers for weights. The individual fitness is obtained from the entropy for gray levels in an output image. The experimental results showed that the method could generate images with smooth gradation and good contrast from multiple exposed images.

VHFp - 13 Contrast Improvement for Displayed Color Image Based on Color Difference

H. Hayashi, F. Saitoh Gifu Univ., Japan

This paper proposes a method to generate a color displayed image with superior contrast from an image with low contrast by software processing. In this method, the Look-up-table(LUT) is generated based on the color difference histogram. And LUT is applied for expanding brightness of low contrast color images. The experimental results showed that the method could generate a displayed color image that has natural and higher contrast visually than the conventional methods.

VHFp - 14 Image Contrast Enhancement Based on Differential Gray Level of Gradient Pixels Pair

F. Saitoh Gifu Univ., Japan

This paper proposes a method for image contrast by using distributions of gray levels and spatial features. For image contrast enhancement, expanding the differences of the gray levels in planes that locate on both sides of contours is supposed to be effective. The differences between the gray levels are treated as the weights. The experimental results showed that the proposed method could generate the good contrast images with less noises in comparison with the conventional methods.

VHFp - 15 Magnification Method for Displayed Image Based on Gradient Direction in Wide Pixels Area

K. Muto, F. Saitoh Gifu Univ., Japan

The magnification of an image is general purposed method for image processing. The typical conventional methods for image magnification are the bi-liner-interpolation and the cubic-convolution. These methods often generate a blurred and unclear image. We proposed a new magnification method by using the gradient information by pixel. And this paper proposes an improved magnification method by using the gauss function and the gradient information in wide pixels area. The experimental results show that the clear magnified images were generated.

VHFp - 16 Detection of Abnormal Conditions Based on Analysis of Cyclic Movement in Displayed Scene Images

Y. Terada, F. Saitoh Gifu Univ., Japan

This paper proposes a general-purposed method for automatic detection of abnormal conditions in displayed scene images using the periodicity of motion-images. FFT is a typical method for detecting wave cycle, but it isn't suited for speedy detection of the disorder. The proposed method can be expected to detect an abnormal condition in real-time. The experimental results showed that the correct detections of periodicity and immediate detections of abnormal conditions were realized in the general situations.

VHFp - 17 Withdrawn

VHFp - 18 Influences of Anti-Glare Surface Treatment on Legibility and Visual Fatigue of Reflective-Type Displays

S.-C. Jeng, Y.-R. Lin, C.-C. Liao, C.-H. Wen, P.-H. Lin^{*}, Y.-T. Lin^{*}, S.-L. Hwang^{*} ITRI, Taiwan ^{*}Nat. Tsing Hua Univ., Taiwan

Influences of anti-glare surface treatment, radius of curvature and ambient illuminance on legibility and visual fatigue of reflective-type displays were studied. The results showed that legibility and visual fatigue only depended on the surface treatment, and surface treatment can improve legibility and reduce visual fatigue especially in the intense ambient illumination.

VHFp - 19 Evaluation of Line Drawings on 3-D Appearance

M. Nagai, K. Shoji, J. Kawashima, F. Toyama, J. Miyamichi Utsunomiya Univ., Japan

We can perceive three-dimensional (3-D) objects from their twodimensional (2-D) line drawings in many cases. The reason why we can perceive only original 3-D shapes and their mirror version is considered that line drawings are usually produced at appropriate points of views for the 3-D objects. In this paper, we propose a method for evaluating 3-D appearance of line drawings that you produced as the illustrations of 3-D objects and confirm its availability by paired comparison method.

VHFp - 20 Layout Analysis of Scene Frames in Comic Images

T. Tanaka, K. Shoji, F. Toyama, J. Miyamichi Utsunomiya Univ., Japan

In this research, a detection method of scene frames in a comics image using density gradient is proposed. The proposed method can be applied to comics with speech balloons or pictures drawn over scene frames. Experimental results show that 60 percent of 672 pages in four print comic booklets are successfully divided into scene frames by the proposed method.

VHFp - 21 Vanishing Point Detection Using Line Segment Clustering by Area Minimization of Triangles

A. Sugawara, K. Shoji, F. Toyama, J. Miyamichi Utsunomiya Univ., Japan

In vanishing point detection, previous methods have a problem on precision because of the errors of voting the lines on the Gaussian sphere. We propose a novel method for vanishing point detection based on clustering of line segments. Each vanishing point is calculated by minimizing the area of triangles formed by the clustered segments and a point. The area can be considered as the cost of the clusters. The proposed method iterates the clustering and the evaluation of the clusters.

VHFp - 22 A Proposal for Generation of High Resolution Image using Image Shift

T. Hashimoto, T. Ikuma, H. Okamura, Y. Shimodaira Shizuoka Univ., Japan

We propose the generation method of the high resolution image using shifted images. Our method uses images that are taken with the small sub-pixel moving. In order to check the effectiveness of high resolution algorithm, we carried out the experiments. For the experimental convenience, shifting the target was used instead of shifting the image sensors. In this paper, the experimental results are discussed. As a result, estimating the gray level of each sub-pixel could be verified using image shift.

Thursday, December 7

9:00 - 10:2	20 Oh	mi 3
	VHF1: Human Factors	
Chair: Co-Chair:	H. Isono, Nippon Inst. of Tech., Japan H. Hiruma, NHK, Japan	
VHF1 - 1 9:00	Three-Dimensional Displacement of the Viewin Space of Secure Display by Use of Visual	g

Cryptography

H. Yamamoto, Y. Hayasaki Univ. of Tokushima, Japan

We propose a secure display technique that ensures the security of displayed information. The encrypted information is perceived when viewed within the limited viewing space. The purpose of this paper is to displace the viewing space of the decoded image by changing only the displayed image. We have analyzed the relationships between the viewing zone and the pitch and position of the displayed image. Furthermore, three-dimensional displacements of the viewing space have been demonstrated by use of two-layered liquid-crystal displays.

VHF1 - 2 Learning Saliency Estimation in the Video Based on 9:20 the Subjective Experiments

S. Nakagawa, N. Tsumura, T. Nakaguchi, Y. Miyake Chiba Univ., Japan

It is considered that the gazing area obtained by the eye tracking camera is the most important region of the image. From the analysis of the gazing area for various kinds of the images, gazing area is well correlated to the truncated region of color, density, and movement. In this paper, we propose a new method to extract saliency region automatically corresponding to the gazing area from the video image.

VHF1 - 3Suitable Reading Conditions for Human Reading9:40Habit

G.-C. Li, P.-J. Su, C.-H. Hsieh, K.-H. Chang, C.-C. Hsiao, S.-Y. Fuh, W.-Y. Cheng, Y.-C. Liao, J.-C. Yang, K.-L. Lo, D.-W. Li, Y.-P. Chang, Y.-A. Sha, J.-W., Shiu ITRI, Taiwan

By adjusting the setting of letters on the document, the suitable conditions for human had been obtained. The settings of the words are respective word size, word type, and polarity. By analyzing the result of recognition, comfort rating, searching time, and density of testing document, the suitable condition is found, the letters with Arial font, positive polarity, and large size were the elements for comfortable reading. From the effect of density on reading, the limitation of comfortable reading is investigated.

VHF1 - 4 A Usability Metric for Displays in Challenging 10:00 Environments

R. Sharpe, C. Cartwright, K. Wilson, S. Riches^{*}, H. Orr^{**}, C. Bailey^{***}, C. Yin^{***}, Y. Lee^{***} Univ. of Abertay Dundee, UK ^{*}Micro Circuit Eng., UK ^{**}Thin Film Solutions, UK ^{***}Univ. of Greenwich, UK

Display use in challenging environments is on the increase. A predictive method of quantifying display usability would be of great use to the display industry. We propose to develop a method using the Just Noticeable Difference (JND) method and a vision model developed by Barten. Our principle objective is to quantify a display and predict its usability for certain tasks in exacting ambient environments.

----- Break -----
10:40 - 12:05

Ohmi 3

VHF2: Color Reproduction

Chair: Y. Shimodaira, Shizuoka Univ., Japan Co-Chair: N. Hiruma, NHK, Japan

VHF2 - 1: Invited Recent Trend of Wide Gamut Standards for 10:40 Color Imaging

T. Matsumoto, T. Nakatsue, H. Eto, Y. Akiyama, S. Haga, M. Sakurai, Y. Shirochi, Y. Shimpuku Sony, Japan

xvYCC - a new wide gamut standard for video systems was standardized by IEC in January 2006. We have developed a new display / video camera and wide-gamut characterizing tools for xvYCC. The definition of xvYCC is the same as the standard for inside the conventional BT.709 gamut and maintains downward compatibility with currently-used video signals. Video systems adapting this standard will have improved accuracy of color reproduction of real world.

VHF2 - 2 Subjective Evaluation of Gamut Extension Methods 11:10 for Wide-Gamut Displays

R. Muijs, J. Laird, J. Kuang^{*}, S. Swinkels Philips Res. Europe, The Netherlands ^{*}Rochester Inst. of Tech., USA

With the rapid emergence of wide-gamut display technologies, there is a growing need for adequate color mapping algorithms with which EBUcompliant video can be extended to a wider reproduction gamut. To identify appropriate gamut extension strategies, we have designed several prototype algorithms and subjectively evaluated their performance. We observed a preference for a method that adaptively balances chroma with lightness modulations. This algorithm consistently outperformed accurate color reproduction within the EBU gamut, thus confirming the added value of wide-gamut displays.

VHF2 - 3 Visual Optical Model to Explain of Displayed Image 11:30 Visibility or Legibility Depending on Colors in Automotive Multicolor Emissive Display Systems

H. Miura, S. Okabayashi, T. Hatada^{*} Meijo Univ., Japan ^{*}Tokyo Polytech. Univ., Japan

This paper, we discussed in-vehicle emissive display systems under bright ambient light, have investigated phenomenon "Inequality Perception of Colors" of multicolor display systems, constructing a "Wash-out" simulator through this investigated we have the occurrence phenomenon and proposal perceptual cognitive model. Then we have promoted the guideline of in-vehicle multicolor display systems design under "Wash-out" phenomena.

VHF2 - 4L Simulation and Evaluation of Viewing Angle 11:50 Characteristics of LCDs based on Colorimetric Modeling Modeling

S. K. Jang, Y. H. Kim, B. T. Ryu, K. T. Kim, Q. S. Chen, J. O. Lee, J. Y. Yeom, C. W. Kim Inha Univ., Korea

This paper presents a colorimetric modeling technique for accurate simulation of LCD images with viewing angles. It generates simulated images of arbitrary viewing angles with limited measurements. It would simplify human visual experiments to evaluate the viewing angle characteristics of LCDs. Also, it can be employed for deriving quantitative measures to describe viewing angle properties of LCDs. Accuracy of simulation is improved compared to gamma modification method. Human visual experiments with the simulated and real images show similar trends.

----- Lunch -----

13:40 - 15:20

Ohmi 3

VHF3: Image Quality

Chair: S. Clippingdale, NHK, Japan

Co-Chair: H. Isono, Nippon Inst. of Tech., Japan

VHF3 - 1A Visualization Tool for Evaluating Angular-
Dependent Colorimetric Performance of LCD

J.-J. Lin, W.-C. Cheng Nat. Chiao Tung Univ., Taiwan

We have developed an interactive visualization tool that emulates the visual effect of an LCD when viewed at a specific angle such that the user can easily assess its colorimetric performance such as color shift, saturation degradation, and contrast/luminance reduction. The target LCD has to be characterized to generate its colorimetric parameters at different viewing angles. The proposed tool then calculates the resulting image by table-lookup and interpolation. This tool is particularly useful when evaluating multiple LCDs simultaneously or remotely.

VHF3 - 2 Physical Properties Influencing the Viewing Angle 14:00 Performance of Flat Displays

S. L. Qin, X. H. Zhu, H. C. Yin, J. Xia, C. Teunissen^{*}, I. Heynderickx^{**} Southeast Univ., China ^{*}Philips Consumer Elect., The Netherlands ^{**}Philips Res. Labs., The Netherlands

The viewing angle of a display is limited by its physical characteristics, which can be measured with appropriate measurement equipment. Display end-users determine which viewing angle is still acceptable, based on their internal reference. In this article, visibility and acceptability thresholds are determined for various displays types in a perceptual experiment, and the displays are physically characterized for a wide range of viewing angles. Differences in threshold viewing angles are explained by physical properties of the display technologies.

VHF3 - 3 CIECAM02 Based Practical Visual Evaluation Method 14:20 for Viewing Angle Characteristics of LCDs Using Hardcopy

Y. Mitsumori, M. Yamada, K. Miyazaki Fuji Film, Japan

We have developed a practical method for evaluating viewing angle characteristics by reproducing each viewing angle image on hardcopy through CIECAM02 model where adaptation effects to the environment are included. The method considering visual adaptation enables to evaluate LCD appearance depending on the way of observation and the viewing conditions.

VHF3 - 4Effect of Backlight Complexity on Perceived Image14:40Quality for HDR Displays

S. Swinkels, R. Muijs, E. Langendijk, F. Vossen Philips Res. Labs., The Netherlands

We evaluated the added value of a segmented dimmable backlight on perceived image quality by means of a subjective experiment. The complexity of the segmented backlight was varied by changing the number of segments and the width of the LED light profiles. The results obtained show that the contrast improvement achieved by backlight dimming is highly preferred over systems without backlight modulation, even when the backlight is only dimmed globally or over a few spatial segments. Furthermore, the image quality increases gradually with the number of segments and then saturates for more than 2000 LEDs.

VHF3 - 5 Gradient Based Synthesized Edge Image Using 15:00 Multiple Exposure Images

A. Rövid, T. Hashimoto, Y. Shimodaira, A. R. Várkonyi-Kóczy^{*} Shizuoka Univ., Japan ^{*}BUTE, Hungary

High dynamic range of illumination may cause serious distortions and other problems in viewing and further processing of digital images. In this paper a new tone reproduction preprocessing algorithm is introduced which may help in developing hardly or non-viewable features and content of the images making easier the further processing of them.

----- Break -----

15:40 - 1	17:00	Ohmi 3
	VHF4: Moving Image Quality (1)	
Chair:	T. Kurita, NHK, Japan	

Co-Chair: T. Tamura, Tokyo Polytech. Univ., Japan

VHF4 - 1Comparison of Methods for Reducing Motion15:40Artifacts in LCD TV

P. Cirkel, P. Vereyken Philips Consumer Elect., Belgium

In this paper the following methods for reducing motion artifacts: Scanning/Blinking backlight, Black data insertion and Double frame rate driving, are compared. This is done by measuring the blur edge time on LCD displays. It appears that a large part of the motion artifact is related to the non-idealities in applying the method rather than the method itself. Moreover in displays were the sample and hold artifact is tackled; ghost images are more distinguishing than the residual blur.

VHF4 - 2 Perceived Motion Blur in LCD Displays 16:00

C. Teunissen, X. Li^{*}, Y. Zhang^{*} Philips Consumer Elect., The Netherlands ^{*}Southeast Univ. China

Several methods to improve the motion performance of LCD displays, such as overdrive and scanning backlight, have been introduced. Different measurement systems have been developed to quantify these improvements. Most systems characterize perceived motion blur with physical characterization only. In this article, measured temporal step responses are used to characterize the perceived motion blur, and model predictions are validated with a perception experiment.

VHF4 - 3 Reduced Flicker Visibility in Impulse Type Displays 16:20 When Rendering Video Sequences

Y. Tu, L. Wang, K. Teunissen^{*}, I. Heynderickx^{**}, C. Li^{**} Southeast Univ., China ^{*}Philips Consumer Elect., The Netherlands ^{**}Philips Res. Labs., The Netherlands

Impulse type backlight driving reduces motion blur, caused by the sample-and-hold effect of LCD displays. A side effect is that large-area flicker will be introduced as in CRTs. The flicker visibility for various settings of a scanning backlight system and with different 60 Hz video fragments is studied in a perception experiment. Results show that the perceived flicker is considerably reduced for a moving sequence, compared to a still image with the same content.

VHF4 - 4 Brightness Enhancement of Advanced Over-Drive 16:40 Technology (AOT)

A. Chao, C. H. Yu, C. Lee, C. C. Chen, F. T. Pai, T. S. Jen HannStar Display, Taiwan

We ever proposed and simulated an advanced over-drive technology (AOT) to improve the moving picture response time (MPRT) on TN type TFT-LCD. However, the brightness sacrifice make the BL cost increased. In order to reduce the brightness sacrifice, we developed and realized a modified AOT by (1) adopting gray data resetting (GDR) function, and (2) incorporating the fastest 3ms LCD cell. In consequence, the brightness can increase up to 20 % compared to our previous system.

----- Break -----

17:20 - 18:35 Ohn	
	VHF5: Moving Image Quality (2)
Chair: Co-Chair:	J. Bergquist, Nokia Japan, Japan T. Kurita, NHK, Japan
VHF5 - 1 17:20	Improvement and Evaluation Methods for Motion Color Blurring by Using Pursuit Camera
	Y. Enami [*] , K. Oka ^{**} [*] Otsuka Elect., Japan ^{**} Nanosoftware, Japan

Motion color blurring is significant problem on flat panel displays. We have proposed index of motion color blurring evaluation namely CBA (Color Blur Area) in IDW '05. In this study, we approach improvement on motion color blurring of PDP-TV and DLP-projector. We evaluate improvement effects of the motion color blurring by using CBA. We confirm that CBA is an effective tool.

VHF5 - 2 Subjective Evaluation Based on Analysis of 17:40 Correlation between Physical Properties and Visualization of Various Motion Blurs on LCDs

Y. Hisatake, H. Ito, Y. Kawata, A. Murayama Toshiba Matsushita Display Tech., Japan

We analyzed the correlation between three kinds of visualization of the motion blur (colour of blurs, luminance of the blur and sharpness of object images) and physical properties in regard to image properties and panel characteristics. We also performed subjective evaluations to specify optimal or allowable level of motion blurring with various images in one CRT display and four types of LCDs with various characteristics.

VHF5 - 3 On the Complexity of Motion Fidelity Metrics 18:00

S. Sluyterman, M. Klompenhouwer^{*} Philips Lighting, The Netherlands ^{*}Philips Res. Labs., The Netherlands

The present method of characterizing the motion fidelity by just looking at the timing of the10% and 90% values of a luminance transient is not sufficient. A number of improvements in motion fidelity are not honored by this metric. A few directions for a new metric for motion blur will be given.

VHF5 - 4LMotion Artifact Comparison of PDP and MBR LCD:18:20World's Best MPRT LCD

K. D. Kim, J. K. Yoon, M. Lim, H. H. Shin, I. J. Chung LG.Philips LCD, Korea

The MBR LCD, the world's best MPRT LCD is reported for the first time. Moving image quality has bothered LCD TVs constantly, compared with PDP and CRT TVs. However, the MBR LCD cleared almost the last weakness of LCD TVs in image quality as we obtained 4.6 ms MPRT. Moreover, by means of visual perception test, we revealed it is superior to a PDP in moving image resolution by about 50%.

Author Interviews 18:40 – 19:40

Supporting Organizations:

Technical Group on Information Display, ITE

Workshop on Projection and Large-Area Displays, and Their Components

Thursday, December 7

9:00 - 12:00 Ohmi 5-	
Poster	LADp: Components and circuits for projector
LADn - 1	Low Power Frame Buffer Divel Circuits for LCOS

LADp - 1 Low Power Frame Buffer Pixel Circuits for LCOS Microdisplays

Y. Song, Z. Ling Changchun Inst. of Optics, Chinese Ac. of Sci., China

In the frame buffer pixel circuits, extra power was dissipated to implement the data transfer operation. Extra power dissipation can not only increase power but also decrease the device reliability. One method to deal with it at pixel level is needed. In this novel pixel circuit, one PMOS transistor acts as a simple analog comparator, in order to determine whether the discharging by comparing the current pixel voltage and the next frame data voltage.

LADp - 2 Projection Lens Design for LED Based Mini Projector

C. R. Ou, K. L. Huang, C.-M. Ou^{*}, C. S. Chen^{**}, C. Y. Kung^{***} Hsiuping Inst. of Tech., Taiwan ^{*}Kainan Univ., Taiwan ^{**}Nat. Kaohsiung Univ. of Applied Sci., Taiwan ^{***}Nat. Chung Hsing Univ., Taiwan

Mini projection devices are getting many attentions for the past few years. Several kinds of excellent approaches have been proposed. This article will discuss some designing issues for the mini projection lens.

9:00 - 10:20 C		imi 8
	LAD1: Projection Components	
Chair: Co-Chair:	H. Moench, Philips Res. Labs., Germany K. Ohara, Texas Instrs., Japan	
LAD1 - 1 9:00	Rear Projection Screen with Improved Wider Ve Viewing Angle	ertical

M. Kimura, T. Kashiwagi, Y. Fukano Dai Nippon Printing, Japan

A new rear projection screen with wider vertical viewing angle has been developed. This screen consists of crossed total-reflection prisms that has a wider vertical viewing angle. The advantages of this screen are not only wider vertical viewing angle, but also higher uniformity, improved black level, and reduced ghost images. The rear-projection TV used this screen can be competitive with other large screen size TVs.

LAD1 - 2 High Contrast Screen for a Front Projection System 9:20

M. Ehashi, T. Fujiwara, A. Kagotani, S. Iwata, K. Moronaga, S. Takahashi Toppan Printing, Japan

Conventional front projection systems have the drawback of a inferior contrast under an ambient light. To avoid this drawback, we made screen design suitable for a projector with selected characteristics for the diffusion and reflection layer. As a result, we could get a better contrast screen than existing screens. The image quality by the new developed front projection screen was less affected.

LAD1 - 5L Micro-Projectors for Virtual Interfaces 9:40

K. Lieberman, Y. Sharon, E. Naimi Lumio, Israel

Static and quasi-dynamic micro-projector modules for virtual interfaces are presented. These miniature modules, which can measure as small as 6mm in diameter can project large images at short throws lengths and strongly oblique angles. Highly efficient diffractive modules suitable for embedding in mobile devices are described. Design considerations and applications for small, quasi-dynamic LED based projectors for a variety of virtual interface geometries are also presented.

LAD1 - 4 Three-Dimensional Simulation of VAN LC 10:00 Configurations for Advanced LCOS Display Panels

D. Cuypers, H. De Smet^{*}, A. Van Calster^{*} IMEC vzw, Belgium ^{*}Ghent Univ., Belgium

LCOS VAN microdisplays are rapidly evolving to be the devices of choice for high-end projection applications. With the advent of very high pixel count devices such as the so-called 8Mpixel displays, it becomes worthwhile to explore the characteristics of the fringe fields and their consequences in such devices in more detail. This paper describes the implementation and application of a three-dimensional simulator that enables us to maximise the optical performance of upcoming 8Mpixel microdisplays by tuning the liquid crystal parameters.

----- Break -----

14:00 - 1	5:30	Ohmi 1
	LAD2: Emerging Illumination	
	L Kausslaami Talaas kasta (Tasha Jaman	

Chair:I. Kawakami, Tokyo Inst. of Tech., JapanCo-Chair:S. Shikama, Mitsubishi Elec., Japan

LAD2 - 1: *Invited* Photonic Crystals - For nano-photonics to 14:00 Display -

> S. Noda, T. Asano, M. Fujita Kyoto Univ., Japan

Photonic crystals, in which the refractive index changes periodically, provide an exciting new tool for the control of light and have received a keen interest from a variety of fields. In this presentation, I will review the recent progress in photonic crys-tals aiming at the applications for nanophotonics to displays.

LAD2 - 2: Invited Trends in Laser Light Sources for Projection 14:25 Display

A. Mooradian, G. Niven Novalux, USA

New laser-based light sources are highly desired for projection displays because of the need for longer lifetime, lower etendue, and higher color gamut. High power, frequency doubled red, green and blue (RGB) surface emitting diode laser arrays have been developed for use in low cost projection microdisplay televisions.

14:50

LAD2 - 3 Personal Projection UJoy

H. Moench, U. Mackens, P. Pekarski, A. Ritz, G. S'Heeren^{*}, W. Verbeek^{*} Philips Res. Labs., Germany ^{*}Philips Lighting, Belgium

Personal projectors are compact and affordable devices used for gaming, entertainment or photo projection. The new 50W Ujoy lamp system enables efficient projection systems with a screen brightness of 200-300lm, combined with an excellent colour performance. Lower cooling requirements, the potential for battery operation and the low voltage input makes it the ideal source for this new category of projectors.

LAD2 - 4 Development of High Efficiency Collection Optics for 15:10 Lamp-Based Projectors

M. Kuwata, H. Takeuchi, T. Sasagawa, S. Okamori, H. Sugiura Mitsubishi Elec., Japan

We have developed high-efficiency collection optics for improving the light use efficiency of lamp sources. The optics, equipped with an aspheric reflector and a front glass, are able to effectively couple light from the light source by controlling the image size of lamp arc on the collecting surface appropriately for each direction of radiation. In the present prototype, luminance at the screen center is improved by 10% of the conventional.

----- Break -----

15:40 - 17	7:00	Ohmi 1
	LAD3: Digital Cinema & Home Theater	
Chair: Co-Chair:	G. Niven, Novalux, USA T. Hayashi, 3M Asia Pacific, Japan	
LAD3 - 1:	Invited Digital Cinema Ready for Full Deploy	yment

15:40 C. Colpaert Barco Media & Entertainment, Belgium

This article will elaborate on the DLP Cinema technology and compare it with other light valve technologies. Further, the importance of the DCI specification for the digital cinema industry will be explained. Next Barco's digital cinema product portfolio is reviewed. And finally the business model (based on virtual print fee) will be discussed.

LAD3 - 2: Invited Outlook of Color Space Management 16:05 Evaluation Material of Digital Cinema

I. Kawakami Tokyo Inst. of Tech., Japan

The mastering monitor of CRT that become the standard of the image evaluation being start disappearing from the market soon become a big problem on the site of the image production digital. As for this color space management evaluation material "CoSME", non-compression data 1920*1080,10bits,RGB 4:4:4 when various data that relates to the color reproduction.

LAD3 - 3 YC-Separation Type Projector with Double 16:30 Modulation

Y. Kusakabe, M. Kanazawa, Y. Nojiri, M. Furuya^{*}, M. Yoshimura^{*} NHK, Japan ^{*}Victor, Japan

We propose a "YC-separation type projector" that features double modulation to obtain high resolution and high dynamic range images. While a conventional projector contains three modulators for red, green and blue and outputs light after combining these modulated lights, our projector has another modulator for luminance to modulate the combined RGB modulated light. An experimental projector was developed for which the resolution was 3840 \times 2160 pixels and we confirmed the projector had a high dynamic of 1.1-million to 1.

LAD3 - 4 Efficient Method of LED Light Recycling for 16:45 Increased Brightness for Projection Display Applications

L. Kenneth, S. Inatsugu Wavien, USA

The Wavien's LED light recycling system allows partial light coupling to the output and the balance of the light back into the LED chip for efficient recycling of light, thus increase the brightness of the LED light source. The recycling can be categorized into spatial recycling, angular recycling, and combined spatial and angular recycling. Theoretical analyses are described here. Experiments are being conducted and the results will be presented.

Author Interviews

17:00 - 18:00

Supporting Organizations:

Technical Group on Information Display, ITE

Technical Committee on Electronic Information Displays, Electronics Society, IEICE

Optop-electronic Materials and Devices Study Specialty Section, IEIJ Liquid Crystal Display Forum, JLCS

Workshop on Electronic Paper

Wednesday, December 6

13:20-14:45 Ohr	
	EP1: Electronic Paper (1)
Chair: Co-Chair:	G. Zhou, Philips Res, The Netherlands A. Suzuki, Ricoh, Japan
EP1 - 1: 13:20	Invited Electronic Paper: It's all about flexibility A. Ancin, A. Henzen, J. van de Kamer, P. Leurs, P. Janssen, G. Zhou [*]

P. Janssen, G. Zhou iRex Techs., The Netherlands *Philips Res. Labs., The Netherlands

It is argued that many forms of flexibility are required to make e-paper the real replacement of paper. Access must be faster and easier, content providers must join to provide documents that are tailor-made for every e-reader on the market or better still make content adapt to its surroundings; reading devices have to become as shock-resistant and writable as paper, without the user realizing he is handling an electronic device. All of this is about to happen.

EP1 - 2: Invited Advances in Microencapsulated 13:45 Electrophoretic Ink for Flexible Electronic Paper Displays

M. D. McCreary E Ink, USA

No abstract was submitted.

EP1 - 3Motion Picture Driven by Active-Matrix Bistable14:10Cholesteric LCD

C.-C. Lu, P.-L. Liu, T.-A. Chen, H.-L. Wang, C.-Y. Chang, B.-C. Chen, W.-T. Hsu, C.-C. Liao, L.-C. Chien ITRI, Taiwan

Fast driving by active-matrix device makes bi-stable cholesteric liquid crystal display (Ch-LCD) behave motion picture. A-Si TFT as the switch device fabricated on the glass forms a 320 \times 240 pixels array. The cell processing VA alignment on one side fills with cholesteric LC. Sub-frame fast driving scheme is used to operate transitions in multiple phases. The demonstrated performance is up to 20Hz of video rate.

EP1 - 4LA Novel Display Structure for Color Electronic Paper14:30Driven with Fully Transparent Amorphous Oxide TFT
Array

M. Ito, M. Kon, M. Ishizaki, C. Miyazaki, K. Imayoshi, M. Tamakoshi, Y. Ugajin, N. Sekine Toppan Printing, Japan

We demonstrate a novel display structure for a color electronic paper for the first time. Fully transparent amorphous oxide TFT array is directly deposited on color filter array and combined with E Ink Imaging Film. Taking advantage of the transparency of the oxide TFT, the color filter and TFT array are positioned at the viewing side of the display. This novel display structure facilitates the alignment of the color filter and TFT remarkably.

----- Break -----

15:00-16	6:15	Ohmi 9
	EP2: Electronic Paper (2)	
Chair:	M Omodani Tokai Univ Japan	

Co-Chair: S. Maeda, Oji Paper, Japan

EP2 - 1: Invited Electronic Paper Based on Particle Movement 15:00 - Electrophoretic and Toner Display

T. Kitamura Chiba Univ., Japan

With the increasing importance of reading electronic documents, expectations are high that a new electronic paper can be developed that is as convenient as conventional hard-copy paper and enables access to digital information. At present, a great deal of fundamental and applied research is being carried out on various methods of producing electronic paper, including microcapsule-type electrophoretic displays and toner displays based on the movement of fine particles.

EP2 - 2 Withdrawn 15:25

EP2 - 3LOptimized Ratio of Two Dyes in Decolorable Toner15:45for Coloring Density, Erasability and Lightfastness

S. Takayama, T. Gotanda, Y. Sekiguchi, K. Sano Toshiba, Japan

The indolyl phthalide dye has high coloring ability and good lightfastness for decolorable toner. In contrast, CVL, crystal violet lacton, has the good erasability. However, it has a problem concerning lightfastness. The optimum ratio of the two dyes for high coloring ability and good erasability without deterioration of lightfastness has been determined to be from 7 to 18 % of CVL in the case of a mixture of the two dyes.

EP2 - 4L All-Solid-State Complementary Coloring 16:00 Electrochromic Windows Based on Viologens

Y. Kim, Y. Kim^{*}, S. Yang^{**}, Y. Kim, E. Kim Yonsei Univ., Korea ^{*}Dongguk Univ., Korea ^{**}Polychrom, Korea

All-solid-state electrochromic windows based on Viologen which has blue color transition were assembled with photo polymerizable electrolyte. Higher and faster electrochromic effect was observed in an ECD with a complementary structure, in which the anode and cathode were coated by poly(aniline-N-butylsulfonate)s and viologen layer, respectively. An all solid state EC display based on an optimized condition showed EC response at -1.8V within 5s.

Author Interviews

18:00 - 19:00

Thursday, December 7

0.00-12.00		Ohmi 5-7
9.00-12.00		011111 5-7
	Poster EPp: Electronic Paper	
EPp - 1	Flow of LC and Migration of Fine Partie Fine Particle Display (MFPD) Cells	cle in Mobile

K. Shimoyama, T. Takahashi, S. Saito, Y. Toko^{*} Kogakuin Univ., Japan ^{*}Stanley Elec., Japan

In our previous paper, we proposed a novel type of electrophoretic display named as an MFPD in which a nematic liquid crystal is used as a solvent for fine particles. In this report, a model for the mechanism of migration of particles in the MFPD cell is proposed. A theoretical expression for the velocity of fine particles is derived. Furthermore, a new type of MFPD cell with layered structure is proposed to improve the contrast ratio of MFPDs.

EPp - 2 Single-Substrate Microencapsulated LCD

S.-H. Liu, W.-H. Chao, K.-L. Cheng, Y.-Y. Hsu ITRI, Taiwan

A mixture of high order parameter dichroic dyes for guest-host liquid crystals has been employed to be the substitute of polarizers. The novel process for reflective mode is created by spattering the metals as a reflector as well as electrode simultaneously. The single-substrate approach by reducing one ITO/PET is responsible to enhance reflectivity and flexibility of the display.

EPp - 3 Inkjet Printed Multicolor Cholesteric LCD

J.-M. Ding, Y.-R. Lin, C.-H. Chen, R.-D. Chen, C.-Y. Lin, H.-L. Wang, C.-C. Lu, C.-C. Liao, W.-H. Hou ITRI, Taiwan

This report represents the manufacturing process for flexible multicolor cholesteric liquid crystal displays with the help of inkjet printing technology. The chiral materials are jetted into the pixel areas with designed patterns. The cholesteric liquid crystal gels are adopted as the display medium. After forming various functional layers on the cholesteric liquid crystal gel filled microcell, we realize a segment type flexible, bistable, multi-color reflective display with single display medium layer.

EPp - 4 Multicolor Cholesteric LCD using an Inkjet Printing System

H. M. Tsai, Y. C. Liao, F. K. Chen, J. P. Lu, K. L. Luo, Y. P. Chang, K. Cheng, Y. Z. Lee ITRI, Taiwan

The ink-jet printing phenomena of three cholesteric liquid crystals with different reflective wavelength were investigated. Due to high viscosity of ChLC in room temperature, we heated the viscous inks to be printable. The behavior of jetting droplets is determined by driving voltage and waveform on print heads. The suitable IJP temperature and driving voltage are 80°C and 100V irrespective of little viscosity difference among three ChLCs. Based on the results, we fabricated the multicolor ChLC display by inkjet printing technology.

EPp - 5L Preparation of Polymer Particle and Its Electrophoretic Properties

S. Watanabe, S. Nakamura, N. Miyagawa, T. Kitamura Chiba Univ., Japan

Polymer particles for an electrophoretic image display (EPID) were prepared by dry in liquid method. Emulsion including styrene-acryl copolymer and solvent in water is dried up for long time. The electronic charge and drift mobility of electrophoretic particle were calculated by the measurement of electrophoretic induced current.

Thursday

EPp - 6L Late-News Paper Enhanced mobility of New Thieno [3,2] Thienophen Oligomer TFTs with Al₂O₃ Gate Dielectrics

L.-M. Do, K.-H. Baek, K.-C. Song^{*}, S. J. Yun, Y.-S. Yang, E. H. Lim^{**}, H.-K. Shim^{**} ETRI, Korea ^{*}Univ. of Chungnam, Korea ^{**}KAIST, Korea

The organic thin field-effect transistor (OTFT) with new 2,5-bis-(50-hexyl-[2,20]bithiophenyl-5-yl)-thieno[3, 2-b] thiophene (T2TT) were examined with various gate dielectrics. The mobility of T2TT semiconductior material strongly depends on interface and insulator properties. The Al_2O_3 gate insulator which prepared low temperature plasma enhanced atomic layer deposition (PEALD) method is better performance than silicon oxide insulator.

Supporting Organization:

The Imaging Society of Japan

Outstanding Poster Paper Awards Ceremony

Friday, December 8

See page 9 for details

Euro Display '07

September 17–20, 2007 Moscow, Russia

Workshop on MEMS for Future Displays and Related Electron Devices

Thursday, December 7

9:00 - 9:05

Ohmi 10

Opening

Opening Remarks 9:00

M. Nakamoto, Shizuoka Univ., Japan

9:05	- 10:35	

Ohmi 10

MEMS1: Emerging MEMS Technologies

Chair: D. Pribat, Ecole PolyTech., France Co-Chair: J. Agostinell, Eastman Kodak, USA

MEMS1 - 1: *Invited* Recent Technological Trend and Application 9:05 of MEMS

H. Fujita Univ. of Tokyo, Japan

MEMS fabrication technology of silicon and related materials in micrometer scale has matured. Three dimensional micro structures and movable devices were made and successfully operated. Three trends are emerging: (1) Integration of MEMS with electronic and optic elements. (2) Large area MEMS by printing or embossing. (3) Utilization of nano and bio materials in MEMS. MEMS application has also expanded to IT apparatus including display and cellular phone, bio chemical chips, and nano technology tools.

MEMS1 - 2: Invited Complexity of MEMS and Multi-Scale Systems 9:30 S.-G. Kim. M. K. Koo^{*}

S.-G. Kim, M. K. Koo MIT, USA ^{*}MEMS Solution, Korea

Tiny products must be designed in a systems context. Design and manufacture of MEMS products would be much more successful if they were designed systematically. Multi-scale systems require an integration of components at nano-, micro- to macro-scales, where complexity increases rapidly as the scale order grows. Manufacturing them will be a much harder challenge than that of MEMS, if not designed systematically. An industrial case of a MEMS projection display development is presented, and will be generalized to multi-scale systems.

MEMS1 - 3 Nanometer- Order Controlled Transfer Mold 9:55 Fabrication Method for Nanostructure Emitters and Devices

M. Nakamoto, G. Sato, K. Shiratori, T. Hayashi, Y. Hanawa, K. Ono Shizuoka Univ., Japan

Transfer Mold fabrication method has been developed to fulfill the requirements of the emitter tip sharpening, the emitter material selection, uniformity and reproducibility. The tip sharpness of less than 10nm (1-5nm) radius, the good uniformity and the low work function material usage are obtained. The Transfer Mold fabrication technique has been one of the best technique of getting and controlling the nanometer order device structures as well as FEA structures.

MEMS1 - 4 Improvement of Luminance Efficiency by AC Mode 10:15 Drive for Large Size CNT-BLU

Y.-C. Jiang, T.-H. Tsou, B.-N. Lin, L.-E. Chou, C.-H. Fu, M.-C. Hsiao, Y.-Y. Chang, W.-Y. Lin, M.-H. Lin, C.-C. Liang, C.-N. Huang, C.-C. Lee ITRI, Taiwan

The luminance efficiency of large size carbon nanotubes backlight unit (CNT-BLU) has been improved by combining frequency and pulse modulation. The frequency modulation well utilize the persistence of the phosphor and has better efficiency than before. In current status, its properties can reach to 85% of uniformity, 8000nits of brightness. Besides, our novel structure design and low cost manufacturing method makes mass production possible in the near future.

----- Break -----

 10:45 - 13:05
 Ohmi 10

 MEMS2: Optical MEMS and Sensors

Chair: S. Kim, MIT, USA Co-Chair: Y. Haga, Tohoku Univ., Japan

MEMS2 - 1: *Invited* Review of MEMS and MOEMS Developed at 10:45 LETI-MINATEC

S. Fanget, P. Robert CEA-LETI-Grenoble, France

Three different devices developed at CEA-LETI within the framework of MOEMS thematic are presented in this paper. We focus at first on two kinds of deformable mirrors (DM) with continuous mirror. These two devices have been realized for optical data storage and astrophysics applications. Afterwards, an optical scanner expendable for a large number of applications will be presented. Technological processes used for their realization and their optical properties will be described.

MEMS2 - 2 Reduction in the Breakdown Voltage of a Rare Gas 11:10 Discharge Plasma by High-Energy Electrons Emitted from a Nanocrystalline Poly-Silicon Ballistic Emitter

T. Ichihara, T. Hatai, K. Aizawa, T. Komoda, N. Koshida^{*} Matsushita Elec. Works, Japan ^{*}Tokyo Univ. of A&T. Japan

Ignition characteristics of a xenon gas discharge have been improved by providing high-energy ballistic electrons as seed electrons. A nanocrystalline poly-silicon cold cathode is used as a ballistic electron source. The dc breakdown voltage for the mercury-free xenon discharge is efficiently reduced compared to a conventional filamenttype hot cathode at the same emission current.

MEMS2 - 3 Through-Hole Interconnection in Si Substrate for 11:30 Wafer Level Package

M. Kamakura, H. Shiroishi, T. Taura, R. Tomoida, T. Saijo, K. Tone and K. Kataoka Matsushita Elec. Works, Japan

The demand for downsizing of devices built in electronic products becomes stronger. These days, Wafer level packaging (WLP) technology is important method to realize drastic downsizing of MEMS devices, in which electric interconnection through package wafer is needed. We developed through-hole interconnection technology which includes through-hole formation by D-RIE and filling conductive material into through-hole by electroplating. In this paper, we report our through-hole interconnections.

MEMS2 - 4 A High-Performance Miniature Microphone with a 11:50 Monocrystalline Silicon Diaphragm

Y. Iguchi, M. Goto, K. Ono, T. Sugimoto, A. Ando, T. Kurita, T. Tajima, F. Takeshi^{*}, T. Himori^{*}, Y. Yasuno^{*} NHK, Japan ^{*}Panasonic SC Device Solutions, Japan

This paper describes a micromachined condenser silicon microphone with a thin monocrystalline silicon diaphragm and a wide air gap. The transducer (the sensing element of a microphone) is fabricated as one body with a simple process using a bonded silicon wafer, which promises outstanding durability and high productivity. Measured sensitivity is comparable to the sensitivity of a conventional broadcasting microphone. The low noise and small distortion of the microphone ensure a sufficiently wide dynamic range for practical use.

MEMS2 - 5Hermetically Sealed Ultra-Miniature Fiber Optic12:10Pressure Sensor

S. Nakamura, T. Matsunaga, K. Totsu, W. Makishi, M. Esashi, Y. Haga Tohoku Univ., Japan

Ultra-Miniature fiber optic sensor of 125 μ m diameter has been developed by using MEMS fabrication techniques. The Fabry-Perot cavity is formed at the end of an optical fiber. The pressure induced deformation of the Fabry-Perot cavity diaphragm alters the cavity length. Fabricated sensor structures exhibited temperature dependency. To solve this problem, hermetic sealing using a thin-film solder bonding and Cr thin-film deposition on the sidewall of the sensor have been tried.

MEMS2 - 6 Fabrication of Field Emission Arrays with Hafnium 12:30 Nitride Cathode

Y. Gotoh, N. Setojima, T. Kanzawa, H. Tsuji, J. Ishikawa Kyoto Univ., Japan

Fabrication of field emission arrays with hafnium nitride cathode is demonstrated by using microfabrication technique. A silicon substrate was etched to form an array of silicon cones, followed by deposition of hafnium nitride thin film by rf magnetron sputtering. After the above process was over, an insulating layer made of silicon dioxide and a gate layer made of niobium were deposited. Using the etching back technique, gate apertures were made. The fabricated device showed a relatively good field emission performance.

MEMS2 - 7L 3-Dimensional Microfabrication of 12:50 Polytetrafluoroethylene by Using Synchrotron Radiation Radiation

M. Horade, M. Tsudo, S. Khumpuang, S. Sugiyama Ritsumeikan Univ., Japan

Microfabrication technique using SR ablation for 3D-PTFE structure is reported in this work. We have investigated a technique to form an arbitrary shape of microstructure. The technique so called PCT is wellknown in fabricating only PMMA microstructure. Since PTFE shows better material characteristic than that of PMMA, the fabrication of PTFE by PCT has been initialized. PTFE microstructures with a sloped side-wall were fabricated by SR ablation controlled by a study of exposed energy distribution to the surface of PTFE.

----- Lunch -----

14:00 - 15:30

Ohmi 10

MEMS3: Fundamental Mechanism, Materials and Process Technologies

Chair: S. Fanget, CEA-LETI-Grenoble, France Co-Chair: H. Fujita, Univ. of Tokyo, Japan

MEMS3 - 1: *Invited* Microgrippers for Biological Applications 14:00

J. K. Luo, W. I. Milne, Y. Q. Fu, A. J. Flewitt, S. M. Spearing^{*} Univ. of Cambridge, UK ^{*}Univ. of Southampton, UK

There is a continuing need to select biological cells from infected tissues for single cell proteomics and genetic research, for microinjection in drug discovery etc. All of these rely on miniaturized microgrippers. We have developed two types of microgrippers. Planar microtweezers were made from a 4μ m thick electroplated Ni, using an in-plane electrothermal actuation mechanism, while the normally closed microcages consist of a polymer/Al/diamond like carbon trilayer structure. Both of these demonstrated the capability of capturing a micro-object.

MEMS3 - 2: *Invited* Nanotechnologies in Displays: the Use of 14:25 Carbon Nanotubes and Semiconductor Nanowires

D. Pribat Ecole PolyTech., France

Devices made from individual carbon nanotubes or semiconductor nanowires are known to exhibit impressive electronic properties. However, they cannot be organised in a way compatible with large scale manufacturing. In this talk, we will review some recent advances in the use of these materials, from random networks of carbon nanotubes to the development of templates for the organised growth of semiconductor nanowires.

MEMS3 - 3 Withdrawn 14:50

MEMS3 - 4 Characteristics of Near-Infrared and Visible 15:10 Femtosecond Laser Processing for Semiconductor

Y. Izawa, S. Tokita, M. Fujita^{*}, M. Hashida^{**} and Y. Izawa Osaka Univ., Japan ^{*}Inst. for Laser Tech., Japan ^{**}Kvoto Univ., Japan

The characteristics of femtosecond laser processing for silicon are reported in this paper. Below the fluence for ablation threshold, femtosecond laser irradiation induced an amorphization of crystalline Si (c-Si). Little above the fluence for the ablation threshold, non-thermal ablation occurred. Processed areas had a negligible heat-affected zone (HAZ). The thickness of the amorphoized layer and the depth of the ablated area were related to the effective light penetration depth.

MEMS3 - 5L Performance of Flexible SR-exposure Stages for 14:50 Multiple Purposes in Micro/Nanofabrication

F. Kato, S. Fujinawa, S. Sugiyama Ritsumeikan Univ.

In SR lithography, a key factor for high precision in fabrication of 3D micro/nanostructures is the performance of SR exposure stage. We have developed a flexible stage for multiple purposes of SR exposure including stepper exposure, and PCT exposure. In this work, the specification, installation and current status of using the multi-functional stage with beamline-5 of AURORA storage ring at Ritsumeikan University is introduced. The performance of the stage was observed at 150nm resolution which is applicable for nanomachining process.

----- Break -----

15:40 - 17	:10	Ohmi 10
	MEMS4: Displays and Imaging (1)	
Chair: Co-Chair:	J. Luo, Univ. of Cambridge, UK M. Nakamoto, Shizuoka Univ., Japan	

MEMS4 - 1: *Invited* GEMS: A Simple Light Modulator for High 15:40 Performance Laser Projection Display

J. Agostinelli, M. W. Kowarz, D. Stauffer, T. Madden, J. G. Phalen Eastman Kodak, USA

GEMS (grating electro-mechanical system), a digital MEMS-based linear light modulator array, will be described. Implementation of the GEMS device in a 1080p laser front-projection display demonstration system will be discussed. The very high native bit depth and resolution, extremely fast line time (no motion blur), together with the use of spectral primaries and absence of visible pixel boundaries, result in a display with superb image quality, even for still images. Preferred methods for calibration and color transformation will be disclosed.

MEMS4 - 2: *Invited* Toward an iMoD[™] Ecosystem 16:05 *M. Miles*

QUALCOMM MEMS Tech., USA

iMoD[™] technology is the basis for a MEMS display that exploits optical interference. QUALCOMM MEMS Technologies (QMT) is engaged in a multi-front effort to commercialize iMoD displays. This presentation will review the history of iMoD technology development to date, and discuss QMT's strategy, philosophy and transformation as it addresses the array of issues it must face to succeed.

MEMS4 - 3 A PZT-Actuated 2D Optical Scanner for MEMS Image 16:30 Projection Display

Y. Yasuda, M. Tani, M. Akamatsu, H. Toshiyoshi^{*} Stanley Elec., Japan ^{*}Univ. of Tokyo, Japan

A MEMS 2D optical scanner for image projection display has been developed by using piezoelectric unimorph actuators of PZT film made by the ADRIP (arc discharge reactive ion plating) technique. Stable raster scan by combining resonant motion for the fast horizontal axis (16.4 kHz, optical 27 degrees) and for the slow vertical axis (77.4 Hz, optical 31 degrees) has made it possible to project monotone bitmap animations. A quasi-static operation for the vertaical axis has been also investigated.

MEMS4 - 4 Dynamic Tactile Display with Arrayed Pin for Blind 16:50 Aid Using Micro Actuators

T. Matsunaga, W. Makishi, Y. Haga TUBERO, Japan

Tactile pindisplay for blind aid and three dimensional pindisplay using Shape Memory Alloy micro actuators has been fabricated and developed. Character and graphic information are dynamically displayed by making pins array up and down. Magnetic material tube is attached to each pin and a permanent magnet fixes position of the pins up or down state. The mechanism solves problems of heat storage and electrical consumption of the SMA actuator because the current is supplied only when the pins move.

----- Break -----

Ohmi 10

17:20 - 18:45

MEMS5: Displays and Imaging (2)

Chair: M. Miles, QUALCOMM MEMS Tech., USA Co-Chair: T. Komoda, Matsushita Elec. Works, Japan

MEMS5 - 1: *Invited* Development of Medical and Welfare 17:20 Microdevices Using Micro Technology

Y. Haga, T. Matsunaga, W. Makishi, K. Totsu^{*}, M. Esashi^{*} TUBERO, Japan ^{*}Tohoku Univ., Japan

Endoscopes and catheters are already widely used and new more precise examinations and diagnoses are required. Small medical devices with several functions for use in the human body can be realized installing microsensors and microactuators in the medical devices. We have developed several microdevices for minimally invasive examinations and therapies using MEMS and related microfabrication technologies. A dynamic tactile pin display which displays Braille characters and graphic information has also been developed using micro actuators.

MEMS5 - 2 Black Board-Type MEMS Interactive Display

17:45

R. Shigematsu, D. Tosu, A. Higo, H. Toshiyoshi, H. Fujita Univ. of Tokyo, Japan

We propose a new type of an electronic re-writable blackboard that keeps the trace of finger-drawn strokes using the bitmap of scatting light from segmental membrane. Images can be erased entirely or partially by releasing voltage or pulling back the membrane with magnetic force, respectively. Thanks to the simplicity of the device structure and principle, the proposed display has scalability to an oversized board that could be made by printing or embossing.

MEMS5 - 32D Laser Microscanner for Precise Laser Surgery18:05and Small Size Head Mount Display

W. Makishi, H. Akahori, T. Matsunaga, M. Esashi and Y. Haga Tohoku Univ., Japan

A 2D (two dimensional) laser microscanner system for head mount display by direct projecting on the retina has been developed. The 2D scanner system is made up of an optical fiber, a micro rod lens and a 2D microscanner. The 2D microscanner has three piezoelectric unimorph cantilevers that have a ball joint and a mirror. These components are packaged into a 3.8 mm external diameter polymer tube. The maximum inclined angle of the mirror is about 30 degrees.

MEMS5 - 4 Angle Tunable Prism for Optical Scanner 18:25

A. Takei, E. Iwase, K. Matsumoto and I. Shimoyama Univ. of Tokyo, Japan

We propose an angle tunable liquid prism actuated by electrowetting. Our prism makes an optical scanner smaller, because the laser source of the scanner can be put just below the prism. The prism consists of two transparent plates and sandwiched liquid. The diameter and the height of the prism are 2 mm and 1.5 mm, respectively. In this research, we achieved the prism capable of shifting the light path to the right and the left by 7 degrees.

Author Interviews 18:40 – 19:40

Otsu Festival

Friday, December 8 12:10–13:50 (before Outstanding Poster Paper Awards Ceremony) Prince Hall (3F) Otsu Prince Hotel

See page 9 for details

Topical Session on Display Electronic Systems

Thursday, December 7

9:00 - 12:00 O	
	DESp: Display Electronic Systems
Chair:	H. Okumura, Toshiba Research & Development Center
DESp - 1	Timing Control System for Flexible Black Data Insertion on IPS-Pro Panel
	J. Maruyama, Y. Ooishi, M. Nakamura [*] , I. Mori [*] ,

J. Maruyama, Y. Ooishi, M. Nakamura , I. Mori , S. Morishita^{*}, T. Furuhashi^{*}, K. Ono^{*} Hitachi, Japan ^{*}Hitachi Displays, Japan

Using 'Flexible BI' (black data insertion) reduces the motion blur of an LCD, without reducing the brightness. We discuss the timing control system that is needed to make this technique suitable for IPS-Pro panels. This system uses various techniques that improve its costperformance: those used to compress the frame memory needed for both over-drive and flexible black data insertion, and those used to make a smooth gamma curve when using a conventional 8-bit driver.

DESp - 2 New Driving Method for Field Sequential Colour LCDs Using OCB Mode

T. Fukami, S. Kawaguchi, S. Araki, M. Takeoka, A. Takimoto Toshiba Matsushita Display Tech., Japan

Recently, FSC-LCDs have been developed. They have several advantages, but can result in artefacts such as colour mixing, gamma mismatch and colour break-up by using conventional driving method. We have developed a 9-inch diagonal FSC-LCD using OCB mode and a new driving technique, which consists of black and white insertion driving. This enables us to achieve a high transmittance of 16% and a high contrast ratio of over 600:1 without causing these problems.

DESp - 3 An Area Efficient True 10-bit Source Driver for Flat Panel Displays

C.-D. Go, J.-S. Kang, M.-S. Shin, J.-H. Kim, O.-K. Kwon Univ. of Hanyang, Korea

In this paper, a true 10-bit gray scale source driver with 8-bit resistor string DAC(Digital to Analog Converter) and 2-bit I-V converter type DAC is proposed for small chip area TFT-LCD source driver. The 2-bit I-V converter type DAC consists of a resistor and OTA(Operational Transconductance Amplifier) whose Gm(trans-conductance) is proportional to a resistor. The chip area of the proposed 10-bit source driver IC is increased only 28% compared with that of the source driver with 8-bit resistor-sting DAC based on layout.

DESp - 4 A Full-Custom 300-Channel High-Voltage Display Driver in an 80V 0.35 µm CMOS Intelligent Interface Technology

> H. De Pauw, J. Doutreloigne, H. De Smet, A. Van Calster Ghent Univ. - IMEC, Belgium

A newly designed high-voltage driver accommodating a large variety of non-versatile flat panel displays is implemented in a HV-extended 0.35μ m CMOS technology. The driver features 65V driving capability on all 300 outputs and is able of generating all kinds of complex high-voltage waveforms that are constituted out of 8 voltage levels (7 high-voltage levels and ground). The capabilities of the integrated circuit are described through an SVGA-resolution passive matrix AFLC display application.

DESp - 5 High Output Impedance LTPS TFT-Based Current Source with Double Compensation

M.-P. Hong, J. Y. Jeong Univ. of Suwon, Korea

We have designed constant current source for LTPS TFT analog circuit. To cope with non-uniform device characteristics of TFT's, we adopted super transistor structure where four TFT's behave as one TFT with very good saturation characteristics. Two compensation means have been developed and implemented. From the HSPICE simulation results, the circuit results less than 5% output current error for 50% device property variation. We verify the usefulness by applying the circuit to the folding ADC.

DESp - 6 Performance Comparison of Motion Estimation Methods for Frame Rate Up-Conversion

S. J. Kang, Y. H. Kim Pohang Univ. of S&T, Korea

Frame rate up-conversion is a promising technique to reduce motion blur of the hold-type display without decreasing luminance. This technique uses motion estimation and its performance highly depends on the performance of the motion estimation method it uses. This paper investigates the performance of three well-known motion estimation methods when used for frame rate up-conversion. In experiments, the block matching method outperformed the optical flow method and the pel recursive method.

DESp - 7 Motion Blur Reduction Algorithm for Mobile LCD

S. R. Shin, H. H. Hwang, B. S. Bae^{*}, S. H. Kim^{**} Image Lab., Korea ^{*}Hoseo Univ., Korea ^{**}LG Innotek. Korea

We have developed a novel algorithm reducing motion blur in mobile LCD. We proved that the proposed algorithm reduces motion blur effectively for moving pictures like movies and sports. This algorithm is very simple and can be merged easily in LDI(LCD driver IC) as a function block, which is a great advantage for low cost and thinner mobile LCD modules.

DESp - 8 Implementation of Image Enhancement Processor Using Saturation Extension

Y.-S. Jo, M.-R. Choi Hanyang Univ, Korea

In this paper, we propose saturation extension methods in order to implement image enhancement processor. The proposed methods are classified with the MIE technique for Intensity enhancement of input image and MSE techniques for saturation enhancement. The proposed methods are focused on processing preference color for human vision in order to generate better image quality than the algorithms focused on processing uniformly to whole images.

DESp - 9 A Preliminary Image Evaluation on MoMA-BTC (Mobile Multi-Level Adaptive Block Truncation Coding) for Small-Size Displays

H. Sasaki, H. Minamizaki, H. Okumura^{*} Toshiba Semiconductor, Japan ^{*}Toshiba Res. Dev. Ctr., Japan

A proposed "mobile multi-level adaptive BTC" reduces size of embedded RAM in mobile source driver to 1/4 (VGA with QVGA-size memory). It corrects border artifact especially of windows on desktop PC images, and corrects jagged edges for natural images. It also improves roughly 6.5 dB PSNR compared with conventional quad decimation for natural images.

DESp - 10L Performance Analysis of Vector Quantizer for Imaging Data Clustering Algorithms

T.-W. Hou^{*}, H.-K. Ku^{*,**}, Y.-T. Chen^{*,***}, H.-S. Koo^{****} ^{*}Nat. Cheng Kung Univ., Taiwan ^{**}Fortune Inst. of Tech., Taiwan ^{***}Bureau of Nat. Healthcare Insurance, Taiwan ^{****}Univ. of Tokyo, Japan

Generalized Lloyd Algorithm(GLA) is the most famous known algorithm technique in the field of vector quantizer design. It runs very fast, but it can only find a poor local optimum in most cases. In 1989, Zeger proposed the Stochastic Relaxation Decoder(SRD) algorithm to overcome the weakness of the GLA. We proposed an improved approach named Codebook Reorganization Algorithm(CRA). It can find better codebooks than GLA. It also can find a codebook as good as SRD in less time.

DESp - 11L An Image Rotation Method for OLED Panel

Y. Kobayashi, A. Satoh Kyocera Display Inst., Japan

Image rotation method is necessary to display a landscape-type picture on a portrait-type panel. And the image rotation requires some additional memory for work area. We have implemented image rotation hardware with using the rim of frame buffer. This Image rotation method requires no additional memory and enables displaying NTSC image on portrait-type OLED panel. 8:50 - 9:00

Ohmi 10

Opening

Opening Remarks 8:50

H. Okumura, Toshiba, Japan

9:00 - 10:20 Ohmi 10 DES1: Circuit Technique for High Quality Image

Chair: K. Sekiya, Tohoku Univ., Japan Co-Chair: Y. Kudo, Hitachi, Japan

DES1 - 1: Invited Interface Technologies for Flat Panel Display 9:00

T. Kim, H. Nam Samsung Elect., Korea

Various interface technologies are investigated to connect two different systems electrically to communicate each other. For digital display devices, specifically FPDs, two interface schemes of intra-panel interface and system interface have existed according to the physical location of interface system. This paper provides summaries of existing interface technologies and technical trends of new advanced interface schemes up to date.

DES1 - 2 Programmable Gamma Voltage Generator for Mobile 9:20 Display Applications

M.-S. Shin, J.-Y. Song, C.-D. Go, O.-K. Kwon Hanyang Univ., Korea

In this paper, a 6-bit source driver with programmable gamma voltages is proposed for mobile display applications. The gamma voltages of the source driver can be adjusted by the 12-bit data register that is programmed by the serial interface of I2C and the tuning range of 9 reference voltages is ± 315 mV with 5mV step. Because 9 output buffers are only used in the source driver for 240/720 output channels, the chip size of the proposed source driver is smaller to 20% and power consumption is lower to 35% than those of the conventional source driver which has an output buffer per channel.

DES1 - 3 One-Chip Driver for 262K-Color QCIF+ Passive Matrix 9:40 OLED Displays

Y.-S. Son, Y.-S. Ahn, H.-S. Song, J.-K. Sung, H.-S. Oh, D.-K. Han, H.-S. Kim^{*}, G.-H. Cho^{**} Silicon Works, Korea ^{*}LG Elect., Korea ^{**}KAIST, Korea

A single-chip driver for 262K-Color QCIF+ (176RGB \times 240) passive matrix OLED displays is presented. The chip consists of a scan driver, a data driver, a digital controller, 3(R/G/B) reference current generators, and two interface circuits. The gray level is controlled by pulse width modulation of data currents. Gradient in pre-charge levels between data lines is applied to remove the effect of scan line resistance. 120Hz of the frame frequency is applied to reduce the flickering.

DES1 - 4 A Memory-Efficient Model-Based Overdrive 10:00

H. Pan, X. Feng, S. Daly Sharp Labs. of America, USA

We propose a novel model-based overdrive (OD) algorithm with frame buffer compression. Our proposed algorithm adds a model to predict the actual display values to increase overdrive accuracy. Then we are able to reduce the implementation cost of our proposed model-based OD algorithms to the level of conventional OD algorithms. In addition, we use an adaptive BTC to reduce the required frame buffer to further lower the implementation cost. The algorithm is evaluated with nine video sequences with satisfactory results.

----- Break -----

10:40 - 12	:00	Ohmi 10		
DES2: Video Processing for High Quality Image				
Chair: Co-Chair:	J. Someya, Mitsubishi Elec., Japan H. Sasaki, Toshiba Semiconductor, Japan			

DES2 - 1: Invited High Frame Rate Picture Rate Conversion

E. B. Bellers, J. G. W. Janssen NXP Semiconductors, USA

Motion blur is one of the major concerns of today's LCD panels. The hold-time is the dominating factor in the motion blur. Driving the panel at a higher refresh rate reduces the hold time, and as such, provides a means to reduce the motion blur. This paper shows the technology that can drive the panel with the proper video content by applying high frame-rate motion-compensated temporal interpolation, and illustrates the architecture that enables implementation at a consumer price level.

DES2 - 2 A Novel LCD System for High Quality Motion 11:00 Pictures by Motion-Adaptive Black-Insertion-Ratio Control

M. Baba, G. Itoh Toshiba, Japan

In this paper, a novel LCD system for high quality motion pictures by motion-adaptive black-insertion-ratio control is proposed. In this system, a driving method of an LCD is switched between a pseudoimpulse driving method like a CRT and a hold-type driving method like a conventional LCD according to input pictures. This LCD system allows the realization of novel LCD-TVs which have the features of both high quality motion pictures and flicker-free still pictures without excessive power consumption.

DES2 - 3 Video Processing for Optimal Motion Portrayal on LCDs

F. H. van Heesch, M. A. Klompenhouwer, E. B. Bellers^{*}, J. G. W. Janssen^{*} Philips Res. Labs., The Netherlands *NXP Semiconductors, USA

For an optimal motion portrayal of video on Liquid Crystal Displays (LCDs), motion artifacts like blur and judder have to be prevented. In this paper, an overview of several motion blur reduction methods is presented and motion judder reduction is discussed. Furthermore, a cost effective video processing system for LCDs is proposed for optimal motion portrayal.

DES2 - 4 A Color Conversion Circuit of Wide Gamut Color 11:40 Spaces for Multi-Primary Color LCDs

H. Moriya, K. Murai, K. Fukasawa, T. Kurumisawa^{*}, E. Chino^{*} Seiko Epson, Japan ^{*}Sanyo Epson Imaging Devices, Japan

A color conversion circuit that reproduces sYCC, AdobeRGB and xvYCC601 color spaces is presented. The proposed circuit converts the encoded signals of sYCC, AdobeRGB and xvYCC601 with their control commands. The circuit is independent of the optical characteristics of LCDs and can be applied to various types of wide color-gamut LCDs. Experimental results show that the proposed circuit and our newly developed four-primary color LCD can reproduce the outside of sRGB color space for the above three encoding methods.

----- Lunch -----

14:00 - 15:00

Ohmi 10

DES3: High Quality Display Technology

Chair: H. Okumura, Toshiba R&D Center, Japan Co-Chair: K. Sekiya, Tohoku Univ., Japan

DES3 - 1: Invited Dual-Modulation High Dynamic Range Display 14:00 Technology

H. Seetzen^{*,**}, G. Ward^{*}, L. Whitehead^{**} ^{*}BrightSide Tech., Canada ^{**}Univ. of British Columbia, Canada

Dual Modulation High Dynamic Range displays offer a number of advantages over conventional single modulation displays. We describe the basic design principles and the benefits of dual modulation displays such as higher contrast, larger color gamut, higher luminance and power savings.

DES3 - 2: *Invited* Advances in Field Sequential Color OCB-LCD 14:20 with Backlight Scanning Technology

Field sequential color method on an LCD in combination with an LED backlight has an advantage in light efficiency but has a disadvantage of motion artifact called color breakup. The method is based on temporal color mixing and therefore, color separation between color fields is essential on scanning backlights. We developed prototypes of OCB-mode LCDs with LED scanning backlights and successfully provided the solutions to the problems.

DES3 - 3 Withdrawn 14:40

DES3 - 4L A Development of Frame Rate Conversion 14:40 Technology for Large-Screen Full-Spec. LCD-HDTV

Y. Yoshida, T. Fujine, K. Yamamoto, H. Furukawa, M. Ueno, Y. Kikuchi, S. Kohashikawa, A. Yamada, N. Takeda, M. Sugino Sharp, Japan

We describe our development of Frame Rate Conversion(FRC) technology that provides picture quality improvement for LCD. Based on an analysis of real broadcasting video, we point out that the "character-telop" is a special type of input signal that is considered to be able to obtain a significant picture quality improvement by using double-frame rate LCD-TV. Then, FRC technology that has a feature of improving a picture quality of "character-telop" in particular, as well as a LSI implementing FRC is introduced.

----- Break -----

15:40 - 17:00		Ohmi 10
	DES4: Mobile Optimized System	
Chair [.]	N. Suzuki Nokia Japan	

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DES4 - 1: Invited High Speed Serial Interface for Mobile 15:40 Displays

R. Lawrence Intel, USA

For handheld products, reducing pincount and power are highest priority. These requirements are shaping a new generation of interfaces in cell phones, PDAs, and other battery-powered products. To avoid market fragmentation, the MIPI Alliance developed standardized interfaces between components in mobile devices. The Display Working Group developed the MIPI DSI standard for the interface between a processor and its displays. DSI specifies high-speed differential signaling technology for the physical layer, and a packet-based protocol for sending pixel or command data.

DES4 - 2: Invited Incorporation of Input Function into Display 16:00 Using LTPS TFT Technology

H. Nakamura, T. Nishibe Toshiba Matsushita Display Tech., Japan

The advancement of Low-Temperature polycrystalline silicon (LTPS) TFT-LCDs has been driven by the evolution of system-on-glass (SOG) technology. Poly-Si TFT performance has been improved in order to achieve higher value-added displays which circuits with various functions are integrated onto the glass substrate. In this paper, recent development of SOG is briefly described focusing on device technologies of function-integrated displays such as touch panel function using poly-Si photo-sensors.

DES4 - 3: Invited Development of SLS Mobile TFT-LCDs 16:20 C. W. Kim, K. C. Park

C. W. Kim, K. C. Park Samsung Elect., Korea

A 1.02" full SOG TFT-LCD with icon-display for subdisplay of cellular phones, 2.2" qVGA TFT-LCD of high-aperture ratio with integrated DC/ DC converter, 1.9" qVGA TFT-LCD with low power analog interface, and 3.0" VGA TFT-LCD compatible with 480-interlaced data format without additional signal processing are introduced. All these devices are developed based on the SLS(Single crystal-Like Silicon) technology.

DES4 - 4: Invited The Dynamic Display Power Optimization 16:40 (D²PO) Driving Scheme Enables Low Power TFT-LCD Modules for Notebook Applications

H. Maeda, T. Hashimoto, A. Okazaki, M. Watanabe, A. Bhowmik Toshiba Matsushita Display Tech., Japan *Intel, USA

Toshiba Matsushita Display Technology Co., Ltd. (TMD) developed prototype TFT LCD module with a unique interface scheme to improve power consumption in portable, battery powered notebook applications. The solution utilizes a multi-field driving method (MFD), and includes TMD's new LCD display control electronics matched to the next generation Intel[®] Centrino[®] Duo mobile technology-based platform. The technology is named Dynamic Display Power Optimization (D²POTM).

Author Interviews 17:00 – 18:00

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September 17–20, 2007 Moscow, Russia

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Det	1 1	Drive and Line (OF)	Ohari 1	Ohmi 0	Ohuri 0	Ohmi 0	Ohmi 0	Ohmi 10					
Date		Prince Hall (3F)	Onmi 1	Onmi 2	Onmi 3	Onmi 8	Onmi 9	Onmi 10	Onm	11 5-7			
ecember 6		Invited Add. 9:00-11:20											
			•		Lu	nch							
			LCT1	AMD1	FMC1	PDP1	EP1	OLED1	Destara				
	Registration		13:20-14:30	13:00-14:25	13:20-14:20	13:20-14:40	13:20-14:45	13:20-14:50					
	8:30-18:00				Bre	eak			VHFp				
Õ			LCT2	AMD2	FMC2	PDP2	EP2	0LED2	13:20-16:20	Exhibition			
day			15.00-10.25	14.40-10.15	15.00-10.00 Br	15.00-10.20	15.00-10.15	15.05-10.35		12.00-18.00			
nes			LCT3	AMD3	EMC3			OI ED3					
/ed			16:40-18:05	16:25-18:00	16:40-18:00			16:50-18:00					
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									18:00	-19:00			
		Banquet 19:10-21:10											
l			LCT4	AMD4/	VHF1	FMC4	PH1	MEMS1	Posters				
			9:00-10:20	9:00-10:25	9:00-10:20	9:00-10:20	9:00-10:15	9:00-10:35	PDPp1.				
					Bre	eak			OLEDp, 3Dp,				
			LCT5		VHE2	EMC5	PH2	MEMS2	LADp, EPp, DESp 9:00-12:00				
7			10:40-12:10	10:40-12:00	10:40-12:05	10:40-12:20	10:40-12:55	10:45-13:05					
Ibei	Registration 8:30-18:00	Lunch											
лəс			LCT6	3D1	VHF3	CBT1	FMC6	MEMS3	Posters	Exhibition			
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ay,			Break AMD/OLEDp,										
Irsd			LCT7	3D2	VHF4	CRT2	PH3	MEMS4	PDPn2				
Thu			15:40-17:05	15:40-16:55	15:40-17:00	15:40-17:00	15:40-16:40	15:40-17:10	14:00-17:00				
			•	•	Bre	eak	•	•	•				
					VHF5	CRT3	PH4	MEMS5					
					17:20-18:35	17:20-18:40	16:55-18:15	17:20-18:45					
									Author Ir 18:40	nterviews -19:40			
			3D3	AMD6	FMC7	LAD1	FED1	DES1					
			9:00-10:30	9:00-10:25	9:00-10:20	9:00-10:20	9:00-10:15	8:50-10:20					
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			3D4	AMD7	FMC8	PDP3	FED2/PH5	DES2		Exhibition			
r 8	Registration	Poetor Awarde	10.30-11.40	10.40-11.40	10.40-11.40	10.40-12.00	10.30-11.40	10.40-12.00		9:00-14:00			
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lay,			LAD2	AMD8	FMC9	PDP4	FED3	DES3					
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			15:40-17:00	15:35-17:00		15:40-17:00	15:30-17:00	15:40-17:00					
									Author Ir	nterviews			
									17:00-18:00				

IDW '06 Timetable

IDW '06 Session Navigator

			Wed	Inesday, Dec. 6			Thursday, Dec. 7					Friday, Dec. 8					
	Location	9:00-11:20		PM		18:00-19:00	A	M	PM			18:40-19:40	AM		PM		17:00-18:00
Keynote & Invite	Prince Hall	Opening, Keynote & Invite Add.															
LCT	Ohmi 1		New Materials	LC Alignment (1)	LC Alignment (2)		LCD Modes (1)	LCD Modes (2)	LCD Modes (3)	Characterization							
	Ohmi5-7		Pos	ters		A.I.						A.I.					
AMD	Ohmi 2		LC-TV	TFT Novel Applications	SOG/Mobile		*AM-OLED	Emerging TFT Tech.					TFT Tech. (1)	TFT Tech. (2)	Organic TFT (1)	Organic TFT (2)	
	Ohmi5-7					A.I.			Pos	sters		A.I.					A.I.
	Ohmi 3		Color Filters	Optical Films (1)	Optical Films (2)								Backlight (1)	Backlight (2)	Backlight (3)		
FMC	Ohmi 8						Manufacturing Tech. (1)	Manufacturing Tech. (2)									
	Ohmi 9								Materials								
	Ohmi5-7					A.I.			Pos	sters		A.I.					A.I.
CRT	Ohmi 8								Future CRT Tech. & Market	Cathode & Mask	Electron Gun						
	Ohmi5-7						Pos	sters				A.I.					
PDP	Ohmi 8		Protective Layer (1)	Protective Layer (2)										Driving Method	Fabrication	PDP TV	
	Ohmi5-7					A.I.	Pos	sters	Pos	sters							A.I.
РН	Ohmi 9						ELDs	LEDs		Phosphors for PDPs	Phosphors			*Phosph. for FED & FEA Backlight			
	Ohmi5-7		Pos	ters								A.I.					A.I.
FED	Ohmi 9												FEDs & Novel Devices	*Phosph. for FED & FEA Backlight	CNT-FEs for FEDs	FED Driving & FE Materials	
	Ohmi5-7																A.I.
	Ohmi 10		OLED Technology	Device Technology	Phosphores. OLED												
OLED	Ohmi 2						*AM-OLED										
	Ohmi5-7					A.I.	Pos	sters	*Posters			A.I.					
	Ohmi 1												Hyper Realistic Disp. & Human Factor	3D Display (2)			
3D	Ohmi 2								3D Display (1)	Holographic & Advan. Disp.							
	Ohmi5-7						Pos	sters				A.I.					A.I.
VHF	Ohmi 3						Human Factors	Color Reproduction	Image Quality	Moving Image Quality (1)	Moving Image Quality (2)						
	Ohmi5-7		Pos	ters								A.I.					
	Ohmi 1														Emerging Illumination	Dig. Cinema & Home Theater	
LAD	Ohmi 8												Projection Components				
	Ohmi5-7						Pos	sters									A.I.
EP	Ohmi 9		Electronic Paper (1)	Electronic Paper (2)													
	Ohmi5-7					A.I.	Pos	sters				L					\square
MEMS	Ohmi 10						Emerging MEMS Tech.	Optical MEMS & Sensors	Mech., Mater. & Process Tech.	Displays & Imaging (1)	Displays & Imaging (2)						
	Ohmi5-7											A.I.					
DES	Ohmi 10												Circuit Technologies.	Video Processing	High Quality Display Tech.	Mobile System	
	Ohmi5-7					1	Pos	sters									A.I.

LCT: Workshop on LC Science & Technologies AMD: Workshop on Active Matrix Displays FMC: Workshop on FPD Manufacturing, Materials & Components CRT: Workshop on CRTs PDP: Workshop on Plasma Displays PH: Workshop on EL Displays, LEDs, & Phosphors FED: Workshop on Field Emission Display OLED: Workshop on Organic LED Displays

3D: Workshop on 3D/Hyper-Realistic Displays & Systems VHF: Workshop on Applied Vision & Human Factors LAD: Wokshop on Projection & Large-Area Displays, & Their Components EP: Workshop on Electronic Paper MEMS:Workshop on MEMS for Future Displays & Related Electron Devices DES:Topical Session on Display Electronic Systems

A.I.: Author Interviews *: Joint Session

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IDW '06 FINAL PROGRAM