

Wed. Nov 27, 2019

Mid-sized Hall A

Oral Presentation

[VHF1] Image Quality and Measurements

Chair: Kenichiro Masaoka (NHK)

Co-Chair: Keita Hirai (Chiba Univ.)

1:40 PM - 3:10 PM Mid-sized Hall A (1F)

[VHF1-OP] Opening

1:40 PM - 1:45 PM

[VHF1-1] A Fundamental Evaluation of Visual Resolution of Displays Considering Different Sub-Pixel Structures*Daisuke Nakayama¹, Midori Tanaka¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

1:45 PM - 2:05 PM

[VHF1-2] Perceptually Optimized Image Enhancement for OLED Displays in Power-constrained Conditions*Hsuan-Chi Huang¹, Pei-Li Sun¹ (1. National Taiwan University of Science and Technology (Taiwan))

2:05 PM - 2:25 PM

[VHF1-3] Estimation of Equivalent Conditions for Display Sparkle Measurement*Makio Kurashige¹, Gen Furui¹, Kazutoshi Ishida¹, Shumpei Nishio¹, Toshiyuki Nakai¹, Hiroko Suzuki¹, Masayuki Tsunekawa¹, Yukimitsu Iwata¹, Norinaga Nakamura¹ (1. Dai Nippon Printing Co., Ltd. (Japan))

2:25 PM - 2:45 PM

[VHF1-4L(Invited)] Repeatability and Reproducibility Considerations for BlackMURA Measurements*Ingo Rotscholl¹, Tobias Porsch¹, Udo Krüger¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))

2:45 PM - 3:10 PM

Oral Presentation

[VHF2] Ergonomics for Automotive Applications

Chair: Yoshie Imai (Mitsubishi Elec.)

Co-Chair: Yukio Endo (AGC)

3:20 PM - 4:45 PM Mid-sized Hall A (1F)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving*Katsunori Okajima¹ (1. Yokohama National University (Japan))

3:20 PM - 3:45 PM

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

3:45 PM - 4:05 PM

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display - Basic Study on the Relationship between Degree of Correction and Driver's Recognition-*Kazuki Matsushashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

4:05 PM - 4:25 PM

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

4:25 PM - 4:45 PM

Oral Presentation

[VHF3/DES3] Virtual Reality

Chair: Takashi Shibata (Tokyo Univ. of Social Welfare)

Co-Chair: Johan Bergquist (Consultant)

5:00 PM - 6:30 PM Mid-sized Hall A (1F)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

5:00 PM - 5:25 PM

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

5:25 PM - 5:50 PM

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is

Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹,
Koudai Ito¹ (1. National Institute of
Advanced Industrial Science and Technology
(Japan))

5:50 PM - 6:10 PM

[VHF3/DES3-4] Color Perception Comparison of Scene
Images between Head-Mounted Display and
Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko
Horiuchi¹ (1. Chiba University (Japan))

6:10 PM - 6:30 PM

Mid-sized Hall B

Oral Presentation

[AMD1] Foldable Technology of OLED Displays

Chair: Koichi Miwa (LG Display Co.,Ltd)

Co-Chair: Keisuke Omoto (Apple)

1:40 PM - 3:15 PM Mid-sized Hall B (1F)

[AMD1-1(Invited)] Development of Foldable AMOLED
Displays Based on Neutral-Plane
Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹,
Masatomo Hishinuma¹, Hajime Yamaguchi¹,
Akio Murayama¹ (1. Japan Display Inc.
(Japan))

1:40 PM - 2:05 PM

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age
of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹,
Xianrui Qian¹, Jiye Xia¹ (1. Visionox
Technology Inc (China))

2:05 PM - 2:30 PM

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung
Hee University (Korea))

2:30 PM - 2:45 PM

[AMD1-4] Positive Bias-Stress Stability of Flexible
Amorphous InGaZnO Thin Film Transistors with
Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng
Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong
University (China))

2:55 PM - 3:15 PM

Oral Presentation

[AMD2] High Resolution Display

Chair: Junichi Takeya (University of Tokyo)

Co-Chair: Hiroki Hamada (Kinki Univ.)

3:20 PM - 4:45 PM Mid-sized Hall B (1F)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED
TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok
Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹, Shin-
Kyun Park¹ (1. LG Display Co., Ltd.
(Korea))

3:20 PM - 3:45 PM

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis
Aligned Crystalline Oxide
Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹,
Takashi Nakagawa¹, Yuki Tamatsukuri¹,
Hideaki Shishido¹, Shogo Uesaka¹, Ryohei
Yamaoka¹, Takaaki Nagata¹, Tomoya
Aoyama¹, Yutaka Okazaki¹, Takayuki
Ikeda¹, Shunpei Yamazaki¹ (1.
Semiconductor Energy Laboratory Co.,
Ltd. (Japan))

3:45 PM - 4:10 PM

[AMD2-3] Novel Compensation Pixel Circuit with
Simultaneous Emission Driving Scheme for
High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun
Chen¹, Chih-Lung Lin¹ (1. National Cheng Kung
University (Taiwan))

4:10 PM - 4:30 PM

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local
Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹,
Yongyuan Qiu¹, Quansheng Liu¹, Yong Yang¹, Junling
Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹,
Xin Zhang¹ (1. Shenzhen China Star
Optoelectronics Technology Co., Ltd (China))

4:30 PM - 4:45 PM

Oral Presentation

[AMD3] Driving Technology of Micro/Mini LED Displays

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Keisuke Omoto (Apple)

5:00 PM - 6:35 PM Mid-sized Hall B (1F)

[AMD3-1(Invited)] Crystal LED Display System for
Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹,
Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony
Semiconductor Solutions Corporation
(Japan), 2. Sony Corporation (Japan))
5:00 PM - 5:25 PM

[AMD3-2(Invited)] Active Matrix Driving mini-LED
Device

*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-
Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹,
Minoru Shibazaki² (1. Innolux
Corporation (Taiwan), 2. Innolux Japan
(Japan))
5:25 PM - 5:50 PM

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix
Micro-LED Display with Low-
Temperature-Poly-Silicon TFT
Backplane

*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki
Ito¹, Takanobu Suzuki¹, Masahiko
Nishide¹, Kunio Imaizumi¹, Katsumi
Yamanoguchi¹, Fanny Rahadian¹, Katsumi
Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹
(1. Kyocera Corporation (Japan))
5:50 PM - 6:15 PM

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro
Display

*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian
Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong
University of Science and Technology (Hong Kong))
6:15 PM - 6:35 PM

Room 107

Oral Presentation

[LCT1] Evaluation Techniques

Chair: Masaru Inoue (Toyo Tech. LLC)
Co-Chair: Yoshinori Iwashita (DIC)
1:40 PM - 3:00 PM Room 107 (1F)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays Caused by Polyimide Anion Radicals

*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC
Petrochemical Corporation (Japan))
1:40 PM - 2:00 PM

[LCT1-2] The Systematically Investigation on the Influence Factor on Vertical Alignment State of Polyimide-free Liquid Crystal Displays

*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-

Jen Tseng², Chung-Ching Hsieh² (1. Peking
University Shenzhen Graduate School (China), 2.
Shenzhen China Star Optoelectronics Technology Co.,
Ltd (China))
2:00 PM - 2:20 PM

[LCT1-3] Second-Harmonic Imaging of Flexoelectric Polarization in Various Liquid Crystal Cells *Koichiro Shiota¹, Fumito Araoka¹, Yutaka Yamagata¹ (1. RIKEN (Japan))

2:20 PM - 2:40 PM

[LCT1-5L] A Novel Orientation Method for Nematic LCs by Using Magnetic Field Lines with Permanent Magnets and Electric Field for Assisting the Reorientation

Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro
Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University
(Japan))
2:40 PM - 3:00 PM

Oral Presentation

[LCT2] LC Flat Diffractive Optics

Chair: Toshiaki Nose (Akita Prefecture University)
Co-Chair: Hiroyuki Yoshida (Osaka University)
3:20 PM - 4:50 PM Room 107 (1F)

[LCT2-1(Invited)] Fundamentals and Applications of Liquid Crystal-Based, Polarization- Dependent Diffractive Optics Fundamentals and Applications of Liquid Crystal-Based, Polarization-Dependent Diffractive Optics

*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto
Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹
(1. Osaka University (Japan))
3:20 PM - 3:40 PM

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and Next Generation Displays

*Nelson Tabirian¹, David Roberts¹, Anna
Tabirian¹, Brian R Kimball², Timothy J
Bunning³ (1. BEAM Engineering for
Advanced Measurements Co. (United States
of America), 2. U.S. Army Natick Soldier
Systems Center, Natick, Massachusetts
(United States of America), 3. Air Force
Research Laboratories, Wright-Patterson
Air Force Base, Ohio (United States of

America))

3:40 PM - 4:05 PM

- [LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements
*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

4:05 PM - 4:30 PM

- [LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up Displays
Xiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))
4:30 PM - 4:50 PM

Oral Presentation

- [LCT3] Advanced LCD Technologies
Chair: Hiroyuki Okada (University of Toyama)
Co-Chair: Koichi Miyachi (JSR)
5:00 PM - 6:20 PM Room 107 (1F)

- [LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method
*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))
5:00 PM - 5:20 PM
- [LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell
*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))
5:20 PM - 5:40 PM
- [LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD
*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))
5:40 PM - 6:00 PM
- [LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application
*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

6:00 PM - 6:20 PM

Room 108

Oral Presentation

- [FMC2] Metrology and Manufacturing
Chair: K Kälantär (Global Optical Solutions)
Co-Chair: Toshiaki Nonaka (Merck Performance Materials)
3:20 PM - 4:40 PM Room 108 (1F)

- [FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices
*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))
3:20 PM - 3:40 PM

- [FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field
*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))
3:40 PM - 4:00 PM

- [FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD
*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))
4:00 PM - 4:20 PM

- [FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM
*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))
4:20 PM - 4:40 PM

Oral Presentation

- [PRJ1/FMC1] AR/VR
Chair: Satoshi Ouchi (Hitachi)
Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)
1:40 PM - 3:05 PM Room 108 (1F)

- [PRJ1/FMC1-OP] Opening
Satochi Ouchi¹, Hirotsugu Yamamoto² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))

1:40 PM - 1:45 PM

[PRJ1/FMC1-1(Invited)] Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays

*Zong Qin¹, Jui-Yi Wu¹, Ping-Yen Chou¹, Cheng-Ting Huang¹, Yu-Ting Chen¹, Yi-Pai Huang¹ (1. National Chiao Tung University (Taiwan))

1:45 PM - 2:05 PM

[PRJ1/FMC1-2] Possibility of Deblurring Aerial Image Based on Deconvolution Processing

*Hayato Kikuta^{1,2}, Hirotsugu Yamamoto^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))

2:05 PM - 2:25 PM

[PRJ1/FMC1-3] Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display

*Takeru Utsugi¹, Mayumi Sasaki², Kazuhiko Ono², Yukinobu Tada² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))

2:25 PM - 2:45 PM

[PRJ1/FMC1-4] High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations

*Ryuji Ukai¹, Takuma Kuno¹, Toshiteru Nakamura¹, Masahito Uchiyama¹, Satoshi Ouchi¹ (1. Hitachi, Ltd. (Japan))

2:45 PM - 3:05 PM

Oral Presentation

[FLX1/FMC3] Advanced Materials and Components for Flexible Electronics

Chair: Toshihide Kamata (National Institute of Advanced Industrial Science and Technology)

Co-Chair: Makoto Arai (ULVAC Inc.)

5:00 PM - 6:30 PM Room 108 (1F)

[FLX1/FMC3-OP] Opening

5:00 PM - 5:05 PM

[FLX1/FMC3-1(Invited)] Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device

*Masato Ohsawa¹, Natsuki

Hashimoto¹, Naoki Takeda², Shota Tsuneyasu², Toshifumi Satoh² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))

5:05 PM - 5:30 PM

[FLX1/FMC3-2] Al alloying effect in functionalization of mechanical resistance to foldable display interconnections

*Chiharu Kura¹, Mototaka Ochi¹, Hiroyuki Okuno², Hiroshi Goto² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))

5:30 PM - 5:50 PM

[FLX1/FMC3-5L] Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics

*John Fahlteich¹, Michiel Top¹, Stefan Hinze¹, Uwe Meyer¹, Tobias Vogt¹, Valentijn von Morgen², Matthias Fahland¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))

5:50 PM - 6:05 PM

[FLX1/FMC3-4] Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer

*Yuto Toshimori¹, Sohei Nonaka¹ (1. Mitsubishi Materials Corporation (Japan))

6:10 PM - 6:30 PM

Small Hall

Oral Presentation

[3DSA1/3D1] Holography 1

Chair: Hoang Yan Lin (Nat. Taiwan Univ.)

Co-Chair: Takashi Kakue (Chiba Univ.)

1:40 PM - 3:05 PM Small Hall (2F)

[3DSA1/3D1-OP] Opening

Shiro Suyama¹ (1. Tokushima Univ. (Japan))

1:40 PM - 1:45 PM

[3DSA1/3D1-1(Invited)] Complex Spatial Light

Modulation for Holographic Displays

*Hwi Kim¹ (1. Korea University (Korea))

1:45 PM - 2:05 PM

[3DSA1/3D1-5L] A Fast Hologram Calculation Method Based on the Light Field Rendering
 *Tiantian Zhang¹, Li Liu¹, Jun Xia¹ (1. Southeast University (China))

2:05 PM - 2:25 PM

[3DSA1/3D1-3] Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging

*Zi Wang¹, Guoqiang Lv¹, Qibin Feng¹ (1. Hefei University of Technology (China))

2:25 PM - 2:45 PM

[3DSA1/3D1-4] Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens

*KiHong Choi¹, Jongmin Kim¹, Keehoon Hong², Joongki Park², Sung-Wook Min¹ (1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

2:45 PM - 3:05 PM

Oral Presentation

[3DSA3/3D3] Light Field 1

Chair: Yasuhiro Takaki (Tokyo Univ. of A&T)

Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)

5:00 PM - 6:20 PM Small Hall (2F)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

5:00 PM - 5:20 PM

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

5:20 PM - 5:40 PM

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoung-ho Lee¹ (1. Seoul National University (Korea))

5:40 PM - 6:00 PM

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

6:00 PM - 6:20 PM

Oral Presentation

[3D2/3DSA2] Holography 2

Chair: Hwi Kim (Korea Univ.)

Co-Chair: Yuji Sakamoto (Hokkaido Univ.)

3:20 PM - 4:40 PM Small Hall (2F)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

3:20 PM - 3:40 PM

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMOG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

3:40 PM - 4:00 PM

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

4:00 PM - 4:20 PM

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

4:20 PM - 4:40 PM

Room 204

Oral Presentation

[OLED1] OLED Devices

Chair: Takahisa Shimizu (NHK)

Co-Chair: Ken-ichi Nakayama (Osaka University)

1:40 PM - 3:00 PM Room 204 (2F)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹ (1. Technische Universität Dresden (Germany))

1:40 PM - 2:00 PM

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

2:00 PM - 2:20 PM

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

2:20 PM - 2:40 PM

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

2:40 PM - 3:00 PM

Oral Presentation

[OLED2] OLED Material

Chair: Takahiro Komatsu (JOLED)

Co-Chair: Hitoshi Kuma (Idemitsu Kosan)

3:20 PM - 4:40 PM Room 204 (2F)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

3:20 PM - 3:40 PM

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

3:40 PM - 4:00 PM

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

4:00 PM - 4:20 PM

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

4:20 PM - 4:40 PM

Oral Presentation

[OLED3] OLED Display

Chair: Taishi Tsuji (NIPPON STEEL Chemical &Material)

Co-Chair: Masaya Adachi (Japan Display Inc)

5:00 PM - 6:25 PM Room 204 (2F)

[OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range

*Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))

5:00 PM - 5:20 PM

[OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display

*Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))

5:20 PM - 5:40 PM

[OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds

*Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))

5:40 PM - 5:55 PM

[OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode

*Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co., Ltd. (Japan), 2. Toray Industries, Inc. (Japan))

5:55 PM - 6:10 PM

[OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs Significance of Energy-Level Alignment in 3D Perovskite ELs

*KIHYUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))

6:10 PM - 6:25 PM

Room 206

Oral Presentation

[AIS1/INP2] Smart Society and Information Display

Chair: Katashi Nagao (Nagoya University)
Co-Chair: Toshiaki Fujii (Nagoya University)
3:20 PM - 4:35 PM Room 206 (2F)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us
*Kazuyuki Fujita¹ (1. Tohoku University (Japan))
3:20 PM - 3:45 PM

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN
*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))
3:45 PM - 4:10 PM

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN
*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))
4:10 PM - 4:35 PM

Oral Presentation

[AIS2] AI and Information Display
Chair: Yuki Ban (The University of Tokyo)
Co-Chair: Kazuyuki Fujita (Tohoku University)
5:00 PM - 6:25 PM Room 206 (2F)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays
*Katashi Nagao¹ (1. Nagoya University (Japan))
5:00 PM - 5:25 PM

[AIS2-2(Invited)] Light-field image processing using deep neural network
*Toshiaki Fujii¹ (1. Nagoya University (Japan))
5:25 PM - 5:50 PM

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering
*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))
5:50 PM - 6:10 PM

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO

algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai²,
Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei²
(1. National Taiwan University of Science and
Technology (Taiwan), 2. National Chung-Hsing
University (Taiwan))

6:10 PM - 6:25 PM

Oral Presentation

[INP1] In-Cell Touch Panels and Fingerprint Sensors

Chair: Noemie Ballot (ISORG)

Co-Chair: Yuji Suzuki (Japan Display Inc.)

1:40 PM - 2:56 PM Room 206 (2F)

[INP1-OP] Opening

Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))

1:40 PM - 1:41 PM

[INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor

*Yuji Suzuki¹, Satoshi Uchino¹, Kohei
Azumi¹, Tadayoshi Katsuta¹, Daichi
Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹
(1. Japan Display Inc. (Japan))

1:41 PM - 2:06 PM

[INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement

*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi
Ishikawa¹ (1. The University of Tokyo (Japan))
2:06 PM - 2:21 PM

[INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones

*Noemie Ballot¹ (1. ISORG (France))
2:31 PM - 2:56 PM

Room 207

Oral Presentation

[EP1] Emerging Electronic Paper Displays

Chair: Makoto Omodani (Tokai University)

Co-Chair: Masayoshi Higuchi (NIMS)

5:00 PM - 6:35 PM Room 207 (2F)

[EP1-OP] Opening

5:00 PM - 5:05 PM

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya
Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹,
Takehisa Ishida¹, Kenji Takagi¹, Isao
Takahashi¹, Hirohisa Amago², Taichi
Takeuchi², Asuka Tejima², Maho Watanabe²,
Yuki Oishi¹, Takahiro Kamei¹, Kazumasa
Nomoto¹ (1. Sony Corporation (Japan), 2.
Sony Global Manufacturing & Operations
Corporation (Japan))

5:05 PM - 5:30 PM

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink.
(Taiwan))

5:30 PM - 5:55 PM

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University
(China))

5:55 PM - 6:20 PM

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanao Fujisaki¹ (1. Tokai University (Japan))
6:20 PM - 6:35 PM

Oral Presentation

[DES1] 8K Systems

Chair: Ryutaro Oke (Panasonic Liquid Crystal Display)

Co-Chair: Hyun-Wook Lim (SAMSUNG ELECTRONICS)

1:40 PM - 3:00 PM Room 207 (2F)

[DES1-OP] Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:40 PM - 1:45 PM

[DES1-1(Invited)] Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹,
Ryutaro Oke², Kenkichi Tanioka¹, Toshio
Chiba¹ (1. Kairos Co., Ltd. (Japan), 2.
Panasonic Liquid Crystal Display Co.,
Ltd. (Japan))

1:45 PM - 2:10 PM

[DES1-2(Invited)] Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho
Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹,

Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

2:10 PM - 2:35 PM

[DES1-3(Invited)] Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application
*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))
2:35 PM - 3:00 PM

Oral Presentation

[DES2] Driving Technology

Chair: Chih-Wen Lu (Nat. Tsing Hua Univ.)

Co-Chair: Keiichi Nakajima (Tianma Japan)

3:20 PM - 4:40 PM Room 207 (2F)

[DES2-1] Relationship Between Charging Rate and Color Gamma Cross-talk for TFT-LCD with Flip Pixel Driven Architecture
*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

3:20 PM - 3:40 PM

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays
*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:40 PM - 4:00 PM

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT
*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

4:00 PM - 4:20 PM

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs
*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

4:20 PM - 4:40 PM

Thu. Nov 28, 2019

Conference Hall

Oral Presentation

[MEET1] Novel Materials, Fundamental Components and Process Technologies

Chair: Jin Jang (KyungHee University)

Co-Chair: Chien-chung Lin (National Chiao Tung University)

9:00 AM - 10:30 AM Conference Hall (1F)

[MEET1-OP] OpeningMasayuki Nakamoto¹ (1. Shizuoka University (Japan))

9:00 AM - 9:10 AM

[MEET1-1(Invited)] High Brightness Electron Beam with Carbon Nanotube (CNT) Cold Cathode*Kyu Chang Park¹, Ha Rim Lee¹, Boklae Cho² (1. KyungHee University (Korea), 2. Korea Research Institute for Science and Standard (Korea))

9:10 AM - 9:30 AM

[MEET1-2] Electron Beam Lithography of PMMA Film Using Direct Growth CNT Cold Cathode Emitter*Ok Jung Hwang¹, Ha Rim Lee¹, Kyu Chang Park¹ (1. University of Kyunghee (Korea))

9:30 AM - 9:50 AM

[MEET1-3] SOURCE 2D Simulation for High Resolution Carbon Nanotube Cold Cathode Fabrication*Da Woon Kim¹, Ha Rim Lee¹, Boklae Cho², Kyu Chang Park¹ (1. University of Kyung Hee (Korea), 2. Korea Research Institute for Science and Standard (Korea))

9:50 AM - 10:10 AM

[MEET1-4] Effects on X-ray Imaging Quality by Manipulation of Cold Cathode Emitter Density*Jisoo Oh¹, Yi Yin Yu¹, Kyu Chang Park¹ (1. Kyung Hee University (Korea))

10:10 AM - 10:30 AM

Oral Presentation

[MEET2] EL Quantum Dots Technologies

Chair: Frank Yan (Fuzhou University)

Co-Chair: Jang Hyuk Kwon (Kyung Hee University)

5:20 PM - 6:40 PM Conference Hall (1F)

[MEET2-1(Invited)] Quantum Dot Electroluminescence to Achieve Saturated Colours for REC2020 Compatibility*Poopathy Kathirgamanathan¹, MuttulingamKumaraverl¹ (1. Brunel University London (UK))

5:20 PM - 5:40 PM

[MEET2-3(Invited)] Ultra-Bright Quantum-Dot Light-Emitting Diodes*Shuming Chen¹ (1. Southern University of Science and Technology (China))

6:00 PM - 6:20 PM

[MEET2-4(Invited)] Efficient and Stable Light Emitting Diodes Based on Luminescent Nanocrystals*Kai Wang¹, Xiangtian Xiao^{1,2}, Zhaojin Wang¹, Taikang Ye¹ (1. Southern University of Science and Technology (China), 2. The University of Hong Kong (China))

6:20 PM - 6:40 PM

Mid-sized Hall A

Oral Presentation

[FMC4/LCT4] Micro LED Display

Chair: K Kälantär (Global Optical Solutions)

Co-Chair: Seiji Shibahara (Sony Home Entertainment & Sound Products Inc.)

9:00 AM - 10:20 AM Mid-sized Hall A (1F)

[FMC4/LCT4-1(Invited)] High-Resolution (1,000 to over 3,000 ppi) Full-Color "Silicon Display" for Augmented and Mixed Reality*Hidenori Kawanishi¹, Hiroaki Onuma¹, Masumi Maegawa¹, Takashi Kurisu², Takashi Ono², Shigeyuki Akase¹, Shinji Yamaguchi¹, Naoto Momotani², Yusuke Fujita¹, Yuhei Kondo², Kentaro Kubota², Toshimi Yoshida¹, Yuta Ikawa¹, Tsuyoshi Ono², Hiroyoshi Higashisaka², Yasuaki Hirano², Shinsuke Anzai¹ (1. Sharp Fukuyama Semiconductor Co., Ltd. (Japan), 2. Sharp Fukuyama Laser Co., Ltd (Japan))

9:00 AM - 9:20 AM

[FMC4/LCT4-2(Invited)] A new generation of HDR display with super multi-zones mini LED
*Jianping Zheng¹, Zhuo Deng¹, Ling Wu¹, Poping Shen¹, Junyi Li¹,

Jianmou Huang¹ (1. XiaMen Tianma
Microelectronics Company, Ltd.
(China))

9:20 AM - 9:40 AM

[FMC4/LCT4-3(Invited)] Monolithic Integration of GaN-
micro-LED and Si-MOSFET for
Bio-application

*Hiroto Sekiguchi^{1,2}, Hiroki
Yasunaga¹, Kazuaki Tsuchiyama¹,
Keisuke Yamane¹, Hiroshi Okada¹,
Akihiro Wakahara¹ (1. Toyohashi
University of Technology (Japan),
2. PRESTO, JST (Japan))

9:40 AM - 10:00 AM

[FMC4/LCT4-4] An Active Matrix Mini-LEDs Backlight
based on a-Si

*Bin Liu^{1,2}, quansheng liu², jia li², yongyuan
qiu², junling liu², yong yang², hongyuan xu²,
Juncheng Xiao², feng zhu², hang zhou¹, Xin
Zhang² (1. Peking University Shenzhen
Graduate School (China), 2. China Star
Optoelectronics Technology (China))

10:00 AM - 10:20 AM

Oral Presentation

[VHF5] Physiological and Psychophysical Factors

Chair: Hiroyasu Ujike (AIST)

Co-Chair: Masamitsu Harasawa (NHK)

5:20 PM - 6:40 PM Mid-sized Hall A (1F)

[VHF5-1(Invited)] A Modeling Approach to Investigate
the Relationship Between Motion
Sickness Severity and Visual Motion

*Akira Tanaka¹, Norihiro Sugita², Makoto
Yoshizawa², Tomoyuki Yambe² (1.
Fukushima University (Japan), 2. Tohoku
University (Japan))

5:20 PM - 5:45 PM

[VHF5-4L] Blue Light Promotes Heart Rate Recovery
After Exercise

*Emi Yuda¹, Yutaka Yoshida², Kento Yamamoto³,
Junichiro Hayano⁴ (1. Tohoku University Graduate
School of Engineering (Japan), 2. Nagoya City
University Graduate School of Art and Engineering
(Japan), 3. University of Tsukuba Graduate School
of Sports Medicine (Japan), 4. Nagoya City
University Graduate School of Medical Sciences

(Japan))

5:45 PM - 6:00 PM

[VHF5-3] Immanent Dichromatic in Trichromatic
Observer: Based on MDS Analyses of R-G
Neutral- and Y-B Only Changed- Stimuli
Observation Results

*Shoko Hira¹, Asuka Sako¹, Ryusuke Uto¹, Kota
Kanari², Minoru Ohkoba², Tomoharu Ishikawa², Miyoshi
Ayama², Sakuichi Ohtsuka¹ (1. Kagoshima University
(Japan), 2. Utsunomiya University (Japan))

6:05 PM - 6:25 PM

[VHF5-5L] Effects of motion sickness on driving tasks

*Daisuke Sugiyama¹ (1. Niigata University
(Japan))

6:25 PM - 6:40 PM

Mid-sized Hall B

Oral Presentation

[AMD4] Emerging TFTs

Chair: Hyun Jae Kim (Yonsei Univ.)

Co-Chair: Yosei Shibata (Tohoku Univ.)

9:00 AM - 10:20 AM Mid-sized Hall B (1F)

[AMD4-1(Invited)] Active-Matrix Driven Flexible mini-
LED Displays based on High-
Performance Organic Single-Crystal
TFTs

*Jun Takeya^{1,2} (1. The University of
Tokyo (Japan), 2. Organo-Circuit Inc.
(Japan))

9:00 AM - 9:25 AM

[AMD4-2(Invited)] Printing of 3D Electronic Circuits
and Organic Thin-Film Transistors

*Takeo Minari¹, Qingqing Sun¹, Wanli Li¹,
Xuying Liu², Masayuki Kanehara³ (1.
National Institute for Materials Science
(NIMS) (Japan), 2. Zhengzhou University
(China), 3. C-INK Co., Ltd. (Japan))

9:25 AM - 9:50 AM

[AMD4-4L] Integrated Polycrystalline Silicon Photomask
Technology for Low-Temperature
Polycrystalline Silicon (LTPS) TFTs

*Jia-Hong Ye¹, Ching-Liang Huang¹, Kuo-Yu Huang¹,
Maw-Song Chen¹, Wen-Ching Tsai¹, Wei-Ming Huang¹,
Yang-An Wu¹ (1. AUO (Taiwan))

9:50 AM - 10:05 AM

[AMD4-5L] Improving Performances of Oxide

Phototransistors Using a Mechano-Chemically Treated Porous Structure as The Visible Light Absorption Layer

*I Sak Lee¹, Bennet Nii Akwei Brown², Dongwoo Kim¹, Sujin Jung¹, Byung Ha Kang¹, Hyun Jae Kim¹
(1. Yonsei University (Korea), 2. Columbia University (United States of America))

10:05 AM - 10:20 AM

Oral Presentation

[FLX2] Stretchable and Flexbile Devices

Chair: Manabu Ito (Toppan Printing Co.)

Co-Chair: Mitsuru Nakata (NHK)

5:20 PM - 6:30 PM Mid-sized Hall B (1F)

[FLX2-1(Invited)] Development of Flexible / Stretchable Epoxy Film with High Thermal Stability, Especially Suitable for Versatile Printed Electronics Applications

*Noriyasu Yamane¹, Kenta Yamamoto¹, Kotaro Nozawa¹, Takashi Komori¹, Tomohide Murase¹, Takayoshi Hirai¹ (1. Mitsubishi Chemical Corporation (Japan))

5:20 PM - 5:45 PM

[FLX2-2(Invited)] High Performance IGT0 Transistors with Stretchable Gate Dielectric Layer

*Jae Kyeong Jeong¹, Jae Seok Hur Hur¹, Jeong Oh Kim¹ (1. Hanyang University (Korea))

5:45 PM - 6:10 PM

[FLX2-3] Study on Top-Gate Self-Aligned InGaZnO TFTs on PI Substrate

*Nian Liu¹, Huafei Xie², Macai Lu¹, Xueru Mei¹, Lei Wen¹, Shujih Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

6:10 PM - 6:30 PM

Room 107

Oral Presentation

[EP2/DES4] Advanced Electronic Paper Displays and Systems

Chair: Norihisa Kobayashi (Chiba Univ.)

Co-Chair: Haruhiko Okumura (Toshiba)

9:00 AM - 10:35 AM Room 107 (1F)

[EP2/DES4-5L(Invited)] High-Performance and Low-Power Full Color Reflective LCD for New Applications

*Hiroyuki Hakoi¹, Ming Ni¹, Junichi Hashimoto¹, Takashi Sato¹, Shinji Shimada¹, Kiyoshi Minoura¹, Akiko Itoh¹, Kohei Tanaka¹, Hiroshi Matsukizono¹, Masashi Otsubo¹ (1. SHARP Corporation (Japan))

9:00 AM - 9:20 AM

[EP2/DES4-2(Invited)] Reflective Electro-Wetting Displays for Out Of Home Display Applications

*Doeke J Oostra¹ (1. Etulipa (Netherlands))

9:25 AM - 9:50 AM

[EP2/DES4-3(Invited)] Specification for Color E-paper

*Alex Henzen^{1,2}, Guofu Zhou^{1,2,3} (1. South China Normal University (China), 2. Liquid Light Ltd. (China), 3. Shenzhen Guohua Optoelectronics (China))

9:50 AM - 10:15 AM

[EP2/DES4-4] The Driving System of Electrowetting Display Based on Multi-Gray Dynamic Symmetry Driving Waveform

*shanling Lin¹, Mingyong Qian¹, Zhixian Lin¹, Tailiang Guo¹ (1. Fuzhou University (China))

10:15 AM - 10:35 AM

Oral Presentation

[EP3] Electrochromic Devices

Chair: Shuichi Maeda (Tokai University)

Co-Chair: Yoshihiko Hotta (Ricoh)

5:20 PM - 6:20 PM Room 107 (1F)

[EP3-1L] Nature-Inspired Flexible Electrochromic Devices

*Masayoshi Higuchi¹, Yukio Fijii¹, Shigeki Kuroiwa², Keishi Ohashi², Yoshiharu Hamada³, Akihiko Kubota³

(1. National Institute for Materials Science (Japan), 2. Waseda University (Japan), 3. Tama Art University (Japan))

5:20 PM - 5:35 PM

[EP3-2L] Optimization of Prussian Blue Modified

Counter Electrode in Ag Deposition-based Electrochromic Device

*Shunsuke Kimura¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

5:35 PM - 5:50 PM

[EP3-3L] Relationship of Thickness of ITO Particle-modified Counter Electrode into Electrochromic Properties of 10-methylphenothiazine

*Zhuang Liang¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

5:50 PM - 6:05 PM

[EP3-4L] Ultrahigh Cycle Stability in an Electrochromic Device with Fe(II)-Based Metallo-Supramolecular Polymer

*SANJOY MONDAL¹, MASAYOSHI HIGUCHI¹ (1. Electronic Functional Macromolecules Group, National Institute for Materials Science (NIMS), (Japan))

6:05 PM - 6:20 PM

Room 108

Oral Presentation

[PRJ2] Optical Components

Chair: Hidekazu Hatanaka (USHIO)

Co-Chair: Juiwei Pan (Chiao Tung Univ.)

9:00 AM - 10:20 AM Room 108 (1F)

- [PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes
- *Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiro Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyota Gosei Co., Ltd. (Japan))
- 9:00 AM - 9:20 AM

- [PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays
- Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway

(Norway))

9:20 AM - 9:40 AM

[PRJ2-3] Achromatic Total Internal Reflection Prism in DLP Projection System

*Ya-Chi Lu¹, Jhong-Syuan Li¹, Kao-Der Chang², Shie-Chang Jeng¹, Jui-Wen Pan¹ (1. National Chiao Tung University (Taiwan), 2. Industrial Technology Research Institute (Taiwan))

9:40 AM - 10:00 AM

[PRJ2-4] High Power Red Laser Diode for Projector Light Source

*Masato Hagimoto¹, Shintaro Miyamoto¹, Yuki Kimura¹, Haruki Fukai¹, Manabu Hashizume¹, Satoshi Kawanaka¹ (1. USHIO OPTO SEMICONDUCTORS, INC. (Japan))

10:00 AM - 10:20 AM

Oral Presentation

[PRJ3] Image Quality and Display Devices

Chair: Andrés Vásquez Quintero (University of Ghent)

Co-Chair: Tetsuji Suzuki (JVC KENWOOD)

5:20 PM - 6:40 PM Room 108 (1F)

- [PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications
- *Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))
- 5:20 PM - 5:40 PM
- [PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology
- *Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))
- 5:40 PM - 6:00 PM
- [PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module
- *Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))
- 6:00 PM - 6:20 PM
- [PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects
- *Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

6:20 PM - 6:40 PM

Small Hall

Oral Presentation

[3DSA5/3D5] Light Field 2

Chair: Jung-Young Son (Konyang Univ.)

Co-Chair: Munekazu Date (NTT)

5:20 PM - 6:40 PM Small Hall (2F)

[3DSA5/3D5-1] An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom*Sangwoon Kwak¹, Joungil Yun¹, Won-Sik Cheong¹, Jeongil Seo¹ (1. ETRI (Korea))

5:20 PM - 5:40 PM

[3DSA5/3D5-2] GPU-Accelerated Interactive Virtual View Synthesis from Light Field Images*Hyeonjin Jung¹, Joungil Yun², Won-Sik Cheong², Youngmin Yi¹ (1. University of Seoul (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

5:40 PM - 6:00 PM

[3DSA5/3D5-3] Accommodation Response to a Super-Multiview Display Based on Time-Division Multiplexing Parallax Barrier*Yuta Watanabe¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:00 PM - 6:20 PM

[3DSA5/3D5-4] An Autostereoscopic Display with Time-Multiplexed Directional Backlight Using a Curved Lens Array*Garimagai Borjigin¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:20 PM - 6:40 PM

Oral Presentation

[3D4/VHF4/3DSA4] Illusion

Chair: Sumio Yano (Shimane University)

Co-Chair: Yuzo Hisatake (Shizuoka Univ.)

9:00 AM - 10:20 AM Small Hall (2F)

[3D4/VHF4/3DSA4-1(Invited)] Innovative mobile force display: Buru-Navi*Hiroaki Gomi¹, Sho Ito¹, Ryoma Tanase¹ (1. NTT Communication Science Labs. (Japan))

9:00 AM - 9:20 AM

[3D4/VHF4/3DSA4-2(Invited)] Displaying Deformation of Virtual Objects Using Visuo-Haptic Interaction*Yuki Ban¹ (1. The University of Tokyo (Japan))

9:20 AM - 9:40 AM

[3D4/VHF4/3DSA4-3(Invited)] Real-World Implementations of Visual Illusions by Using Augmented Reality Techniques*Takahiro Kawabe¹ (1. NTT Communication Science Laboratories (Japan))

9:40 AM - 10:00 AM

[3D4/VHF4/3DSA4-4] Gloss Enhancement beyond Projector Performance using the Glare Illusion*Shinji Nagata¹, Toshiyuki Amano¹ (1. Wakayama University (Japan))

10:00 AM - 10:20 AM

Room 204

Oral Presentation

[OLED4] QD Material & Devices

Chair: Takeo Wakimoto (Merck Performance Materials)

Co-Chair: Toshiaki Ikuta (JNC Corp.)

9:00 AM - 10:35 AM Room 204 (2F)

[OLED4-1(Invited)] Anion Exchange Perovskite Quantum-Dots for Highly Efficient Light Emitting Devices*Takayuki Chiba¹, Junji Kido¹ (1. Yamagata University (Japan))

9:00 AM - 9:20 AM

[OLED4-2(Invited)] Efficient Perovskite Light-Emitting Diodes Enabled by Synergetic Device ArchitectureYanqing Li¹, Yang Shen¹, *Jianxin Tang¹ (1. Soochow University (China))

9:20 AM - 9:40 AM

[OLED4-3] "Efficient Indium Phosphate based Quantum Dot Light Emitting Diode using Sol-gel processed Electron Transfer Layer"*Ji Eun Yeom¹, Dong Hyun Shin¹, Mude Nagarjuna Naik¹, Raju Lampande¹, Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

9:40 AM - 10:00 AM

[OLED4-4] Ambient Contrast Ratio Study of QD-OLED Devices

*SU PAN¹ (1. Shenzhen China Star Optoelectronics Display Technology Co.,Ltd (China))

10:00 AM - 10:20 AM

[OLED4-5L] Solution-Processed Indium-Gallium-Nitride (InGaN) Blue Light-Emitting Diodes (LEDs)

*TADAHIKO HIRAI¹, TETSUO TSUCHIYA² (1. CSIRO (Australia), 2. AIST (Japan))

10:20 AM - 10:35 AM

Oral Presentation

[OLED5] OLED Optical Design

Chair: Yasunori Kijima (Huawei Technologies Japan K. K.)
Co-Chair: kengo Kishino (idemitsu Kosan Co, Ltd.)

5:20 PM - 6:40 PM Room 204 (2F)

[OLED5-1(Invited)] Self assembled cathode patterning for AMOLED

*Michael G. Helander¹, Zhibin Wang¹,
Jacky Qiu¹, Yilu Chang¹, Qi Wang¹,
Yingjie Zhang¹ (1. OTI Lumionics Inc.
(Canada))

5:20 PM - 5:40 PM

[OLED5-2] Thermal evaporation process based organic/Ag/ organic transparent conducting electrode for flexible optoelectronic applications

*Subin Lee¹, Hyeong Woo Bae¹, Jang Hyuk Kwon¹, Jun Sik Oh¹ (1. Kyung Hee University (Korea))

5:40 PM - 6:00 PM

[OLED5-3] Design of Color Filter based on Metallic Nanostructure and Color Conversion Material for White OLED Display

*Hye-Bin Yang¹, Wonrea Kim², Younghoon Kim², Musun Kwak², Young-Joo Kim¹ (1. Yonsei University (Korea), 2. LG Display (Korea))

6:00 PM - 6:20 PM

[OLED5-4] Light Extraction and Viewing Angle Characteristics of Nano-structure embedded Top-emitting OLEDs fabricated by Vacuum Deposition Processes

*Doo-Hee Cho¹, Young-Sam Park¹, Hyunsu Cho¹, Kang Me Lee¹, Hye Jin Yun¹, Seung-Youl Kang¹, Seong-Deok Ahn¹, Hyunkoo Lee¹ (1. ETRI (Korea))

6:20 PM - 6:40 PM

Room 206

Oral Presentation

[INP3] Haptic Technologies (1)

Chair: Makoto Sato (Tokyo Institute of Technology)

Co-Chair: Nobuyuki Hashimoto (Citizen)

9:00 AM - 10:15 AM Room 206 (2F)

[INP3-1(Invited)] Widespread Hapbeat: Tension Based Necklace Type Haptic Display

*Yusuke Yamazaki¹, Hironori Mitake¹,
Akihiko Shirai², Shoichi Hasegawa¹ (1.
Tokyo Institute of Technology (Japan),
2. GREE, Inc. (Japan))

9:00 AM - 9:25 AM

[INP3-2(Invited)] Comptics: A system for making and sharing haptic experience

*Toshiki Wada¹, Hiroyoshi Togo¹ (1. NTT
(Japan))

9:25 AM - 9:50 AM

[INP3-3(Invited)] Buttock Skin Stretch Devices for Enhancing Driving Experience

*Masashi Konyo¹ (1. Tohoku University
(Japan))

9:50 AM - 10:15 AM

Oral Presentation

[INP4] Haptic Technologies (2)

Chair: Masashi Konyo (Tohoku University)

Co-Chair: Vibol Yem (Tokyo Metropolitan University)

5:20 PM - 6:50 PM Room 206 (2F)

[INP4-1(Invited)] Sensory Illusion beyond Real Haptics

*Norio Nakamura^{1,2} (1. AIST (Japan), 2.
Miraisens, Inc. (Japan))

5:20 PM - 5:45 PM

[INP4-2(Invited)] Wearable Tactile Device for Fingertip Interaction with Virtual World

*Vibol Yem¹ (1. Tokyo Metropolitan
University (Japan))

5:45 PM - 6:10 PM

[INP4-3(Invited)] Input and Output Interaction Technologies for Flexible Touch Panels

*Ki-Uk Kyung¹ (1. KAIST (Korea))

6:10 PM - 6:35 PM

[INP4-4L] 8.4" Tactile Touch Display using Segmented-electrode array as both tactile pixels and

touch sensors

*Takuya Asai¹, Hiroshi Haga¹, Shin Takeuchi¹,
Harue Sasaki¹, Koji Shigemura¹ (1. Tianma Japan
(Japan))

6:35 PM - 6:50 PM

Fri. Nov 29, 2019

Conference Hall

Oral Presentation

[MEET3] Emerging Quantum Dots and Nanotechnologies (1)

Chair: Christophe Martinez (CEA LETI)

Co-Chair: Haizheng Zhong (Beijing Institute of Technology)

9:00 AM - 10:20 AM Conference Hall (1F)

[MEET3-1(Invited)] Developing Cd-free QLEDs for Display Applications

*Zhuo Chen¹, Dong Li¹, Boris Kristal¹,
Jingwen Feng¹, Zhigao Lu¹, Gang Yu¹,
Yanzhao Li¹, Xinguo Li¹, Xiaoguang Xu¹
(1. BOE Technology Group Co., Ltd.
(China))

9:00 AM - 9:20 AM

[MEET3-2(Invited)] Horizontally Oriented Exciton Dipoles in Solution-Processed Quantum Dot Solids

*Chih-Jen Shih¹, Jakub Jagielski¹, Simon
Solari¹, Sudhir Kumar¹ (1. ETH Zurich,
Switzerland (Switzerland))

9:20 AM - 9:40 AM

[MEET3-3(Invited)] Controlling Charge Injection Properties of Quantum Dot Light-Emitting Diodes

*Jeonghun Kwak¹, Seunghyun Rhee¹, Taesoo
Lee¹, Guen-Woo Baek¹, Kyunghwan Kim¹,
Yeseul Park¹ (1. Seoul National
University (Korea))

9:40 AM - 10:00 AM

[MEET3-4(Invited)] High Efficiency Cadmium-free Red Quantum Dot-Light Emitting Diodes

*Jang Hyuk Kwon¹ (1. Kyung Hee
University (Korea))

10:00 AM - 10:20 AM

Oral Presentation

[MEET4] Emerging Quantum Dots and Nanotechnologies (2)

Chair: Shuming Chen (Southern University of Science and Technology)

Co-Chair: Zhaojun Liu (Southern University of Science and Technology)

10:40 AM - 11:40 AM Conference Hall (1F)

[MEET4-1(Invited)] In-situ Fabricated Perovskite

Quantum Dots for Display

Applications

*Haizheng Zhong¹ (1. Beijing Institute
of Technology (China))

10:40 AM - 11:00 AM

[MEET4-3(Invited)] Hybrid Colloidal Quantum Dot Photonic Devices

*Chien-chung Lin^{1,2} (1. National Chiao
Tung University (Taiwan), 2. Industrial
Technology Research Institute
(Taiwan))

11:20 AM - 11:40 AM

Oral Presentation

[MEET5] Micro/NanoDisplays and Nanotechnology Application (1)

Chair: Poopathy Kathirgamanathan (Brunel University London)

Co-Chair: Kyu Chang Park (KyungHee University)

1:20 PM - 2:40 PM Conference Hall (1F)

[MEET5-1(Invited)] Design Considerations for Holographic Retinal Projection Display

*Christophe Martinez¹, Fabian
Rainouard¹, Basile Meynard¹ (1. CEA
Leti (France))

1:20 PM - 1:40 PM

[MEET5-2(Invited)] Highly Efficient Stack Quantum-dot Light Emitting Diodes using Charge Generation Junctions

*Jin Jang¹, Suihui Lee¹, Hyo-min Kim¹,
Yuanfeng Chen¹ (1. Advanced Display
Research Center, Kyung Hee University
(Korea))

1:40 PM - 2:00 PM

[MEET5-3(Invited)] Investigation of Temperature-dependent Behaviors of Micro-LED Displays

*Zhaojun Liu¹, Bo Lu¹, Minggang Liu²,
Yong Fan², Jiayu Lee², Yan Wang¹, Hao-
Chung Kuo³, Xiaowei Sun¹ (1. Southern
University of Science and Technology
(China), 2. Shenzhen China Star
Optoelectronics Technology Co., Ltd
(China), 3. National Chiao Tung
University (Taiwan))

2:00 PM - 2:20 PM

[MEET5-4(Invited)] Towards High Resolution Active-Matrix GaN μ -LED Based Micro Displays
 Junyang Nie^{2,1}, Zhijie Ke³, Yongai Zhang¹, Xiongtu Zhou¹, Tailiang Guo¹, Congyan Lu⁵, Yiren Chen⁵, Zhangxu Pan⁶, Ling Li⁴, Di Geng⁴, Hang Song⁵, Zheng Gong⁶, *Jie Sun¹, Qun Yan^{1,2} (1. Fuzhou University (China), 2. Xi'an Jiaotong University (China), 3. Xiamen Changelight Co. Ltd. (China), 4. Institute of Microelectronics, Chinese Academy of Sciences (China), 5. Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science, China (China), 6. Guangdong Institute of Semiconductor Industry Technology, Guangdong Academy of Sciences (China))
 2:20 PM - 2:40 PM

Oral Presentation

[MEET6] Micro/NanoDisplays and Nanotechnology Application (2)

Chair: Chih-Jen Shih (ETH Zurich, Switzerland)
 Co-Chair: Jeonghun Kwak (Seoul National University)
 3:00 PM - 4:20 PM Conference Hall (1F)

[MEET6-1(Invited)] Toward for Ultimate Displays with MicroLED by PixelLED Display Technology
 *Ying-Tsang (Falcon) Liu¹, Kuan-Yung Liao¹, Yun-Li Li¹ (1. PlayNitride Inc. (Taiwan))
 3:00 PM - 3:20 PM

[MEET6-2(Invited)] Impressive Technologies for MicroLED Displays
 *Zine Bouhamri¹, Eric Virey¹ (1. Yole Developpement (France))
 3:20 PM - 3:40 PM

[MEET6-3] 17.3-in Mini-LEDs halo effect and human factor study for high-end notebook application
 *Hao-Hao Wu¹, Jenn-Jia Su¹, Chun-Sheng Li¹, Han-Ping Kuo¹, Yu-Hsiu Chang¹, Chia-En Fuh¹, Bo-Yuan Su¹ (1. AU Optonics Corporation (Taiwan))
 3:40 PM - 4:00 PM

[MEET6-4L] In-situ EUV Irradiation for Etching Residual Removal of AM Mini-LED
 YONG DENG¹, JUNLING LIU¹, *MINLI TAN¹, MIN XIONG¹, LIANGYI CAI¹, WENBO LIU¹, QUANSHENG LIU¹, YIFENG YANG¹, RUI ZHAO¹, WEIMIN ZHANG¹ (1. Shenzhen China Star Optoelectronic Technology Company, Ltd. (China))
 4:00 PM - 4:20 PM

Mid-sized Hall A

Oral Presentation

[LCT5/FMC5] High Performance 8K LCDs

Chair: Koichi Miyachi (JSR)
 Co-Chair: Toshimitsu Tsuzuki (NHK)
 9:00 AM - 10:35 AM Mid-sized Hall A (1F)

[LCT5/FMC5-1(Invited)] Novel Liquid Crystal Display mode "UV²All" with Photo Alignment Technology for a Large-Screen 8K Display
 *Shinichi Terashita¹, Kouichi Watanabe¹, Fumikazu Shimoshikiryo¹ (1. Sharp Corporation (Japan))
 9:00 AM - 9:25 AM

[LCT5/FMC5-2(Invited)] Novel Pixel Structure for the Improving Optical Performances of 8K LCD Panel
 *Kwangsoo Bae¹, Minjoeng Oh¹, Beomsoo Park¹, Young Je Cho¹, Sang Hwan Cho¹, Dong Hwan Kim¹ (1. Samsung Display (Korea))
 9:25 AM - 9:50 AM

[LCT5/FMC5-3(Invited)] 17-inch Laser Backlight LCD with 8K, 120-Hz Driving and BT.2020 Color Gamut
 Yoichi Asakawa¹, Ken Onoda¹, Hiroaki Kijima¹, *Shinichi Komura¹ (1. Japan Display Inc. (Japan))
 9:50 AM - 10:15 AM

[LCT5_FMC5-4L] 55" High Contrast Ratio Panel Produced by Pixel Level Local Dimming Technology
 *Chun-chi Chen¹, Yan-Xue Wang¹, Young-Yuan Qiu¹, Gang Yu¹, Chung-Yi Chiu¹, Bin Zhao¹, Xin Zhang¹ (1. China Star Optoelectronics Technology Company, Ltd. (China))
 10:15 AM - 10:35 AM

Oral Presentation

[LCT6] New LC Applications

Chair: Hideo Ichinose (Merck Performance Materials Ltd.)

Co-Chair: Fumito Araoka (RIKEN)

10:40 AM - 12:10 PM Mid-sized Hall A (1F)

[LCT6-1(Invited)] Transport of Ions, Electrons and Molecules in Nanostructured Liquid Crystals for Their New Applications*Takashi Kato¹ (1. The University of Tokyo (Japan))

10:40 AM - 11:05 AM

[LCT6-2(Invited)] Cellulose Derivatives for Color Imaging Applications*Seiichi Furumi¹ (1. Tokyo University of Science (Japan))

11:05 AM - 11:30 AM

[LCT6-4L] Dye-doped liquid crystal light shutter fabricated by thermally-induced phase separation*Yeongyu Choi¹, Seung-Won Oh¹, Tae-Hoon Yoon¹ (1. Pusan National University (Korea))

11:30 AM - 11:50 AM

[LCT6-5L] High Performance Liquid Crystal on Silicon Spatial Light Modulator (LCOS-SLM) and Flicker Noise Reduction of Multiple Spots*Hiroshi Tanaka¹, Hiroto Sakai¹, Munenori Takumi¹, Haruyoshi Toyoda¹ (1. Hamamatsu photonics K.K. (Japan))

11:50 AM - 12:10 PM

Oral Presentation

[VHF6] Ergonomics for Display Applications I

Chair: Nobuyuki Hiruma (NHK-ES)

Co-Chair: Gosuke Ohashi (Shizuoka University)

1:20 PM - 2:45 PM Mid-sized Hall A (1F)

[VHF6-1(Invited)] Trends in Human-Centric Office Design*Michihiko Okamoto¹, Takao Kiyoshige¹, Toru Ohkawa¹, Taishiro Iwasaki¹, Yousuke Shimoda¹ (1. Takenaka Corporation (Japan))

1:20 PM - 1:45 PM

[VHF6-2(Invited)] Development and IEC Standardization of Electronic Display for Elevator and Escalator*Junkai Li¹, Huixun Li², Weixiang Xue³ (1. Zhejiang Usenc Technology Co.,Ltd

(China), 2. CANNY ELEVATOR CO.,LTD

(China), 3. Otis Electric Elevator Co., Ltd (China))

1:45 PM - 2:10 PM

[VHF6-3] Educational Effectiveness and Learner Behavior When Using Desktop-Style VR System*Takashi Shibata¹, Erika Drago², Takayuki Araki³, Tatsuya Horita⁴ (1. Tokyo University of Social Welfare (Japan), 2. Musashino University Chiyoda High School (Japan), 3. Musashino University (Japan), 4. Tohoku University (Japan))

2:10 PM - 2:30 PM

[VHF6-4L] Cylindrical Transparent Display with Hologram Screen*Tomoharu Nakamura¹, Akira Tanaka¹, Tsuyoshi Kaneko¹, Masanori Iwasaki¹, Takayuki Kurihara¹, Noriyuki Kato¹, Koji Kuramoto¹, Hidehiko Takanashi¹, Yuji Nakahata¹ (1. Sony Corporation (Japan))

2:30 PM - 2:45 PM

Oral Presentation

[VHF7] Ergonomics for Display Applications II

Chair: Nobuyuki Hiruma (NHK-ES)

Co-Chair: Shin-ichi Uehara (AGC)

3:00 PM - 4:25 PM Mid-sized Hall A (1F)

[VHF7-1(Invited)] Standardization of ergonomics requirements for 'Dynamics Sign' in ISO*Hiroshi Watanabe¹, Hiroyasu Ujike¹, Nana Itoh¹, Ken Sagawa¹, Reiko Sakata², Akiko Imahashi², Naoki Furuhashi², Masami Aikawa² (1. AIST (Japan), 2. Mitsubishi Elec. (Japan))

3:00 PM - 3:25 PM

[VHF7-4L(Invited)] Development of an 8K-class 3D Shooting System for Microscopic Surgery and the World's First Shooting*Taichiro Kurita¹ (1. NHK Technologies, Inc. (Japan))

3:25 PM - 3:50 PM

[VHF7-3] Computational Classification of Texture Contents in the Shitsukan Research Database*Norifumi Kawabata¹ (1. Tokyo University of Science (Japan))

3:50 PM - 4:10 PM

[VHF7-5L] Advanced Reflectionless Technology for Reflected Glare Reduction*Yu Hung Chen¹, Kai Chieh Chang¹ (1. AU Optronics Corporation (Taiwan))

4:10 PM - 4:25 PM

Mid-sized Hall B

Oral Presentation

[AMD5] Oxide TFT: Device Fundamentals

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Hideya Kumomi (Tokyo Tech.)

9:00 AM - 10:30 AM Mid-sized Hall B (1F)

[AMD5-1(Invited)] Switching Characteristic Enhancement of P-type Cu₂O TFTsDongwoo Kim¹, I Sak Lee¹, Sujin Jung¹, Sung Min Rho¹, *Hyun Jae Kim¹ (1. Yonsei University (Korea))

9:00 AM - 9:25 AM

[AMD5-2(Invited)] High Mobility Metal-Oxide Devices for Display SoP and 3D Brain-Mimicking IC*Albert Chin¹, Te Jui Yen¹, Cheng Wei Shih¹, You-Da Chen¹ (1. National Chiao Tung University (Taiwan))

9:25 AM - 9:50 AM

[AMD5-3] High Mobility Oxide TFT Based on In-rich In-Ga-Sn-O Semiconductors with Nanocrystalline Structures*XUERU MEI², HUAFAEI XIE¹, NIAN LIU², MACAI LU², Lei Wen², Shujhih Chen², Shengdong Zhang², Chiayu Lee², Xin Zhang² (1. Peking University (China), 2. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd (China))

9:50 AM - 10:10 AM

[AMD5-4] Simulation Study of Self-Heating and Edge Effects on Oxide-Semiconductor TFTs: Channel-Width Dependence*Katsumi Abe¹, Kazuki Ota¹, Takeshi Kuwagaki¹ (1. Silvaco Japan Co., Ltd. (Japan))

10:10 AM - 10:30 AM

Oral Presentation

[AMD6] Oxide TFT: Device Application

Chair: Chuan Liu (Sun Yat-sen University)

Co-Chair: Susumu Horita (JAIST)

10:40 AM - 12:15 PM Mid-sized Hall B (1F)

[AMD6-1(Invited)] High Performance Short Channel Oxide TFTs for Transparent Top Emission OLED TVs*Chanki Ha¹, Eunah Heo¹, Wonbeom Yoo¹, Heungjo Lee¹, Keun-Yong Ban¹, Jonguk Bae¹, Jongwoo Kim¹ (1. LG Display (Korea))

10:40 AM - 11:05 AM

[AMD6-2(Invited)] Development of high mobility top gate IGZO-TFT for Automotive OLED display.*Yujiro Takeda¹, Aman Mehadi¹, Shogo Murashige¹, Kazuatsu Ito¹, Izumi Ishida¹, Shinji Nakajima¹, Hiroshi Matsukizono¹, Naoki Makita¹ (1. SHARP Corporation (Japan))

11:05 AM - 11:30 AM

[AMD6-3(Invited)] Top-Gate Oxide TFTs with Ion-Implanted Source/Drain Regions in Advanced LTPS Technology*Isao Suzumura¹, Toshihide Jinnai¹, Hajime Watakabe¹, Akihiro Hanada¹, Ryo Onodera¹, Tomoyuki Ito¹ (1. Japan Display Inc. (Japan))

11:30 AM - 11:55 AM

[AMD6-4] Fabrication of Top-Gate Self-Aligned

Amorphous InGaSnO TFTs with High Mobility

*Nian Liu¹, Huafei Xie², Xueru Mei¹, Macai Lu¹, Lei Wen¹, Shujhih Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

11:55 AM - 12:15 PM

Oral Presentation

[AMD7] Oxide TFT: Fabrication Process

Chair: Toshiaki Arai (JOLED Inc.)

Co-Chair: Yujiro Takeda (Sharp)

1:20 PM - 2:40 PM Mid-sized Hall B (1F)

[AMD7-1(Invited)] Nanostructured IGZO thin-film transistors with remarkably enhanced current density and on-off ratio
Kairong Huang¹, *Chuan Liu¹ (1. Sun Yat-sen University (China))

1:20 PM - 1:45 PM

[AMD7-2] Effect of Lanthanum Doping on the Electrical Performance of Spray Coated ZnO Thin Film Transistor

*RAVINDRA NAIK BUKKE¹, NARENDRA NAIK MUDE, JEWEL KUMER SAHA, YOUNGGOO KIM, JIN JANG (1. KYUNG HEE UNIVERSITY (Korea))

1:45 PM - 2:05 PM

[AMD7-3] Highly Stable High Mobility Top-gate Structured Oxide TFT by Supplying Optimized Oxygen and Hydrogen to Semiconductors

*Jong Beom Ko¹, Seung-Hee Lee¹, Sang-Hee Ko Park¹ (1. Korea Advanced Institute of Science and Technology (Korea))

2:05 PM - 2:25 PM

[AMD7-4L] Low-Temperature IGZO Technology on Transparent Plastic Foil by Atmospheric Spatial Atomic Layer Deposition

Corné Frijters^{1,2}, Roy Verbeek¹, Gerard de Haas¹, Tung Huei Ke³, Erwin Vandenplas³, Marc Ameys³, Jan-Laurens van der Steen¹, Gerwin Gelinck^{1,4}, Eric Meulenkamp¹, Paul Poodt^{1,2}, Auke Kronemeijer¹, *Ilias Katsouras¹ (1. TNO/Centre (Netherlands), 2. SALDtech B.V. (Netherlands), 3. imec (Belgium), 4. Eindhoven University of Technology (Netherlands))

2:25 PM - 2:40 PM

Oral Presentation

[AMD8] Advanced Driving Technology for High-quality Display

Chair: Masahide Inoue (Huawei Techs. Japan)
Co-Chair: Isao Suzumura (Japan Display Inc.)
3:00 PM - 4:25 PM Mid-sized Hall B (1F)

[AMD8-1(Invited)] High Performance Oxide TFT Technology for Med.-Large Size OLED Displays

*Toshiaki Arai¹ (1. JOLED Inc. (Japan))
3:00 PM - 3:25 PM

[AMD8-2] A 6T1C dynamic threshold voltage compensation IGZO-GOA circuit for 31-inch AMOLED display with slim border

*Yan Xue^{1,2}, Baixiang Han¹, Xian Wang¹, Shuai Zhou¹, Gary Chaw¹, Chun-Hsiung Fang¹, Yuan-Chun Wu¹ (1. CSOT (China), 2. Peiking university (China))

3:25 PM - 3:45 PM

[AMD8-3] New 3.5T2C Pixel Circuit with Symmetrical Structure for 3D AMOLED Displays

*Chieh-An Lin¹, Li-Jung Chen¹, Chia-Ling Tsai¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:45 PM - 4:05 PM

[AMD8-4] A Novel OLED Pixel Circuit with Controllable Threshold Voltage Compensation Time

*Jung Chul Kim¹, Seonghwan Hong¹, Sujin Jung¹, Mihee Sin², Jun Suk Yoo², Han Wook Hwang², Yong Min Ha², Hyun Jae Kim¹ (1. Yonsei University (Korea), 2. LG Display, Ltd. (Korea))

4:05 PM - 4:25 PM

Room 107

Oral Presentation

[DES5] Video Coding

Chair: Seishi Takamura (NTT)
Co-Chair: Haruhiko Okumura (Toshiba)
1:20 PM - 2:35 PM Room 107 (1F)

[DES5-1(Invited)] Emerging Technologies toward Future Video Coding

*Seishi Takamura¹ (1. NTT Corporation (Japan))

1:20 PM - 1:45 PM

[DES5-2(Invited)] Next Generation Video coding in 8K era - Versatile Video Coding and AI

*Tomohiro Ikai¹, Eiichi Sasaki¹, Yukinobu Yasugi¹, Tomonori Hashimoto¹, Tianyang Zhou¹, Takeshi Chujoh¹, Tomoko Aono¹, Norio Itoh¹ (1. Sharp Corporation (Japan))

1:45 PM - 2:10 PM

[DES5-3(Invited)] MPEG Point Cloud Compression; First Standard for Immersive Media

*Ohji Nakagami¹ (1. Sony Corporation (Japan))

2:10 PM - 2:35 PM

Oral Presentation

[DES6/AIS4] Image Processing

Chair: Yuji Oyamada (Tottori University)
Co-Chair: Mutsumi Kimura (Ryukoku univ.)
3:00 PM - 4:10 PM Room 107 (1F)

[DES6/AIS4-1(Invited)] Deep Learning-based Image Processing Algorithms in 8K Era

*SukJu Kang¹ (1. Sogang University
(Korea))

3:00 PM - 3:25 PM

[DES6/AIS4-2(Invited)] Omnidirectional/360-degree

Image and Video

Standardizations Status

*Junichi Hara¹ (1. RICOH Company,
LTD. (Japan))

3:25 PM - 3:50 PM

[DES6/AIS4-3] An Advanced TV Program Logo Processing
Algorithm for Preventing OLED TV Image
Sticking

*Lin Cheng¹, Yang Rao¹, Yufeng Jin¹, Yin-Hung
Chen¹, Ming-Jong Jou¹, Bin Zhao¹, Xin Zhang¹
(1. Shenzhen China Star Optoelectronics
Technology Company (China))

3:50 PM - 4:10 PM

Oral Presentation

[FLX3] Printed TFT Technologies

Chair: Hiroki Meada (Dai Nippon Printing Co., Ltd.)

Co-Chair: Takashi Nagase (Osaka Prefecture University)

9:00 AM - 10:15 AM Room 107 (1F)

[FLX3-1(Invited)] Printed Thin Film Transistors using
Semi-conductive Single Wall Carbon
Nanotube-Polymer Complexes

*Seiichiro Murase¹, Kazuki Isogai¹,
Takayoshi Hirai¹, Yasuhiro Kobayashi¹,
Kenta Noguchi¹, Hiroji Shimizu¹ (1.
Toray Industries, Inc. (Japan))

9:00 AM - 9:25 AM

[FLX3-2(Invited)] Towards Ideal Printed Organic
Transistors

Fuhua Dai¹, *Chuan Liu¹ (1. Sun Yat-sen
University (China))

9:25 AM - 9:50 AM

[FLX3-3(Invited)] Development of High Performance
Semiconductor Inks for Printed
Field-Effect Transistors For
Flexible Display

Huihui Zhu¹, Ao Liu¹, Dongseob Ji¹,
*YONG-YOUNG NOH¹ (1. Pohang University
of Science and Technology (POSTECH)
(Korea))

9:50 AM - 10:15 AM

Oral Presentation

[FLX4] Wearable Sensors and Devices

Chair: Yasuyoshi Mishima (National Institute of Advanced
Industrial Science and Technology)

Co-Chair: Hiroyuki Endoh (NEC Corp.)

10:40 AM - 12:15 PM Room 107 (1F)

[FLX4-1(Invited)] Ultra-flexible organic imager and
sensors

*Tomyouki Yokota¹, Takao Someya¹ (1. The
University of Tokyo (Japan))

10:40 AM - 11:05 AM

[FLX4-2(Invited)] Organic TFT-based Biosensors
Functionalized with Artificial
Receptors

*Tsuyoshi Minami¹ (1. Institute of
Industrial Science, The University of
Tokyo (Japan))

11:05 AM - 11:30 AM

[FLX4-3(Invited)] Ultra-Conformable Biodevice for
Advanced Medicine and Healthcare

*Toshinori Fujie¹ (1. Tokyo Institute of
Technology (Japan))

11:30 AM - 11:55 AM

[FLX4-4] Polysilicon CMOS TFTs on Ultrathin and
Flexible Stainless Steel Substrates

*Miki Trifunovic¹, Aditi Chandra¹, Mao Ito¹, Sarah
Khoo¹, Arvind Kamath¹ (1. Thin Film Electronics
Inc. (United States of America))

11:55 AM - 12:15 PM

Room 108

Oral Presentation

[PRJ4] Projection Mapping and Lighting

Chair: Shinsuke Shikama (Setsunan Univ.)

Co-Chair: Petra Aswendt (ViALUX GmbH)

9:00 AM - 10:35 AM Room 108 (1F)

[PRJ4-1(Invited)] Projection and Large Area Displays
of Artworks for Public Exhibits

*Naoko Tosa¹, Yang Qin¹, Ryohei Nakatsu¹
(1. Kyoto University (Japan))

9:00 AM - 9:20 AM

[PRJ4-2(Invited)] Perceptual Appearance Control by
Projection-Induced Illusion

*Ryo Akiyama¹, Goshiro Yamamoto²,
Toshiyuki Amano³, Takafumi Taketomi¹,
Alexander Plopski¹, Yuichiro Fujimoto¹,
Masayuki Kanbara¹, Christian Sandor⁴,

Hirokazu Kato¹ (1. Nara Institute of Science and Technology (Japan), 2. Kyoto University (Japan), 3. Wakayama University (Japan), 4. City University of Hong Kong (Hong Kong))

9:20 AM - 9:40 AM

[PRJ4-3(Invited)] New Concept Ultra Short Throw Projector for Consumer

*Ryutaro Otake¹, Misa Sakurai, Masakatsu Ito, Hiroshi Nakade, Yuuji Taniue, Masaru Matsumori (1. Panasonic Corporation (Japan))

9:40 AM - 10:00 AM

[PRJ4-4(Invited)] Industrial DLP Projection Technology

*Petra Aswendt¹, Roland Hoeftling¹ (1. ViALUX GmbH (Germany))

10:00 AM - 10:20 AM

[PRJ4-5L] Laser Phosphor Light Source with Hot Spot for Intelligent Headlight using DMD for Ultra-High Beam Applications

*Kenneth Li¹, Y.P. Chang² (1. Optonomus Technologies Inc. (United States of America), 2. Taiwan Color Optics, Inc. (Taiwan))

10:20 AM - 10:35 AM

Oral Presentation

[PRJ5] Automotive Display

Chair: Kazuhiro Ohara (Marubun)

Co-Chair: Masayuki Takayama (Honda)

10:40 AM - 12:20 PM Room 108 (1F)

[PRJ5-1(Invited)] Advanced Automotive Interior Lighting and Exterior Displays

*Karlheinz Blankenbach¹, Robert Isele², Mathias Roennfeldt³, Uli Hiller⁴ (1. Pforzheim University (Germany), 2. BMW (Germany), 3. Lightworks (Germany), 4. Osram Opto Semiconductors (Germany))

10:40 AM - 11:00 AM

[PRJ5-2(Invited)] Laser Crystal Phosphor Automobile Headlight Integrated with Beam Control and LiDAR

*Y. P. Chang^{1,2}, Alan Wang¹, Wood-Hi Cheng², Kenneth Li³ (1. Taiwan Color Optics, Inc. (Taiwan), 2. National Chun Hsing University (Taiwan), 3. Optonomus Technologies Inc. (United States of

America))

11:00 AM - 11:20 AM

[PRJ5-3(Invited)] Laser Light Sources for Next Generation Automotive Lighting Applications

*MENG HAN¹, Julian Carey¹, Paul Rudy¹ (1. SLD Laser (United States of America))

11:20 AM - 11:40 AM

[PRJ5-4(Invited)] Augmenting Reality In Automobiles

*Jamieson Jamieson Christmas¹ (1. Envisics Ltd (UK))

11:40 AM - 12:00 PM

[PRJ5-5] Development of Image Quality Simulation for Laser Scanning Projector using Microlens Screen

*Hiroyuki Tanabe¹ (1. Ricoh Industrial Solutions Inc (Japan))

12:00 PM - 12:20 PM

Oral Presentation

[PRJ6/AIS3] AI

Chair: Makio Kurashige (DNP)

Co-Chair: Satoshi Ouchi (Hitachi)

1:20 PM - 2:35 PM Room 108 (1F)

[PRJ6/AIS3-1(Invited)] Visual Illusions Expressed by Deep Neural Networks

*Taisuke Kobayashi¹, Eiji

Watanabe^{1,2} (1.

Japan/Aichi/National Institute for Basic Biology (Japan), 2.

Japan/Aichi/The Graduate University for Advanced Studies (SOKENDAI) (Japan))

1:20 PM - 1:40 PM

[PRJ6/AIS3-2] Vertical View Human Action Recognition from Range Images

*Akinobu Watanabe¹, Keiichi Mitani¹ (1. Hitachi, Ltd. (Japan))

1:40 PM - 2:00 PM

[PRJ6/AIS3-3] High Efficiency Information Presentation Method for Head Mounted Display on Work Support

*Takuya Nakamichi¹, Chiyo Ohno¹, Shoji Yamamoto¹, Koji Yamasaki¹ (1. Hitachi, Ltd. (Japan))

2:00 PM - 2:20 PM

[PRJ6/AIS3-4L] High-Speed and High-Brightness Color
Single-Chip DLP Projector Using High-
Power LED-Based Light Sources

*Yoshihiro Watanabe^{1,2}, Masatoshi Ishikawa²

(1. Tokyo Institute of Technology (Japan),

2. University of Tokyo (Japan))

2:20 PM - 2:35 PM

Oral Presentation

[PRJ7/LCT8] Eyewear

Chair: Dieter Cuypers (CMST)

Co-Chair: Subaru Kawasaki (JNC Korea)

3:00 PM - 4:20 PM Room 108 (1F)

[PRJ7/LCT8-1] LC Lens Fabricated by Photoalignment for
AR/VR Systems

*Wei-Wei Chen¹, Jui-Wen Pan¹, Shie-Chang Jeng¹

(1. National Chiao Tung University

(Taiwan))

3:00 PM - 3:20 PM

[PRJ7/LCT8-2] Effect of Processing Parameters on
Visual Quality for Liquid Crystal
Displays Compatible with Contact Lenses

*Andres Vasquez Quintero¹, Pablo Perez-Merino², Sudha Sudha¹, Lucas Oorlynck¹,Herbert De Smet¹ (1. Ghent University /

imec, Centre for Microsystems Technology CMST

(Belgium), 2. Instituto de Investigacion

Sanitaria Fundacion Jimenez Diaz (Spain))

3:20 PM - 3:40 PM

[PRJ7/LCT8-3] Miniature Liquid Crystal Lens
Optimizations

*Dieter Cuypers¹, Rik Verplancke¹, Herbert DeSmet¹ (1. imec and Ghent University

(Belgium))

3:40 PM - 4:00 PM

[PRJ7/LCT8-4] Ferroelectric Liquid Crystal Dammann
Grating: for LiDAR Applications

*Zhengnan YUAN¹, Zhibo SUN¹, Abhishek KSRIVASTAVA¹ (1. The Hong Kong University of

Science and Technology (Hong Kong))

4:00 PM - 4:20 PM

Small Hall

Oral Presentation

[3DSA7/3D7] Virtual Reality 1

Chair: Tomohiro Tanikawa (The Univ. of Tokyo)

Co-Chair: Kenji Yamamoto (NICT)

10:40 AM - 12:00 PM Small Hall (2F)

[3DSA7/3D7-1(Invited)] Research and Development of
Second Generation Virtual
Reality

*Michitaka Hirose¹ (1. The

University of Tokyo (Japan))

10:40 AM - 11:00 AM

[3DSA7/3D7-2(Invited)] Computer vision, AI, AR
technology in various
industries

*You-Kwang Wang^{1,2}, Hung-Ya Tsai²,Chih-Hao Chuang³, Chien-Yu Chen¹

(1. National Taiwan University of

Science and Technology (Taiwan), 2.

OSENSE Technology Co. (Taiwan), 3.

National Taiwan University

(Taiwan))

11:00 AM - 11:20 AM

[3DSA7/3D7-3(Invited)] Impressive 3D CG technologies
for automotive HUDs with wide
FOV

*Haruhiko Okumura¹, TakashiSasaki¹, Aira Hotta¹, MasahiroSekine¹ (1. Toshiba Corp.

(Japan))

11:20 AM - 11:40 AM

[3DSA7/3D7-4(Invited)] Air Floating Image based on a
Dihedral Corner Reflector Array

*YUKI MAEDA¹ (1. Parity

Innovations Co. Ltd. (Japan))

11:40 AM - 12:00 PM

Oral Presentation

[3DSA9/3D9] Data Compression

Chair: Hideaki Kimata (NTT)

Co-Chair: Miwa Katayama (NHK)

3:00 PM - 4:20 PM Small Hall (2F)

[3DSA9/3D9-1] Verification of Compression Architecture
for 3DoF+ Immersive Video Delivery

*Gwangsoon Lee¹, Hong-Chang Hong¹, Homin Eum¹,Jeongil Seo¹ (1. ETRI (Korea))

3:00 PM - 3:20 PM

[3DSA9/3D9-2] FDM-based Global Motion Estimation for
Dynamic 3D Point Cloud Compression

*SO MYUNG LEE¹, Li Cui¹, Tianyu Dong¹, Eun-Yong Chang², Jihun Cha², Euee S. JANG¹ (1. Hanyang University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

3:20 PM - 3:40 PM

[3DSA9/3D9-3] MPEG Video-based Point Cloud Coding based on JPEG

*Tianyu Dong¹, So Myung Lee¹, Euee S. Jang¹ (1. Hanyang University (Korea))

3:40 PM - 4:00 PM

[3DSA9/3D9-4] Fast calculation method for computer-generated holograms using saccade suppression by lowering the resolution based on Fresnel zone plate reduction

*WEI LINGJIE¹, Fumio Okuyama², Yuji Sakamoto¹ (1. Hokkaido University (Japan), 2. New Generation Medical Center (Japan))

4:00 PM - 4:20 PM

Oral Presentation

[3D6/3DSA6] Distinguished Display

Chair: Hideki Kakeya (Univ. of Tsukuba)

Co-Chair: Yuki Maeda (Parity Innovations)

9:00 AM - 10:20 AM Small Hall (2F)

[3D6/3DSA6-1(Invited)] Importance of Continuous Motion

Parallax in Monocular and Binocular 3D Perception

*Haruki Mizushima¹, Shiro Suyama¹ (1. Tokushima University (Japan))

9:00 AM - 9:20 AM

[3D6/3DSA6-2] Further Crosstalk Reduction Method with Eye-Tracking for Glasses-Free Stereoscopic Display in Both Portrait and Landscape Modes

*Yukiya Yamaguchi¹, Hiroyuki Nakamura¹, Goro Hamagishi¹, Kayo Yoshimoto¹, Takuya Matsumoto², Kaoru Kusafuka², Hideya Takahashi¹ (1. Osaka City University (Japan), 2. Kyocera Corporation (Japan))

9:20 AM - 9:40 AM

[3D6/3DSA6-3] Measurement of Moiré Patterns in 3D Display

*Hea In Jeong¹, Seo Young Choi², Young Ju Jeong¹ (1. Sookmyung Women's University (Korea), 2. Korea Institute of Lighting & ICT

(Korea))

9:40 AM - 10:00 AM

[3D6/3DSA6-4] GPU Acceleration of Algorithm to Design Directional Volumetric Display for Real-time Processing

*Daiki Matsumoto¹, Ryuji Hirayama^{2,3}, Naoto Hoshikawa⁴, Hirotaka Nakayama⁵, Tomoyoshi Shimobaba¹, Tomoyoshi Ito¹, Atsushi Shiraki¹ (1. Chiba University (Japan), 2. Research Fellow of the Japan Society for the Promotion of Science (Japan), 3. Tokyo University of Science (Japan), 4. National Institute of Technology, Oyama College (Japan), 5. National Astronomical Observatory of Japan (Japan))

10:00 AM - 10:20 AM

Oral Presentation

[3D8/3DSA8] Virtual Reality 2

Chair: You Kwang Wang (Osense Technology)

Co-Chair: Haruki Mizushima (Tokushima University)

1:20 PM - 2:40 PM Small Hall (2F)

[3D8/3DSA8-1(Invited)] Service VR Training System: VR Simulator of Man-to-Man Service with Mental/Emotional Sensing and Intervention

*TOMOHIRO TANIKAWA¹, Yuki Ban¹, Kazuma Aoyama¹, Eiji Shinbori², Shigeru Komatsubara², Michitaka Hirose¹ (1. The University of Tokyo (Japan), 2. Dai Nippon Printing Co., Ltd. (Japan))

1:20 PM - 1:40 PM

[3D8/3DSA8-2] A HMD for users with any interocular distance

*Jung-Young Son¹, Hyoung Lee¹, Jung Kim¹, Beom-Ryeol Lee², Wook-Ho Son², Tetiana Venkel³ (1. Konyang University (Korea), 2. Electronics and Telecommunication Research Institute (Korea), 3. Chernivtsi University (Ukraine))

1:40 PM - 2:00 PM

[3D8/3DSA8-5L] Proposal for Light Field Mirage

*Yoshiharu Momono^{1,2}, Koya Yamamoto², Yasuhiro Takaki² (1. Samsung R&D Institute Japan (Japan), 2. Tokyo University of

Agriculture and Technology (Japan))

2:00 PM - 2:20 PM

- [3D8/3DSA8-4] Accuracy verification of visual appearance acquisition device of non-metallic material based on Sparse SVBRDF
- *Tsung-Lin Lu¹, Yu-Lun Liu¹, Yu-Cheng Hsieh¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))
- 2:20 PM - 2:40 PM

Room 204

Oral Presentation

[LCT7/FLX5] Flexible LCDs

Chair: Shinichiro Oka (Japan Display Inc.)

Co-Chair: Toshimasa Eguchi (Sumitomo Bakelite Co., Ltd.)

1:20 PM - 2:50 PM Room 204 (2F)

[LCT7/FLX5-1(Invited)] Flexible LCD with Colorless Polyimide

*Kaijun Wang¹, Chungue Yuan¹, Zhuhui Li¹, Li Zhang¹, Qiao Huang¹, Linshuang Li¹, Shujih Chen¹, Chia-Yu Lee¹, Xin Zhang² (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd. (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd. (China))

1:20 PM - 1:45 PM

[LCT7/FLX5-2(Invited)] Ultra-high contrast OLCD: Thin and light dual cell LCDs on plastic

*Paul A Cain¹, James Harding¹, William Reeves¹, May Wheeler¹ (1. FlexEnable Ltd (UK))

1:45 PM - 2:10 PM

[LCT7/FLX5-3] Formation of polymer walls with a high aspect ratio on a plastic substrate

*Su Min Do¹, Tae Hoon Choi¹, Jae Won Huh¹, Yeongyu Choi¹, Tae Hoon Yoon¹ (1. Pusan National University (Korea))

2:10 PM - 2:30 PM

[LCT7_FLX5-4L] New Approach to Process Simplification for Flexible TFT-LCD

*Cheng-He Ruan¹, Chih-Yuan Hou¹, Chia-Jen Li¹, Shih-Min Chen¹, Min-Zi Hong¹ (1. AU

Optronics Corporation (Taiwan))

2:30 PM - 2:50 PM

Oral Presentation

[PH1] Phosphors and Devices

Chair: Rong-Jun Xie (Xiamen University)

Co-Chair: Koutoku Ohmi (Tottori University)

10:40 AM - 11:55 AM Room 204 (2F)

[PH1-1(Invited)] Discovery of novel nitride phosphors by high throughput calculation

*Rong-Jun Xie¹, Shuxing Li¹, Zhenbin Wang², Shyue Ping Ong² (1. Xiamen University (China), 2. University of California, San Diego (United States of America))

10:40 AM - 11:00 AM

[PH1-2] Monolithic Full-color LED Micro-display Using Dual Wavelength LED Epilayers

*Peian Li¹, Xu Zhang¹, Yangfeng Li¹, Longheng Qi¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

11:00 AM - 11:20 AM

[PH1-3] Polarized Emitting qLEDs based on Aligned Quantum Rods as Active Material

Hendrik Schlicke¹, Christoph Schloen¹, Tobias Jochum¹, Sören Becker¹, Horst Weller^{1,2}, *Jan S Niehaus¹ (1. Fraunhofer CAN (Germany), 2. University of Hamburg (Germany))

11:20 AM - 11:40 AM

[PH1-4L] Development of (La,Y)₃Si₆N₁₁:Ce³⁺ Nitride Yellow Phosphors for High-Power Excitation

*Yuhei Inata¹, Shiho Takashina¹ (1. Mitsubishi Chemical Corp. (Japan))

11:40 AM - 11:55 AM

Oral Presentation

[OLED6] OLED Advanced Technologies

Chair: Yoshimasa Sakai (MITSUBISHI CHEMICAL)

Co-Chair: Sukekazu Aratani (Samsung Electronics)

9:00 AM - 10:15 AM Room 204 (2F)

[OLED6-1(Invited)] OLED/OPD-on-Silicon for Near-to-Eye Microdisplays and Sensing Applications

*Karsten Fehse¹, Dirk Schlebusch¹, Philipp Wartenberg¹, Steffen Ulbricht¹, Gerd Bunk¹, Stephan Brenner¹, Matthias Schober¹, Christian Schmidt¹, Bernd Richter¹, Uwe Vogel¹ (1. Fraunhofer

Institute for Organic Electronics,
Electron Beam and Plasma Technology FEP
(Germany))

9:00 AM - 9:20 AM

[OLED6-2] Ultra High Resolution Imaging Light
Measurement Device for Subpixel Metrology of
μ-LEDs and OLED-Displays

*Tobias Steinell¹, Thilo Gemeinhardt¹, Martin Wolf¹
(1. Instrument Systems GmbH (Germany))

9:20 AM - 9:40 AM

[OLED6-3] Enhanced Operational Stability of Quantum
Dot based Light-Emitting Diodes by Improving
Charge Injection Balance

*Seunghyun Rhee¹, Jun Hyuk Chang¹, Donghyo Hahm¹,
Kyunghwan Kim¹, Hak June Lee¹, Kookheon Char¹,
Changhee Lee¹, Wan Ki Bae², Jeonghun Kwak¹ (1.
Seoul National University (Korea), 2.
Sungkyunkwan University (Korea))

9:40 AM - 10:00 AM

[OLED6-4L(Invited)] Formation mechanism of spontaneous
orientation polarization in
evaporated films of organic light-
emitting diode materials

*Yutaka Noguchi¹, Kohei Osada¹, Hisao
Ishii² (1. Meiji University (Japan),
2. Chiba University (Japan))

10:00 AM - 10:15 AM

Oral Presentation

[FLX6] Advanced Process and Evaluation for
Flexible Electronics

Chair: Tadahiro Furukawa (Yamagata University)

Co-Chair: Akira Nakazawa (AGC Inc.)

3:00 PM - 4:00 PM Room 204 (2F)

[FLX6-1(Invited)] Solution-Processing of Inorganic and
Hybrid Materials for High
Performance Flexible Electronics

*Myung-Gil Kim¹ (1. Sungkyunkwan
University (Korea))

3:00 PM - 3:25 PM

[FLX6-2] Analysis and Design of Mechanical Stresses on
Foldable Devices

*Nao Ando¹, Kei Hyodo¹, Hisao Sasaki¹, Yoshihito
Ota¹, Tomoki Sasayama², Yoshihiko Iwao², Tomoya
Tsuda², Nao Terasaki³ (1. YUASA SYSTEM (Japan), 2.
Shimadzu Co. (Japan), 3. AIST (Japan))

3:25 PM - 3:45 PM

[FLX6-4L] To Make a Flexible Patch Type Photoelectric
Pulse Wave Sensor Highly Sensitivity

*Mana Hashimoto¹, Kazuki Ihara¹, Hiroshi
Kajitani¹, Hiroyuki Endo¹ (1. NEC Corporation.
(Japan))

3:45 PM - 4:00 PM

Room 206

Oral Presentation

[FMC6] Retardation Management

Chair: Takashi Sato (ZEON)

Co-Chair: Daisuke Ogomi (Nitto Denko Corporation)

10:40 AM - 11:40 AM Room 206 (2F)

[FMC6-2] New type 1/4-Wave Plate Film for OLED Panels

*Jiro Ishihara¹, Kenji Yoda¹, Shunsuke Takagi¹,
Kazuhiro Osato¹, Yuji Shibata¹, Taku Hatano¹ (1.
ZEON CORPORATION (Japan))

11:00 AM - 11:20 AM

[FMC6-3] Novel Chromakey Technology with Polarizer and
Retardation Film

*Yoshiaki Asano¹, Muneo Kaneko², Kazuya Yoshimura¹,
Katsunori Takada¹, Akinori Izaki¹ (1. Nitto Denko
Corporation (Japan), 2. Kansai Televisiaion Co.Ltd.
(Japan))

11:20 AM - 11:40 AM

Oral Presentation

[FMC7] Quantum Dot

Chair: Takao Tomono (Toppan Printing)

Co-Chair: Yukito Saitoh (FUJIFILM Corporation)

1:20 PM - 2:20 PM Room 206 (2F)

[FMC7-1(Invited)] Quantum Rod Enhancement Films for
Modern LCDs

Swadesh Kumar Gupta¹, Maksym F Prodanov¹,
Chengbin Kang¹, Cheng Chun Hin¹, Valerii
V Vashchenko¹, *Abhishek Kumar
Srivastava¹ (1. hong kong university of
science and technology (Hong Kong))

1:20 PM - 1:40 PM

[FMC7-2] Wide Color Gamut Display Solution Using
Hybrid-typed Perovskite Quantum Dots White
LEDs

Chieh-Yu Kang¹, Chih-Hao Lin¹, *Chun-Lin Tsai¹,
Chin-Wei Sher², Ting-zhu Wu³, Po-Tsung Lee¹, Hao-
Chung Kuo¹ (1. National Chiao Tung University

(Taiwan), 2. HKUST Fok Ying Tung Research Institute
(China), 3. Xiamen University (China))

1:40 PM - 2:00 PM

[FMC7-3] A Novel Display Technology— Perovskite
Quantum Dot Display with Blue OLEDs

*Miao Duan¹, Dongze Li¹, Zhiping Hu¹, Wenxiang
Peng¹, Yongwei Wu¹, Yongming Yin¹, Bo He¹, Pei
Jiang¹, Feng Jiang², Lifu Shi², Haizheng Zhong²,
Shu-jih Chen¹, Chia-Yu Lee¹, Xin Zhang¹ (1.
Shenzhen China Star Optoelectronics Semiconductor
Display Technology Co., Ltd. (China), 2. Beijing
Institute of Technology (China))

2:00 PM - 2:20 PM

Oral Presentation

[FMC8] Advanced Material

Chair: Atsuko Fujita (JNC Corporation)

Co-Chair: Seiki Ohara (AGC)

3:00 PM - 4:20 PM Room 206 (2F)

[FMC8-1(Invited)] Carrier Glass Substrates for
Electronic Display Fabrication

*Kazutaka Hayashi¹ (1. AGC Inc.
(Japan))

3:00 PM - 3:20 PM

[FMC8-2] Blackening of TFT wiring by depositing high
durability film

*Keita Umemoto¹, Shin Okano, Yukiya Sugiuchi,
Takeshi Ohtomo, Ichiro Shiono (1. Mitsubishi
Materials Corporation (Japan))

3:20 PM - 3:40 PM

[FMC8-5L] Transparent Flexible Electrode with
Conductive Coating Induced by Proton
Implantation of Emeraldine Polyaniline
Covalently Functionalized on
Polydimethylsiloxane

*Pen-Cheng Wang¹, Tsan-Feng Lu¹, Tzu-Hsiang Lin¹,
Ching-Jung Lo², Ping-Ching Pai², Chen-Kan Tseng²,
Hui-Yu Tsai¹, Ming-Wei Lin¹, Tsung-Min Hung² (1.
National Tsing Hua University (Taiwan), 2. Chang
Gung Memorial Hospital (Taiwan))

3:40 PM - 3:55 PM

[FMC8-4] Photosensitive Materials with Zirconia
Nanotechnology

*Hiroki Chisaka¹, Kouichi Misumi¹, Dai Shiota¹,
Katsumi Ohmori¹, Lei Zheng², Robert J. Wiacek², Z.
Serpil Gonen Williams² (1. Tokyo Ohka Kogyo Co.,

Ltd. (Japan), 2. Pixelligent Technologies LLC
(United States of America))

4:00 PM - 4:20 PM

Oral Presentation

[INP5] AR/VR Interactive Technologies

Chair: Takamichi Nakamoto (Tokyo Institute of Technology)

Co-Chair: Shunsuke Yoshimoto (University of Tokyo)

9:00 AM - 10:35 AM Room 206 (2F)

[INP5-1(Invited)] Utilization or Elimination of Mona
Lisa Effect for Eye Contact with
Characters

*Hironori Mitake¹, Hsueh Han Wu¹, Taro
Ichii¹, Kazuya Tateishi¹, Shoichi
Hasegawa¹ (1. Tokyo Institute of
Technology (Japan))

9:00 AM - 9:25 AM

[INP5-2(Invited)] Olfactory Display and its
Application

*Takamichi Nakamoto¹ (1. Tokyo Institute
of Technology (Japan))

9:25 AM - 9:50 AM

[INP5-3(Invited)] Electromechanical Impedance
Tomography for Soft Tactile Sensor

*Shunsuke Yoshimoto¹ (1. The University
of Tokyo (Japan))

9:50 AM - 10:15 AM

[INP5-4] An Interactive Holographic Light-Field
Display Color-Aided 3D-touch User Interface

*Ivan Alexis Sanchez Salazar Chavarria¹, Tomoya
Nakamura¹, Masahiro Yamaguchi¹ (1. Tokyo Institute
of Technology (Japan))

10:15 AM - 10:35 AM

 Oral Presentation

[VHF1] Image Quality and Measurements

Chair: Kenichiro Masaoka (NHK)

Co-Chair: Keita Hirai (Chiba Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A (1F)

- | | |
|--------------------|--|
| [VHF1-OP] | Opening
1:40 PM - 1:45 PM |
| [VHF1-1] | A Fundamental Evaluation of Visual Resolution of Displays
Considering Different Sub-Pixel Structures
*Daisuke Nakayama ¹ , Midori Tanaka ¹ , Takahiko Horiuchi ¹ (1. Chiba University (Japan))
1:45 PM - 2:05 PM |
| [VHF1-2] | Perceptually Optimized Image Enhancement for OLED Displays
in Power-constrained Conditions
*Hsuan-Chi Huang ¹ , Pei-Li Sun ¹ (1. National Taiwan University of Science and Technology (Taiwan))
2:05 PM - 2:25 PM |
| [VHF1-3] | Estimation of Equivalent Conditions for Display Sparkle
Measurement
*Makio Kurashige ¹ , Gen Furui ¹ , Kazutoshi Ishida ¹ , Shumpei Nishio ¹ , Toshiyuki Nakai ¹ , Hiroko Suzuki ¹ , Masayuki Tsunekawa ¹ , Yukimitsu Iwata ¹ , Norinaga Nakamura ¹ (1. Dai Nippon Printing Co., Ltd. (Japan))
2:25 PM - 2:45 PM |
| [VHF1-4L(Invited)] | Repeatability and Reproducibility Considerations for
BlackMURA Measurements
*Ingo Rotscholl ¹ , Tobias Porsch ¹ , Udo Krüger ¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))
2:45 PM - 3:10 PM |

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-OP] Opening

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-1] A Fundamental Evaluation of Visual Resolution of Displays Considering Different Sub-Pixel Structures

*Daisuke Nakayama¹, Midori Tanaka¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

Keywords: Display resolution, Visual experiment, Sub-pixel

We conducted a psychometric evaluation of different display sub-pixel structures. Our assessments of the RGB sub-pixel structure showed that the vertical visual resolution was higher than the horizontal visual resolution. In addition, the visual resolution itself differed according to the sub-pixel structures.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-2] Perceptually Optimized Image Enhancement for OLED Displays in Power-constrained Conditions

*Hsuan-Chi Huang¹, Pei-Li Sun¹ (1. National Taiwan University of Science and Technology (Taiwan))

Keywords: OLED Display, APL (Average Pixel Level), Low-power Image Enhancement

A psycho-visual experiment was conducted to optimize the parameters of an image enhancement model for OLED displays to maintain image quality in power-constrained conditions.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-3] Estimation of Equivalent Conditions for Display Sparkle Measurement

*Makio Kurashige¹, Gen Furui¹, Kazutoshi Ishida¹, Shumpei Nishio¹, Toshiyuki Nakai¹, Hiroko Suzuki¹, Masayuki Tsunekawa¹, Yukimitsu Iwata¹, Norinaga Nakamura¹ (1. Dai Nippon Printing Co., Ltd. (Japan))

Keywords: sparkle, sparkle contrast, anti-glare display

Various measurement conditions of sparkle contrast were analysed in terms of the equivalent area of the resolution spot of the imaging system on the display. The results show the possibility to achieve the equivalent measurement conditions among different measurement distance, F-number and focal length of imaging lens.

2:45 PM - 3:10 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-4L(Invited)] Repeatability and Reproducibility Considerations for BlackMURA Measurements

*Ingo Rotscholl¹, Tobias Porsch¹, Udo Krüger¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))

Keywords: BlackMURA, Measurement Uncertainty, Reproducibility, Imaging Luminance Measurement Device

The "Uniformity measurement standard for Displays", which is used for automotive applications, describes precise setup and alignment procedures to ensure reproducible measurement results. However, the influences of the tested device and the ILMD are not considered in detail. This contribution shows experiments and simulations to estimate these influences as well.

Oral Presentation

[VHF2] Ergonomics for Automotive Applications

Special Topics of Interest on Automotive Displays

Chair: Yoshie Imai (Mitsubishi Elec.)

Co-Chair: Yukio Endo (AGC)

Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A (1F)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving

*Katsunori Okajima¹ (1. Yokohama National University (Japan))

3:20 PM - 3:45 PM

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition

*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

3:45 PM - 4:05 PM

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display -Basic Study on the Relationship between Degree of Correction and Driver's Recognition-

*Kazuki Matsushashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

4:05 PM - 4:25 PM

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display

*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

4:25 PM - 4:45 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving

*Katsunori Okajima¹ (1. Yokohama National University (Japan))

Keywords: Visibility, Character, Visual distance, Visual size, Luminance

We demonstrate VIF (Visibility Index Function) can be applied for precisely simulating and improving the visibility of driving environments as well as human-interface devices in driving. The VIF is convenient to design information display and traffic signs with considering visibility while driving.

3:45 PM - 4:05 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition

*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

Keywords: external Human Machine Interface (eHMI), automated vehicle, interaction, pedestrian, crosswalk

The interaction between a pedestrian and an automated vehicle equipped with an external human machine interface at an unsignalized crosswalk is discussed. The external human machine interface has the potential to provide an effective communication cue from which the pedestrian can judge whether the automated vehicle is yielding to them.

4:05 PM - 4:25 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display -Basic Study on the Relationship between Degree of Correction and Driver's Recognition-

*Kazuki Matsushashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

Keywords: human factors, human machine interface, head-up display, recognition, depth perception

This study discusses the driver's depth perception and subjective conviction to be corrected for in the display contents of an automotive three-dimensional head-up display, such as navigation arrows, based on the levels of the basic correction method used to reduce the effect of car vibration due to various road surfaces.

4:25 PM - 4:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display

*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

Keywords: Transparent display, Transparent screen, Visibility, Back image, HUD

Transparent display is useful device for some applications but has a privacy issue that a back image appears on the opposite side to the display image. We investigated the condition human cannot see a back image.

Oral Presentation

[VHF3/DES3] Virtual Reality

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Takashi Shibata (Tokyo Univ. of Social Welfare)

Co-Chair: Johan Bergquist (Consultant)

Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A (1F)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution

*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

5:00 PM - 5:25 PM

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation

*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

5:25 PM - 5:50 PM

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹, Koudai Ito¹ (1. National Institute of Advanced Industrial Science and Technology (Japan))

5:50 PM - 6:10 PM

[VHF3/DES3-4] Color Perception Comparison of Scene Images between Head-Mounted Display and Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

6:10 PM - 6:30 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution

*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

Keywords: Virtual reality, Resolution, ppi, ppd, VR-1

With current display manufacturing methods, it would be very hard to produce a single near eye display that offers 60 pixels / degree resolution over the whole field of view and is small enough to fit into the headset. In case of greater than 90-degree field of view, basically 6k x 6k panel would be required. With the high refresh rates of virtual reality applications, this would mean also very large data transfer rates and high rendering load on GPU's.

Varjo overcome these challenges by composing the single eye image from two different display sources, while minimizing the effect on total rendering load. High angular resolution is used on the area where it is mostly needed. Precise analysis of displays with geometrical- and optical adjustments is needed to blend the 2 separate images to a one uniform scene.

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation

*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

Keywords: AR/VR near-eye display Eye-Box, pupil rotation versus eye rotation, Resolution, Luminance, Color

We present metrology challenges and solutions to measure Near Eye Displays performance parameters that can produce visual discomfort and headaches. Accurate measurement data correlates to what the eye perceives when the entrance pupil of the Light Measurement Device (LMD) matches the location and pointing direction of the display user's eye.

5:50 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹, Koudai Ito¹ (1. National Institute of Advanced Industrial Science and Technology (Japan))

Keywords: VR sickness, VIMS, optic flow, retinal flow, SSQ

We conducted an experiment measuring VR sickness using HMD, manipulating optic flow and retinal flow in three conditions. The results showed that sickness scores increased according to the amount of optic flow, but not of retinal flow, indicating that optic flow, not retinal flow, is essential to induced VR sickness.

6:10 PM - 6:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-4] Color Perception Comparison of Scene Images between Head-Mounted Display and Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

Keywords: Color perception, Image appearance, Visual experiment, Virtual reality, CIELAB color difference

In this paper, subjective evaluation experiments using scene images were conducted to investigate the difference of luminance and chroma perception between an HMD and a desktop display. The results showed that the perception of luminance and chroma of the HMD were higher compared with those of the desktop display.

Oral Presentation

[AMD1] Foldable Technology of OLED Displays

Chair: Koichi Miwa (LG Display Co.,Ltd)

Co-Chair: Keisuke Omoto (Apple)

Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B (1F)

[AMD1-1(Invited)] Development of Foldable AMOLED Displays Based on Neutral-Plane Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹, Masatomo Hishinuma¹, Hajime Yamaguchi¹, Akio Murayama¹ (1. Japan Display Inc. (Japan))

1:40 PM - 2:05 PM

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹, Xianrui Qian¹, Jiye Xia¹ (1. Visionox Technology Inc (China))

2:05 PM - 2:30 PM

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung Hee University (Korea))

2:30 PM - 2:45 PM

[AMD1-4] Positive Bias-Stress Stability of Flexible Amorphous InGaZnO Thin Film Transistors with Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong University (China))

2:55 PM - 3:15 PM

1:40 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-1(Invited)] Development of Foldable AMOLED Displays Based on Neutral-Plane Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹, Masatomo Hishinuma¹, Hajime Yamaguchi¹, Akio Murayama¹ (1. Japan Display Inc. (Japan))

Keywords: Foldable display, Neutral-plane splitting, Bending stiffness, Adhesive, Organic light-emitting diode

Splitting of the mechanical neutral plane is a promising concept for foldable displays because it reduces the folding stress and stiffness of the display. We verified the concept experimentally and developed 5.5-inch full high-definition foldable AMOLED displays, which endured 150 k inward folding cycles with folding radius of 3 mm.

2:05 PM - 2:30 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹, Xianrui Qian¹, Jiye Xia¹ (1. Visionox Technology Inc (China))

Keywords: AMOLED, Flexible display

The AMOLED display technology became more and more popular in the display field. However, there are still many challenges for this technology. We spend a lot of time working on it to make progress of the mass production of AMOLED, especially for the flexible AMOLED.

2:30 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung Hee University (Korea))

Keywords: Amorphous indium gallium zinc oxide (a-IGZO), Thin-film transistor (TFT), Stretchable substrate

We present stretchable amorphous indium-gallium-zinc-oxide (a-IGZO) thin-film transistors (TFTs) transferred onto styrene ethylene/butylene styrene (SEBS) thermoplastic elastomer. The fabricated stretchable oxide TFT showed electrical properties even after 40% strain without mechanical and electrical degradations. This stiff island on the stretchable substrate was demonstrated to enable for stretchable electronics.

2:55 PM - 3:15 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-4] Positive Bias-Stress Stability of Flexible Amorphous InGaZnO Thin Film Transistors with Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong University (China))

Keywords: flexible, a-IGZO TFT, Double-stacked Gate Insulator, PBS

Double-stacked gate insulators (SiO_x/TaO_x) made flexible amorphous InGaZnO thin film transistors more stable under both mechanical bending and positive bias-stress, which was assumed to result from their better neutral plane position and front-channel interface states. A simple model was built to explain this improvement effect.

Oral Presentation

[AMD2] High Resolution Display

Chair: Junichi Takeya (University of Tokyo)

Co-Chair: Hiroki Hamada (Kinki Univ.)

Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B (1F)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹,
Shin-Kyun Park¹ (1. LG Display Co., Ltd. (Korea))

3:20 PM - 3:45 PM

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis Aligned Crystalline Oxide Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹, Takashi Nakagawa¹, Yuki Tamatsukuri¹,
Hideaki Shishido¹, Shogo Uesaka¹, Ryohei Yamaoka¹, Takaaki Nagata¹, Tomoya
Aoyama¹, Yutaka Okazaki¹, Takayuki Ikeda¹, Shunpei Yamazaki¹ (1. Semiconductor
Energy Laboratory Co., Ltd. (Japan))

3:45 PM - 4:10 PM

[AMD2-3] Novel Compensation Pixel Circuit with Simultaneous Emission Driving Scheme for High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun Chen¹, Chih-Lung Lin¹ (1.
National Cheng Kung University (Taiwan))

4:10 PM - 4:30 PM

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹, Yongyuan Qiu¹, Quansheng Liu¹, Yong
Yang¹, Junling Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹, Xin Zhang¹
(1. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

4:30 PM - 4:45 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹, Shin-Kyun Park¹ (1. LG Display Co., Ltd. (Korea))

Keywords: OLED, 8K, oxide TFT, white on color filter, mass production

88-inch 8K OLED TV has been launched to the market. The display features 7680 x 4320 pixel resolution and 120Hz refresh rate. White OLED on Oxide TFT backplane architecture is applied as were in our 4K/2K OLED TV products. Design and driving features will be presented in this paper.

3:45 PM - 4:10 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis Aligned Crystalline Oxide Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹, Takashi Nakagawa¹, Yuki Tamatsukuri¹, Hideaki Shishido¹, Shogo Uesaka¹, Ryohei Yamaoka¹, Takaaki Nagata¹, Tomoya Aoyama¹, Yutaka Okazaki¹, Takayuki Ikeda¹, Shunpei Yamazaki¹ (1. Semiconductor Energy Laboratory Co., Ltd. (Japan))

Keywords: IGZO, VR, OLED, High resolution, Micro display

C-axis aligned crystalline oxide semiconductor field-effect transistor (CAAC-OS FET) can be scaled down to a width and length of 60 nm. We have fabricated an organic light-emitting diode (OLED) display with more than 5000 ppi required in virtual reality (VR) displays by using CAAC-OS FETs as the backplane.

4:10 PM - 4:30 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-3] Novel Compensation Pixel Circuit with Simultaneous Emission Driving Scheme for High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun Chen¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

Keywords: Active-matrix organic light-emitting diode, low-temperature polycrystalline silicon thin-film transistor, pixel circuit

This proposed work using simultaneous emission (SE) driving scheme to compensate for the V_{TH} variations of LTPS TFTs for high-resolution AMOLED displays. Simulated results demonstrate that the relative current error rates are all below 3.5% when V_{TH} of driving TFT varies by ± 0.5 V.

4:30 PM - 4:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹, Yongyuan Qiu¹, Quansheng Liu¹, Yong Yang¹, Junling Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

Keywords: AM miniLED, local dimming, halo effect

We developed AM miniLED local dimming backlight systems on glass for 75-inch LCD displays, with each consisting of 5184 zones. The display achieves HDR, which is comparable to those of Dual-cells and OLEDs. In addition, the system exhibit advantages such as low fabrication cost, long life time and more energy-efficient.

Oral Presentation

[AMD3] Driving Technology of Micro/Mini LED Displays

Special Topics of Interest on Micro/Mini LEDs

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Keisuke Omoto (Apple)

Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B (1F)

[AMD3-1(Invited)] Crystal LED Display System for Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹, Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony Semiconductor Solutions Corporation (Japan), 2. Sony Corporation (Japan))

5:00 PM - 5:25 PM

[AMD3-2(Invited)] Active Matrix Driving mini-LED Device

*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹, Minoru Shibasaki² (1. Innolux Corporation (Taiwan), 2. Innolux Japan (Japan))

5:25 PM - 5:50 PM

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix Micro-LED Display with Low-Temperature-Poly-Silicon TFT Backplane

*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki Ito¹, Takanobu Suzuki¹, Masahiko Nishide¹, Kunio Imaizumi¹, Katsumi Yamanoguchi¹, Fanny Rahadian¹, Katsumi Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹ (1. Kyocera Corporation (Japan))

5:50 PM - 6:15 PM

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro Display

*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

6:15 PM - 6:35 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-1(Invited)] Crystal LED Display System for Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹, Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony Semiconductor Solutions Corporation (Japan), 2. Sony Corporation (Japan))

Keywords: micro LED, micro IC, Crystal LED display system, ambient contrast ratio

We developed a novel active matrix driving technology that integrates RGB micro LEDs and a micro IC in each pixel for our Crystal LED display system. With precise tiling technology, a large-scale image with immersive viewing experience can be delivered.

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-2(Invited)] Active Matrix Driving mini-LED Device

*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹, Minoru Shibazaki² (1. Innolux Corporation (Taiwan), 2. Innolux Japan (Japan))

Keywords: mini-LED, active matrix driving, LCD backlight, public information display

We have developed a glass- or flexible substrate-based AM driving mini-LED device. The AM driving mini-LED device controls each mini-LED element precisely with TFT, and can be applied to PID and BL of LCD, improving the optical performance of dynamic range, CR, color purity and viewing angle performance of the display.

5:50 PM - 6:15 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix Micro-LED Display with Low-Temperature-Poly-Silicon TFT Backplane

*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki Ito¹, Takanobu Suzuki¹, Masahiko Nishide¹, Kunio Imaizumi¹, Katsumi Yamanoguchi¹, Fanny Rahadian¹, Katsumi Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹ (1. Kyocera Corporation (Japan))

Keywords: micro-LED, LTPS, TFT backplane, MPRT, HDR

A 1.8-inch 200-ppi full color active matrix micro light emitting diode (LED) display prototype has been developed with a low-temperature-poly-silicon (LTPS) TFT backplane. The frame rate of 240Hz and the luminance of 2000nits, both of which are promising attributes for high motion image quality and high dynamic range (HDR) applications, being superior to existing display technologies, were achieved by our LTPS TFT technology.

6:15 PM - 6:35 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro Display

*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

Keywords: Active matrix, Full-color, Micro-LED, QDs-PR

An active matrix monolithic full-color LED micro-display is demonstrated, combining monolithic blue GaN-on-Si LED array and quantum dots down conversion technology. This full-color scheme shows feasible manufacturability and visual quality, paving a new pathway toward volume production of full-color LED micro-display in the near future.

Oral Presentation

[LCT1] Evaluation Techniques

Chair: Masaru Inoue (Toyo Tech. LLC)

Co-Chair: Yoshinori Iwashita (DIC)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107 (1F)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays Caused by Polyimide Anion Radicals

*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC Petrochemical Corporation (Japan))

1:40 PM - 2:00 PM

[LCT1-2] The Systematically Investigation on the Influence Factor on Vertical Alignment State of Polyimide-free Liquid Crystal Displays

*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-Jen Tseng², Chung-Ching Hsieh² (1. Peking University Shenzhen Graduate School (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

2:00 PM - 2:20 PM

[LCT1-3] Second-Harmonic Imaging of Flexoelectric Polarization in Various Liquid Crystal Cells

*Koichiro Shirota¹, Fumito Araoka¹, Yutaka Yamagata¹ (1. RIKEN (Japan))

2:20 PM - 2:40 PM

[LCT1-5L] A Novel Orientation Method for Nematic LCs by Using Magnetic Field Lines with Permanent Magnets and Electric Field for Assisting the Reorientation

Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University (Japan))

2:40 PM - 3:00 PM

1:40 PM - 2:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays Caused by Polyimide Anion Radicals

*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC Petrochemical Corporation (Japan))

Keywords: Imide anion radical, DC image sticking, LCD reliability

We investigated the anion radical effect from aromatic imide groups in polyimide alignment layers of liquid crystal cells by means of electron spin resonance and absorption measurements. We found anion radicals generated by ultra-violet or blue light irradiation shows a clear correlation to DC image sticking.

2:00 PM - 2:20 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-2] The Systematically Investigation on the Influence Factor on Vertical Alignment State of Polyimide-free Liquid Crystal Displays

*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-Jen Tseng², Chung-Ching Hsieh² (1. Peking University Shenzhen Graduate School (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

Keywords: polyimide-free, liquid crystal displays, vertical alignment, self-assembly capability, hydrogen bond

In this report, we systematically investigated the influence of types of substrate, different treatment method, the concentration of additive, the routes and temperature of process on the polyimide-free liquid crystal display. We presume two key factors, one is self-assembly capability, the other is hydrogen bond force.

2:20 PM - 2:40 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-3] Second-Harmonic Imaging of Flexoelectric Polarization in Various Liquid Crystal Cells

*Koichiro Shirota¹, Fumito Araoka¹, Yutaka Yamagata¹ (1. RIKEN (Japan))

Keywords: Flexoelectric effect, SHG microscopy, Nematic, IPS cell

Since the flexoelectric polarization of LCs attracts much attention in the LCD industry, we visualize the flexoelectric polarization in nematic LCs with SHG microscopy. The observed flexoelectric polarization is induced by applying an electric field to various nematic LCs with positive or negative dielectric anisotropy in several types of cells.

2:40 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-5L] A Novel Orientation Method for Nematic LCs by Using Magnetic Field Lines with Permanent Magnets and Electric Field for Assisting the Reorientation

Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University (Japan))

Keywords: Radial orientation, Permanent magnet, LC lens, Polymer stabilization

We proposed an LC orientation treatment method that was used by the magnetic field lines and the electric field for assisting the director reorientation. It was shown that a radial orientation could be obtained by performing this process with the vertical alignment cell in the initial state.

Oral Presentation

[LCT2] LC Flat Diffractive Optics

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Toshiaki Nose (Akita Prefecture University)

Co-Chair: Hiroyuki Yoshida (Osaka University)

Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107 (1F)

[LCT2-1(Invited)] Fundamentals and Applications of Liquid Crystal-Based, Polarization-Dependent Diffractive Optics

*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹ (1. Osaka University (Japan))

3:20 PM - 3:40 PM

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and Next Generation Displays

*Nelson Tabirian¹, David Roberts¹, Anna Tabirian¹, Brian R Kimball², Timothy J Bunning³ (1. BEAM Engineering for Advanced Measurements Co. (United States of America), 2. U.S. Army Natick Soldier Systems Center, Natick, Massachusetts (United States of America), 3. Air Force Research Laboratories, Wright-Patterson Air Force Base, Ohio (United States of America))

3:40 PM - 4:05 PM

[LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements

*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

4:05 PM - 4:30 PM

[LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up Displays

Xiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))

4:30 PM - 4:50 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-1(Invited)] Fundamentals and Applications of Liquid Crystal-Based, Polarization-Dependent Diffractive Optics

*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹ (1. Osaka University (Japan))

Keywords: Diffractive Optics, Holography, Photoalignment

There is recently interest in LC-based diffractive optical elements (DOEs) that enable modulation of the light phasefront through the spatial distribution of its optic axis. The operating principles of both transmissive and reflective devices are reviewed and their applications are discussed.

3:40 PM - 4:05 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and Next Generation Displays

*Nelson Tabirian¹, David Roberts¹, Anna Tabirian¹, Brian R Kimball², Timothy J Bunning³ (1. BEAM Engineering for Advanced Measurements Co. (United States of America), 2. U.S. Army Natick Soldier Systems Center, Natick, Massachusetts (United States of America), 3. Air Force Research Laboratories, Wright-Patterson Air Force Base, Ohio (United States of America))

Keywords: Switchable optics, Flat lenses, Augmented reality, Displays, Liquid crystals

Only one planar optics technology - diffractive waveplates - has shown capability to match large sizes and low-cost of Fresnel optics and the bandwidth of refractive optics. Electrically switchable and tunable with low-power controls, the thinnest lenses, prisms, and holograms make diffractive waveplate optics best suitable for AR/VR applications.

4:05 PM - 4:30 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements

*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

Keywords: near-eye displays, flat optics, liquid crystals, Pancharatnam-Berry phase

Near-eye displays with enhanced images quality are developed with planar optics employing Pancharatnam-Berry (PB) phase. Advanced broadband PB deflectors and lenses are fabricated to enhance the apparent pixel density and reduce the chromatic aberrations in immersive near-eye displays. Both simulation and experimental results are presented.

4:30 PM - 4:50 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up Displays

Xiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))

Keywords: Pancharatnam-Berry lens, fast-response, head-up display, adjustable distance

In this paper we demonstrate fast-response Pancharatnam-Berry lenses (PBLs) based on polymer-stabilized liquid crystal. After photo-alignment technique and UV curing, the PBLs show submillisecond response time. Based on two identical PBLs, a head-up display system that can generate four different diopters is demonstrated.

Oral Presentation

[LCT3] Advanced LCD Technologies

Chair: Hiroyuki Okada (University of Toyama)

Co-Chair: Koichi Miyachi (JSR)

Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107 (1F)

[LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method

*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

5:00 PM - 5:20 PM

[LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell

*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))

5:20 PM - 5:40 PM

[LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD

*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

5:40 PM - 6:00 PM

[LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application

*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

6:00 PM - 6:20 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method

*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

Keywords: Four-Ways, Viewing Angle, Controllable, Specify Pixel, Separated Rubbing

We present a viewing angle controllable display capable of displaying in two viewing modes, i.e. wide view mode and four-ways privacy mode. Pixel is divided into two domains of perpendicular LC orientation direction with separated rubbing method. By controlling the LC phase retardation at off-axis, viewing angle switching realized.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell

*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))

Keywords: liquid crystal, dichroic dye, dye-doped liquid crystal, transmittance-control device

Among various dye-doped liquid crystal (LC) devices, a chiral-nematic LC cell provides the highest transmittance difference between its transparent and opaque states. We propose a systematic approach to find the optimal dye mixing for black color in the opaque state and optimization method in the parameter space for the maximum transmittance difference.

5:40 PM - 6:00 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD

*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

Keywords: Full-Screen Display, LCD, In-Screen Optical Fingerprint Recognition Structure

We report a new type of LCD screen with an in-screen optical fingerprint recognition structure. This in-screen fingerprint recognition structure uses layers on the TFT&CF glass to make a collimating structure for accurate recognition. It can achieve fingerprint recognition at any position on the screen. It has a better user experience than traditional fixed location recognition.

6:00 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application

*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. XiaMen Tianma Microelectronics Co., Ltd. (China))

Keywords: low reflection, ambient contrast ratio, automotive display

A LCD for a 12.3 inch vehicle dashboard was proposed to enhance ambient contrast ratio. The LCD can achieve 0.8% reflection by using AR treatment and optimizing shielding layer material. It demonstrates high contrast ratio and color gamut under high ambient light situation.

Oral Presentation

[FMC2] Metrology and Manufacturing

Chair: K Käläntär (Global Optical Solutions)

Co-Chair: Toshiaki Nonaka (Merck Performance Materials)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108 (1F)

[FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices

*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))

3:20 PM - 3:40 PM

[FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field

*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))

3:40 PM - 4:00 PM

[FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD

*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

4:00 PM - 4:20 PM

[FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM

*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices

*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Flexible, Foldable, Wearable, Strain, Bending

Fracture and fatigue of bending flexible materials and devices prevent their commercialization. The problem is that quantitative understanding has not been explored on bending behavior. Here we report quantitative analysis of surface strain of bending substrates by a surface labeled grating method.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field

*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))

Keywords: Non-planar light source, arbitrary curvature, single curvature, curved display, curved light source

The effect of small curvature radius on characteristics of non-planar light sources (NPLS) has been studied using flexible OLEDs. The bending effect on light emission through the substrate was simulated and the issues extracted. The metrologies of NPLSs were studied by simulating the MF's area on different NPLSs.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD

*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

Keywords: mask reduction, half-tone mask, product process, LCD

In this paper, a better condition is found to maintain the thickness of PR for half-tone technology, and some issues of process reduction in B-ITO and M3 layers are solved. These issues of topology for M3 after ashing and last wet etching are still being studied.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM

*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))

Keywords: Salt Spray Test, COG 2.4mm-down-border, LCM, Full-screen-display

The salt spray test is failed more and more frequently for full-screen display. Experiments were done to research the possible factors. It revealed that the combination of PI (polyimide), silver conductive glue and the dispensed location resulted in the failure. Based on the analysis, the improvement solutions were proposed.

Oral Presentation

[PRJ1/FMC1] AR/VR

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Satoshi Ouchi (Hitachi)

Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108 (1F)

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- | | |
|------------------------|--|
| [PRJ1/FMC1-OP] | Opening
Satochi Ouchi ¹ , Hirotsugu Yamamoto ² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))
1:40 PM - 1:45 PM |
| [PRJ1/FMC1-1(Invited)] | Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays
*Zong Qin ¹ , Jui-Yi Wu ¹ , Ping-Yen Chou ¹ , Cheng-Ting Huang ¹ , Yu-Ting Chen ¹ , Yi-Pai Huang ¹ (1. National Chiao Tung University (Taiwan))
1:45 PM - 2:05 PM |
| [PRJ1/FMC1-2] | Possibility of Deblurring Aerial Image Based on Deconvolution Processing
*Hayato Kikuta ^{1,2} , Hirotsugu Yamamoto ^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))
2:05 PM - 2:25 PM |
| [PRJ1/FMC1-3] | Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display
*Takeru Utsugi ¹ , Mayumi Sasaki ² , Kazuhiko Ono ² , Yukinobu Tada ² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))
2:25 PM - 2:45 PM |
| [PRJ1/FMC1-4] | High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations
*Ryuji Ukai ¹ , Takuma Kuno ¹ , Toshiteru Nakamura ¹ , Masahito Uchiyama ¹ , Satoshi Ouchi ¹ (1. Hitachi, Ltd. (Japan))
2:45 PM - 3:05 PM |

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-0P] Opening

Satochi Ouchi¹, Hirotsugu Yamamoto² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-1(Invited)] Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays

*Zong Qin¹, Jui-Yi Wu¹, Ping-Yen Chou¹, Cheng-Ting Huang¹, Yu-Ting Chen¹, Yi-Pai Huang¹ (1. National Chiao Tung University (Taiwan))

Keywords: Light field display, Integral imaging, 3D display, Resolution enhancement

A physical model incorporating all factors affecting the retinal image formation in a near-eye light field display is proposed, based on which, an algorithm recombining subpixels across elemental images to nearly triple the resolution is developed. Finally, an e-shifting method is suggested to further enhance the resolution to 30 pixels-per-degree.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-2] Possibility of Deblurring Aerial Image Based on Deconvolution Processing

*Hayato Kikuta^{1,2}, Hirotsugu Yamamoto^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))

Keywords: Aerial image by retro-reflection, Point spread function, Image deconvolution

This paper proposes a deblurring an aerial image formed with aerial imaging by retro-reflection. We have measured the point spread function (PSF) according to the incident angle to the retro-reflector. Simulated results show possibility of deblurring the aerial image by applying the deconvolution processing based on the obtained PSF.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-3] Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display

*Takeru Utsugi¹, Mayumi Sasaki², Kazuhiko Ono², Yukinobu Tada² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))

Keywords: Waveguide, Volume hologram, Argument Reality, Photopolymer

As a waveguide for a head mounted display, we propose a volume-holographic multiplexed-mirror waveguide, which could achieve high luminance efficiency, wide field of view and excellent transparency. We clearly demonstrate that high performance waveguide is achieved by the combination of multiplex-recorded hologram and broad wavelength light sources.

2:45 PM - 3:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-4] High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations

*Ryuji Ukai¹, Takuma Kuno¹, Toshiteru Nakamura¹, Masahito Uchiyama¹, Satoshi Ouchi¹ (1. Hitachi, Ltd. (Japan))

Keywords: waveguide, head mounted display, specifications, transmittance, luminance

We have developed head mounted displays with high see-through property and high luminance which could be utilized outside safely without dimming glasses. We specified required performance threshold and developed beam-splitter-array waveguide to achieve the requirements. We also established versatile waveguide measurement method applicable to different-type waveguides.

Oral Presentation

[FLX1/FMC3] Advanced Materials and Components for Flexible Electronics

Chair: Toshihide Kamata (National Institute of Advanced Industrial Science and Technology)

Co-Chair: Makoto Arai (ULVAC Inc.)

Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108 (1F)

- | | |
|------------------------|--|
| [FLX1/FMC3-OP] | <p>Opening</p> <p>5:00 PM - 5:05 PM</p> |
| [FLX1/FMC3-1(Invited)] | <p>Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device</p> <p>*Masato Ohsawa¹, Natsuki Hashimoto¹, Naoki Takeda², Shota Tsuneyasu², Toshifumi Satoh² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))</p> <p>5:05 PM - 5:30 PM</p> |
| [FLX1/FMC3-2] | <p>Al alloying effect in functionalization of mechanical resistance to foldable display interconnections</p> <p>*Chiharu Kura¹, Mototaka Ochi¹, Hiroyuki Okuno², Hiroshi Goto² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))</p> <p>5:30 PM - 5:50 PM</p> |
| [FLX1/FMC3-5L] | <p>Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics</p> <p>*John Fahlteich¹, Michiel Top¹, Stefan Hinze¹, Uwe Meyer¹, Tobias Vogt¹, Valentijn von Morgen², Matthias Fahland¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))</p> <p>5:50 PM - 6:05 PM</p> |
| [FLX1/FMC3-4] | <p>Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer</p> <p>*Yuto Toshimori¹, Sohei Nonaka¹ (1. Mitsubishi Materials Corporation (Japan))</p> <p>6:10 PM - 6:30 PM</p> |

5:00 PM - 5:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-0P] Opening

5:05 PM - 5:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-1(Invited)] Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device

*Masato Ohsawa¹, Natsuki Hashimoto¹, Naoki Takeda², Shota Tsuneyasu², Toshifumi Satoh² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))

Keywords: Invisible Ag-grid, PEDOT:PSS, Gravure offset printing, Epoxy film, Electroluminescence

Invisible Ag-grid transparent electrodes have been printed on a flexible epoxy film. The Ag-grid electrode were laminated with a poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) layer. The electrode shows no noticeable resistance change throughout the bending cycles at a bending radius of 1.0 mm. The transparent electrode-based powder electroluminescent device develops excellent flexibility.

5:30 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-2] Al alloying effect in functionalization of mechanical resistance to foldable display interconnections

*Chiharu Kura¹, Mototaka Ochi¹, Hiroyuki Okuno², Hiroshi Goto² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))

Keywords: Al alloys, bending resistance, intermetallic compounds

For the metal interconnection in foldable displays, bending resistance is essential in addition to heat resistance and low electrical resistivity. The bending resistance of Al-Nd alloy interconnections can be controlled by precipitation of intermetallic compounds. Then, the Al alloy interconnections capable of dry-etching patterning have also been developed.

5:50 PM - 6:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-5L] Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics

*John Fahlteich¹, Michiel Top¹, Stefan Hinze¹, Uwe Meyer¹, Tobias Vogt¹, Valentijn von Morgen², Matthias Fahland¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))

Keywords: Permeation Barrier, Flexible Electronics Encapsulation, Magnetron Sputtering, PECVD, Roll-to-Roll

Water vapor permeability of permeation barrier films and thin film encapsulation coatings is determined both by intrinsic factors: material and technology selection and extrinsic factors: e.g. particle contamination or process defects. This paper discusses optimization strategies to achieve low permeability gas barrier films that are robust in roll-to-roll processing and integration to devices. Water vapor transmission rates of $<5 \cdot 10^{-4}$ g/(m² d) at 38° C / 90 % r.h. are demonstrated reproducibly in a full roll-to-roll process chain using a sputtered barrier layer and a protective top-coat.

6:10 PM - 6:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-4] Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer

*Yuto Toshimori¹, Sohei Nonaka¹ (1. Mitsubishi Materials Corporation (Japan))

Keywords: Transparent conductive layer, TCO/Ag/TCO structure, Ag alloy, Corrosion

The corrosion resistance of TCO/Ag/TCO structure was improved by using new Ag alloy and TCO. These can inhibit corrosion defect which was one of the biggest challenges for practical use. It can be applied to various devices, such as display electrodes, touch sensor and IR cut film.

Oral Presentation

[3DSA1/3D1] Holography 1

Chair: Hoang Yan Lin (Nat. Taiwan Univ.)

Co-Chair: Takashi Kakue (Chiba Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall (2F)

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|------------------------|---|
| [3DSA1/3D1-0P] | Opening
Shiro Suyama ¹ (1. Tokushima Univ. (Japan))
1:40 PM - 1:45 PM |
| [3DSA1/3D1-1(Invited)] | Complex Spatial Light Modulation for Holographic Displays
*Hwi Kim ¹ (1. Korea University (Korea))
1:45 PM - 2:05 PM |
| [3DSA1/3D1-5L] | A Fast Hologram Calculation Method Based on the Light Field Rendering
*Tiantian Zhang ¹ , Li Liu ¹ , Jun Xia ¹ (1. Southeast University (China))
2:05 PM - 2:25 PM |
| [3DSA1/3D1-3] | Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging
*Zi Wang ¹ , Guoqiang Lv ¹ , Qibin Feng ¹ (1. Hefei University of Technology (China))
2:25 PM - 2:45 PM |
| [3DSA1/3D1-4] | Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens
*KiHong Choi ¹ , Jongmin Kim ¹ , Keehoon Hong ² , Joongki Park ² , Sung-Wook Min ¹
(1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))
2:45 PM - 3:05 PM |

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-0P] Opening

Shiro Suyama¹ (1. Tokushima Univ. (Japan))

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-1(Invited)] Complex Spatial Light Modulation for Holographic Displays

*Hwi Kim¹ (1. Korea University (Korea))

Keywords: holographic display, spatial light modulation, complex light modulation, diffractive optics

Complex light modulation is a fundamental and crucial issue for holographic displays. We propose three-phase amplitude structure that has three fixed phase and controllable amplitudes to implement a single complex value. In this study, it is also expected to implement an ultra-low noise holographic display with active complex modulation.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-5L] A Fast Hologram Calculation Method Based on the Light Field Rendering

*Tiantian Zhang¹, Li Liu¹, Jun Xia¹ (1. Southeast University (China))

Keywords: Computer holography, Wavefront encoding, Holographic display

We propose a new method based on ray-sampling (RS) algorithm to reconstruct the holographic light field. Different from the previous method, we accumulate elemental images in the space domain without any Fourier transform. The results demonstrate that the proposed method successfully reconstructs the 3D scene with accurate depth cues.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-3] Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging

*Zi Wang¹, Guoqiang Lv¹, Qibin Feng¹ (1. Hefei University of Technology (China))

Keywords: Computer holography, integral imaging, holographic stereogram

We want to introduce several recent works for improving the performance of integral imaging (II) based holographic stereogram (HS). First, we have proposed a resolution-enhanced II-based HS using the moving array lenslet technique (MALT). [1] Second, we have proposed the concept of resolution priority HS (RPHS) for the first time, which is based on the principle of resolution priority II, by adding a quadratic phase term on the conventional Fourier transform. [2] Finally, a simple and fast algorithm for computer-generated hologram (CGH) based on pinhole-type II using a look-up table was

proposed. [3]

2:45 PM - 3:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-4] Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens

*KiHong Choi¹, Jongmin Kim¹, Keehoon Hong², Joongki Park², Sung-Wook Min¹ (1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

Keywords: Digital holography, Self-interference, Geometric phase

Self-interference incoherent digital holography utilizing the geometric phase lens has recently been developed with a super-simple design and the compactness of system structure. In this study, some of the acquisition performance related to the system parameters are analyzed to enhance the hologram acquisition quality.

Oral Presentation

[3DSA3/3D3] Light Field 1

Chair: Yasuhiro Takaki (Tokyo Univ. of A&T)

Co-Chair: Hirotugu Yamamoto (Utsunomiya Univ.)

Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall (2F)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

5:00 PM - 5:20 PM

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

5:20 PM - 5:40 PM

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoung-ho Lee¹ (1. Seoul National University (Korea))

5:40 PM - 6:00 PM

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

6:00 PM - 6:20 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

Keywords: autostereoscopic 3D display, light field, linear blending, depth range

Light field displays have limited display depth range, which is a serious issue in supporting live action content. Though generating depth maps and re-rendering is a solution, it incurs huge computational cost. In this paper, we achieve depth range compression simply by calculating the weighted average of multi-camera images.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Autostereoscopy, Active Barrier, Fractional Time-Division, Subpixel

We propose an autostereoscopic display allowing multiple observers with adaptive time-division multiplexing parallax barrier. To make sure that every observer is in the proper viewing zone to enable stereoscopy, the number of time-division multiplexing is switched in accordance with the distance between the observers.

5:40 PM - 6:00 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoungho Lee¹ (1. Seoul National University (Korea))

Keywords: holographic display, holographic optical element, near-eye display, augmented reality

By using holographic printing, high field-of-view (FOV) holographic eyepiece for near-eye display can be implemented. However, due to the high FOV, it is hard to separate the reference and signal beam. We used total internal reflection prism to solve the problem and an augmented reality holographic near-eye display is implemented.

6:00 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

Keywords: Near-eye display, Holographic waveguide, Holographic optical elements

In this paper, we propose a slim system for holographic retina display on the basis of holographic waveguide and holographic optical elements (HOEs), promising in augmented reality (AR) system. By attaching the spatial light modulator (SLM) to the waveguide directly, we decrease the form factor of the AR system greatly.

Oral Presentation

[3D2/3DSA2] Holography 2

Chair: Hwi Kim (Korea Univ.)

Co-Chair: Yuji Sakamoto (Hokkaido Univ.)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall (2F)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

3:20 PM - 3:40 PM

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMoG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

3:40 PM - 4:00 PM

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

4:00 PM - 4:20 PM

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

Keywords: Digital spatial light modulator, Analog spatial light modulator, Image quality evaluation, human factors experiment

A prototype system of head-mounted holographic display with multi-depth is presented. The system adopts the modified Gerchberg-Saxton algorithm to produce the phase-only functions on digital and analog types of spatial light modulators. Furthermore, the proposed system could achieve multi-depth by using human-eye focusing and zooming mechanism. Finally, the quality of images is also analyzed and evaluated.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMoG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

Keywords: digital holography system, SLM on Glass, vertically stacked TFT, high-capacity data handling

We present ultra-high-resolution digital holography operation system supporting 72K x 3.2K spatial-light-modulator on glass (SLMoG) panel which is composed of the state-of-the-art 1μm-pitch pixel. To control the high-capacity digital holography image, we have developed 40 Gbps optical transmit (Tx) / receive (Rx) and high-speed data handling system. Furthermore, we designed 6K channel of source driver IC with 1:2 demultiplexer (DeMux) control signal to operate 72K column line by using multi-MIPI interface.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

Keywords: defocused image, rasterize encoding, multi-depth

Crosstalk noise from defocused light affects the image quality of target image in multi-depth holographic display system. In this study, we propose a defocused light noise reduction with the rasterize encoding method. With the objective image quality analysis, it proves that the proposed method could improve the image quality.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

Keywords: Holographic optical element, Computer-generated hologram, Aberration correction

In this paper, a projection type holographic display based on HOE was proposed. The viewing angle of the holographic image is larger than the maximum diffraction angle of the SLM which was employed to display CGH. The theory and aberration were analyzed via the ray tracing technique.

Oral Presentation

[OLED1] OLED Devices

Chair: Takahisa Shimizu (NHK)

Co-Chair: Ken-ichi Nakayama (Osaka University)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204 (2F)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹
(1. Technische Universität Dresden (Germany))

1:40 PM - 2:00 PM

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

2:00 PM - 2:20 PM

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

2:20 PM - 2:40 PM

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

2:40 PM - 3:00 PM

1:40 PM - 2:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹ (1. Technische Universität Dresden (Germany))

Keywords: organic light-emitting diodes, recombination, stability, phosphorescence, TADF

This presentation will discuss both a detailed investigation of the charge carrier recombination in state-of-the-art OLEDs and an engineering route to increase device lifetime and efficiency by forming so-called ultrastable glass layers. For the latter, both phosphorescent and TADF OLEDs are presented.

2:00 PM - 2:20 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

Keywords: TADF-OLED, magnetic field effect

We investigated magnetic field effects (MFEs) of thermally activated delayed fluorescence based organic light-emitting diodes (TADF-OLEDs) to understand exciton dynamics under device operation. Our analysis showed a clear evidence of triplet annihilation such as triplet exciton-polaron interaction.

2:20 PM - 2:40 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

Keywords: Micro-cavity effect, Polyfluorene, Color purity, Solution process, Purcell effect

We introduced the micro-cavity effect on Alternating Current-Driven Polymer Light Emitting Diodes and investigated the color purity enhancement effect depending on the organic layer thickness condition. We have analyzed the electric field inside the device by the finite-difference time-domain method and fabricated the designed optimal devices.

2:40 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

Keywords: Organic light-emitting diode, degradation, aging condition, current model

This work presents a new aging current model of organic light-emitting diode (OLED). It can predict the OLED current with different stress time under some aging conditions, which can be used in related simulation software to describe the degradation of OLED.

Oral Presentation

[OLED2] OLED Material

Chair: Takahiro Komatsu (JOLED)

Co-Chair: Hitoshi Kuma (Idemitsu Kosan)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204 (2F)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

3:20 PM - 3:40 PM

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

3:40 PM - 4:00 PM

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

4:00 PM - 4:20 PM

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

Keywords: Organic Long-Persistent Luminescence, Photoluminescence, Organic semiconductor

We demonstrate long persistent luminescence from simple mixtures of two appropriate organic materials. Moreover, emission color of organic LPL can be tuned by the extra emitter dopants. We also demonstrated a polymer-based organic LPL system that is flexible, transparent, and solution-processable.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

Keywords: Boron TADF, blue TADF, Narrow FWHM

We synthesized and evaluated new deep blue fluorescence emitter, KH-FBD1. This emitter exhibits pure deep blue PL spectrum peak at 452 nm with 20 nm full width half maximum. Fabricated device shows high efficiency of 7.4% with deep blue color coordinate of (0.14, 0.07). In addition, this device indicates long operational lifetime (LT₉₅) of 100 hours at initial luminance 1,000 cd/m². It also shows high efficiency of 12.7% in high T₁ device with maintaining the deep blue color characteristic.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

High-performance soluble OLED materials have been developed. Our wide library of platform was effective for improving device performance. For wide color gamut, new emitters with deep in color and narrow full-width at half maximum were developed. Further, solvent systems having physical properties suitable for improving film uniformity were found.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition

Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

Keywords: solution process, deposition process, organic light emitting diodes, time-of-flight secondary ion mass spectrometry, gas cluster ion beam

Ellipsometry, XRR, and GCIB-TOF-SIMS are applied to investigation of the spin-coating process as comparison of spin-coated samples and vacuum evaporated samples. The residual solvent of spin-coating process was observed in spin-coated samples by GCIB-TOF-SIMS. The result suggested that it can cause the decrease of refractive index observed in ellipsometry.

Oral Presentation

[OLED3] OLED Display

Chair: Taishi Tsuji (NIPPON STEEL Chemical &Material)

Co-Chair: Masaya Adachi (Japan Display Inc)

Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204 (2F)

- [OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range
 *Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))
 5:00 PM - 5:20 PM
- [OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display
 *Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))
 5:20 PM - 5:40 PM
- [OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds
 *Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))
 5:40 PM - 5:55 PM
- [OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode
 *Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co.,Ltd. (Japan), 2. Toray Industries, Inc. (Japan))
 5:55 PM - 6:10 PM
- [OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs
 *KIHYUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))
 6:10 PM - 6:25 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range

*Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))

Keywords: OLED display, Lifetime, Hole-transport layer, High temperature, Automotive application

We developed the long lifetime OLED display by optimizing each organic layer materials. In particular, the optimization of a hole-transport layer material improved the lifetime of the blue-OLED significantly at high temperature such as 85 °C. The developed OLED display would be useful for automotive application.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display

*Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))

Keywords: OLED, circular polarizer, retardation, the slow axis, QWP film

This work reports the experimental research results of the retardation change of a reactive mesogen type quarter-wave plate (QWP) by bending when the slow axis the QWP is oriented with the bending axis according to perpendicular or parallel directions. Moreover, the effect of the retardation changes on the antireflective properties of a quasi-circular polarizer taken accounts for an organic light-emitting diode in the simulation. Based on the obtained results, we assign that the light leakage reduced gradually with bending effect in the vertical viewing orientation, while it was increased in the horizontal viewing direction regardless of the orientation of the slow axis.

5:40 PM - 5:55 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds

*Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))

Keywords: Electron injection, Hydrogen bond, Flexible OLED

It was found that stable bases widely used in organic syntheses as catalysts can lower the electron injection barrier in organic light-emitting diodes. In contrast to conventional n-doping, the reduction of the injection barrier caused by adding bases is induced by the formation of hydrogen bonds between hosts and bases.

5:55 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode

*Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co.,Ltd. (Japan), 2. Toray Industries, Inc. (Japan))

Keywords: Organic Light Emitting Diode, Deep Red, Fluorescence, TADF, Top-Emission

We developed both thermally activated delayed fluorescence materials with high performances and spectral-narrow fluorescent dopants for deep-red organic light-emitting diodes. We achieved the efficiency of 46 cd/A at 10 mA/cm² and the LT95 of around 90 hours at 50 mA/cm² in the top emission device at CIE_x = 0.679.

6:10 PM - 6:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs Significance of Energy-Level Alignment in 3D Perovskite ELs

*KIHYUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))

Keywords: Metal Halide Perovskite, Perovskite light-emitting diode (PeLED), Electron Transport layer (ETL), Exciton Confinement Effect, Charge Balance

In this study, we report a significant phenomenon that EL performances for 3D materials, such as CsPbX₃, are governed by adjacent charge transport layers, which is possibly due to nonradiative recombination resulting from the small exciton binding energy. To overcome this issue, we developed a new electron transport layer (ETL) that enhances exciton confinement effect in 3D CsPbX₃. Consequently, we achieved ultra-high brightness of 500,000 cd/m² at a very small operating voltage of 5V.

Oral Presentation

[AIS1/INP2] Smart Society and Information Display

Chair: Katashi Nagao (Nagoya University)

Co-Chair: Toshiaki Fujii (Nagoya University)

Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206 (2F)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us

*Kazuyuki Fujita¹ (1. Tohoku University (Japan))

3:20 PM - 3:45 PM

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN

*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))

3:45 PM - 4:10 PM

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN

*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))

4:10 PM - 4:35 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us

*Kazuyuki Fujita¹ (1. Tohoku University (Japan))

Keywords: human-computer interaction, adaptive spatial user interface, workspace

His talk covers adaptive spatial user interfaces to make the users more active and productive. He introduces several projects including Ambient Suite that enhances communication among multiple participants and AI-Supported Meeting Space in which the space itself behaves as "another participant" to make the meeting more productive.

3:45 PM - 4:10 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN

*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))

Keywords: Haptic display, Vibration design

We propose the vibrotactile feedback designing system using GAN-based vibrotactile signal generator. Our system generate signals presenting specific tactile impression based on user-defined parameters or images. User studies showed that it was not possible to distinguish between vibrations generated using this model and vibrations recorded from the actual material surface.

4:10 PM - 4:35 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN

*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))

Keywords: Vibrotactile information, Acceleration, GAN

To create valuable content for haptic display, we propose a method of generating alternative data from acquired one instead of collecting a great number of data from real textures. We made a data generation model based on Generative Adversarial Network and held experiments to evaluate the performance of the model.

Oral Presentation

[AIS2] AI and Information Display

Chair: Yuki Ban (The University of Tokyo)

Co-Chair: Kazuyuki Fujita (Tohoku University)

Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206 (2F)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays

*Katashi Nagao¹ (1. Nagoya University (Japan))

5:00 PM - 5:25 PM

[AIS2-2(Invited)] Light-field image processing using deep neural network

*Toshiaki Fujii¹ (1. Nagoya University (Japan))

5:25 PM - 5:50 PM

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering

*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

5:50 PM - 6:10 PM

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai², Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei² (1. National Taiwan University of Science and Technology (Taiwan), 2. National Chung-Hsing University (Taiwan))

6:10 PM - 6:25 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays

*Katashi Nagao¹ (1. Nagoya University (Japan))

Keywords: Smart learning environment, Digital poster panel, Automatic evaluation, Machine learning

Our university is currently developing a smart learning environment that can train students to enhance their presentation and discussion skills. It includes an automatic evaluation system that efficiently records, analyses, and evaluates the presenter's presentation and discussion skills. We call such education promoted by the AI technologies "AI-Powered Education."

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-2(Invited)] Light-field image processing using deep neural network

*Toshiaki Fujii¹ (1. Nagoya University (Japan))

Keywords: 3D image processing, Light field, Deep neural network

In this paper, we report results of our experiments where deep neural networks (DNNs) are adopted to perform the light-field image processing. Experimental results show that we can successfully reduce the computation cost by using DNN with almost the same performance of conventional methods.

5:50 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering

*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

Keywords: Deep learning, Non-photorealistic rendering, Computer graphics

A 3D rendering model which uses deep convolutional neural networks to imitate 2D painting style is proposed. User can feed the networks with simple paintings of specific objects to render images of 3D objects with any orientations in accordance with the painting style.

6:10 PM - 6:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai², Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei² (1. National Taiwan University of Science and Technology (Taiwan), 2. National Chung-Hsing University (Taiwan))

Keywords: Deep Learning, Object detection, Small Object

This study focuses on outdoor bird detection in video surveillance to reduce the risk of avian influenza (AI) in poultry farms. Once a bird is detected, our system will trigger another action to drive away the bird. We utilized YOLO algorithm for object detection, and add diversity samples to the dataset to train the model, then recognition accuracy is improved.

Oral Presentation

[INP1] In-Cell Touch Panels and Fingerprint Sensors

Special Topics of Interest on Automotive Displays

Chair: Noemie Ballot (ISORG)

Co-Chair: Yuji Suzuki (Japan Display Inc.)

Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206 (2F)

- [INP1-OP] Opening
Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))
1:40 PM - 1:41 PM
- [INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor
*Yuji Suzuki¹, Satoshi Uchino¹, Kohei Azumi¹, Tadayoshi Katsuta¹, Daichi Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹ (1. Japan Display Inc. (Japan))
1:41 PM - 2:06 PM
- [INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement
*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi Ishikawa¹ (1. The University of Tokyo (Japan))
2:06 PM - 2:21 PM
- [INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones
*Noemie Ballot¹ (1. ISORG (France))
2:31 PM - 2:56 PM

1:40 PM - 1:41 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-OP] Opening

Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))

1:41 PM - 2:06 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor

*Yuji Suzuki¹, Satoshi Uchino¹, Kohei Azumi¹, Tadayoshi Katsuta¹, Daichi Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹ (1. Japan Display Inc. (Japan))

Keywords: Electromagnetic resonance, In-cell touch sensor, LTPS, reflective LCD

We developed in-cell EMR reflective LCD panel, which shares the sensor pattern with capacitive touch sensor, without additional sensor layer. This technology contributes many benefits for thin design and less weight of the panel compared with conventional EMR products. This paper shows our in-cell EMR and capacitive touch sensing performance.

2:06 PM - 2:21 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement

*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi Ishikawa¹ (1. The University of Tokyo (Japan))

Keywords: optical illusion, eye tracking, dynamic image compensation, visual information control

Optical illusions distort our visual information. We propose a system that enables control of imagery rotation synchronously with eye movement. Our subject experiment using Rotating Snakes Illusion suggests that the appropriate performances of compensation can reduce the intensity of the illusion even without eye fixation.

2:31 PM - 2:56 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones

*Noemie Ballot¹ (1. ISORG (France))

Printing-based organic photodiodes have demonstrated cost effective process and compatibility with Flat Panel industry equipment making large area optical fingerprint sensors viable for volume production. Large area thin film-based optical collimator enables simple behind display integration. Advantages of this technology are high security level for fingerprint, enhanced ease of use and slim

module.

Oral Presentation

[EP1] Emerging Electronic Paper Displays

Chair: Makoto Omodani (Tokai University)

Co-Chair: Masayoshi Higuchi (NIMS)

Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207 (2F)

[EP1-OP] Opening

5:00 PM - 5:05 PM

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹, Takehisa Ishida¹, Kenji Takagi¹, Isao Takahashi¹, Hirohisa Amago², Taichi Takeuchi², Asuka Tejima², Maho Watanabe², Yuki Oishi¹, Takahiro Kamei¹, Kazumasa Nomoto¹ (1. Sony Corporation (Japan), 2. Sony Global Manufacturing & Operations Corporation (Japan))

5:05 PM - 5:30 PM

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink. (Taiwan))

5:30 PM - 5:55 PM

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University (China))

5:55 PM - 6:20 PM

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanao Fujisaki¹ (1. Tokai University (Japan))

6:20 PM - 6:35 PM

5:00 PM - 5:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-0P] Opening

5:05 PM - 5:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹, Takehisa Ishida¹, Kenji Takagi¹, Isao Takahashi¹, Hirohisa Amago², Taichi Takeuchi², Asuka Tejima², Maho Watanabe², Yuki Oishi¹, Takahiro Kamei¹, Kazumasa Nomoto¹ (1. Sony Corporation (Japan), 2. Sony Global Manufacturing & Operations Corporation (Japan))

Keywords: rewritable sheet, single pixel full-color, parallax, high-resolution, photographic quality

We have developed a laser-addressed photographic-quality rewritable sheet by using a 426-ppi single pixel full-color structure of a thin stacked C/M/Y thermochromic leuco-dye system with an unrecognized parallax. This development will facilitate new applications of on-demand rewritable image design on various surfaces.

5:30 PM - 5:55 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink. (Taiwan))

A new magnetically written electrophoretic display technology (MEPD) has been demonstrated that requires no TFT backplane to image. MEPD maintains the essential paper-like characteristics of ePaper. It has the reflective "paperlike" look, and is readable in direct sunlight. Moreover no power is required for static image. It has the flexibility suitable for bendable, rollable, or foldable applications. MEPD has been coated in a roll-to-roll production line, and is especially applicable for no-lag stylus input and/or large format applications.

5:55 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University (China))

Keywords: E-Paper, Electrophoretic Display, Microcapsules, Bistable Displays

Owing to the unique features of electrophoretic E-ink displays, including the bistability, paper-like appearance, and sunlight visibility, E-ink has been applied in many IoT environments. We will summarize the mechanisms frequently used while designing the E-ink displays, which may facilitate the new beginners to start their research in E-ink fields.

6:20 PM - 6:35 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanako Fujisaki¹ (1. Tokai University (Japan))

Keywords: e-paper, tablet, paperless

Evaluations were performed in writing speed and subjective impression of handwriting task on paper, tablet, e-paper. The tasks were performed at the three conditions: (1)writing on a desk, (2)writing without desk, (3)writing in a standing position. Our results indicated advantages of e-paper especially in the standing position.

Oral Presentation

[DES1] 8K Systems

Chair: Ryutaro Oke (Panasonic Liquid Crystal Display)

Co-Chair: Hyun-Wook Lim (SAMSUNG ELECTRONICS)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207 (2F)

[DES1-OP]

Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:40 PM - 1:45 PM

[DES1-1(Invited)]

Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹, Ryutaro Oke², Kenkichi Tanioka¹, Toshio Chiba¹ (1. Kairos Co., Ltd. (Japan), 2. Panasonic Liquid Crystal Display Co., Ltd. (Japan))

1:45 PM - 2:10 PM

[DES1-2(Invited)]

Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹, Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

2:10 PM - 2:35 PM

[DES1-3(Invited)]

Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application

*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))

2:35 PM - 3:00 PM

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-OP] Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:45 PM - 2:10 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-1(Invited)] Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹, Ryutaro Oke², Kenkichi Tanioka¹, Toshio Chiba¹ (1. Kairos Co., Ltd. (Japan), 2. Panasonic Liquid Crystal Display Co., Ltd. (Japan))

Keywords: 8K ultra -high definition (UHD), rigid endoscope, microscope, eye surgery

We have developed a prototype of 55-inch 8K ultra-high definition (UHD) three-dimensional (3D) display using a polarization filter for advanced digital surgical imaging with the new camera system with 8K-UHD resolution (7680 x 4320 pixels), which is 16 times as much as that of high-definition (HD; 1920 x 1080 pixels).

2:10 PM - 2:35 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-2(Invited)] Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹, Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

Keywords: 8K UHD, Column Driver, Equalization, Line Overdriving, Auto calibration

Driver technology for large 8K UHD 120Hz 10bit color display is presented in 0.13-μ m high-voltage CMOS process for column driver IC, and 14nm CMOS process for TCON. The proposed auto-optimized equalizer could compensate -21.4dB channel loss for 4Gbps receiver per lane for 82-inches 8K UHD panel. The proposed line-overdrive technique could compensate insufficient charging time for each line using variable LUT.

2:35 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-3(Invited)] Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application

*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))

Keywords: 8K4K LCD panel, Spatial Over Drive (Spatial OD), Digital Low Color Shift (DLCS)

Many panel makers keep committed to manufacture 8K4K LCD panel in recent years. There are some panel issues accompanying by higher resolution and larger panel size, like source driver ability and side viewing color shift (especially in the VA type panel). We propose the adaptive functions to improve the image quality for high resolution and large size panel in Timing Controller (T-CON).

Oral Presentation

[DES2] Driving Technology

Chair: Chih-Wen Lu (Nat. Tsing Hua Univ.)

Co-Chair: Keiichi Nakajima (Tianma Japan)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207 (2F)

[DES2-1] Relationship Between Charging Rate and Color Gamma Cross-talk for TFT-LCD with Flip Pixel Driven Architecture

*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

3:20 PM - 3:40 PM

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays

*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:40 PM - 4:00 PM

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT

*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

4:00 PM - 4:20 PM

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs

*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-1] Relationship Between Charging Rate and Color Gamma Crosstalk for TFT-LCD with Flip Pixel Driven Architecture

*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

Keywords: TFT-LCD, charging rate, color gamma crosstalk, line overdrive

Color gamma crosstalk (CCT) formula, which compares the luminance of three primary-color images with the luminance of gray-level image, is a way of measuring color expression. In this paper, the negative correlation between charging rate and CCT in the thin film transistor liquid crystal display (TFT-LCD) with flip pixel driven architecture is studied. Based on the analysis and understanding, line overdrive (OD) technology is applied to reduce the value of CCT to the standard range.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays

*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

Keywords: AMOLED, external compensation, low-temperature polycrystalline silicon thin-film transistor

This work presents a new pixel circuit based on LTPS TFTs compensating for TFT V_{TH} variations and V_{DD} I-R drops for AMOLED displays. The simulated results show that the relative current error rates are less than 4.87% with TFT V_{TH} of ± 0.5 V and -0.5 V V_{DD} I-R drops.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT

*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

Keywords: Oxide TFT, Gate Driver Circuit, Reliability, Duty Ratio

We present the highly reliable gate driver circuit using AC-driven method of a pull-down TFTs. Two pull-down TFTs are driven with duty ratio of 33.3% and 66.7%, respectively, VOUT discharge completely. The proposed circuit can minimize coupling noise by discharging the Q and VOUT node constantly except for output period.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs

*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

Keywords: Gate Driver Circuit, Thin-Film Transistor, Depletion Mode, Threshold Voltage, Reliability

We introduce novel driving methods of pull-down unit in a gate driver circuit for enhancement and depletion mode a-IGZO thin-film transistors (TFTs). Using 3T1C diode connection structure, our circuit can compensate for V_{TH} of pull-down unit in the enhancement mode and can be normally operated in the depletion mode.

 Oral Presentation

[MEET1] Novel Materials, Fundamental Components and Process Technologies

Chair: Jin Jang (KyungHee University)

Co-Chair: Chien-chung Lin (National Chiao Tung University)

Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall (1F)

- [MEET1-OP] Opening
 Masayuki Nakamoto¹ (1. Shizuoka University (Japan))
 9:00 AM - 9:10 AM
- [MEET1-1(Invited)] High Brightness Electron Beam with Carbon Nanotube (CNT) Cold Cathode
 *Kyu Chang Park¹, Ha Rim Lee¹, Boklae Cho² (1. KyungHee University (Korea),
 2. Korea Research Institute for Science and Standard (Korea))
 9:10 AM - 9:30 AM
- [MEET1-2] Electron Beam Lithography of PMMA Film Using Direct Growth CNT Cold Cathode Emitter
 *Ok Jung Hwang¹, Ha Rim Lee¹, Kyu Chang Park¹ (1. University of Kyunghee (Korea))
 9:30 AM - 9:50 AM
- [MEET1-3] SOURCE 2D Simulation for High Resolution Carbon Nanotube Cold Cathode Fabrication
 *Da Woon Kim¹, Ha Rim Lee¹, Boklae Cho², Kyu Chang Park¹ (1. University of Kyung Hee (Korea), 2. Korea Research Institute for Science and Standard (Korea))
 9:50 AM - 10:10 AM
- [MEET1-4] Effects on X-ray Imaging Quality by Manipulation of Cold Cathode Emitter Density
 *Jisoo Oh¹, Yi Yin Yu¹, Kyu Chang Park¹ (1. Kyung Hee University (Korea))
 10:10 AM - 10:30 AM

9:00 AM - 9:10 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-OP] Opening

Masayuki Nakamoto¹ (1. Shizuoka University (Japan))

9:10 AM - 9:30 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-1(Invited)] High Brightness Electron Beam with Carbon Nanotube (CNT) Cold Cathode

*Kyu Chang Park¹, Ha Rim Lee¹, Boklae Cho² (1. KyungHee University (Korea), 2. Korea Research Institute for Science and Standard (Korea))

Keywords: Carbon nanotube (CNT), Cold Cathode, high brightness

We fabricated high brightness electron beam with carbon nanotube (CNT) cold cathode. The beam brightness strongly depends on the virtual source size of CNT cold cathode. Based on the beam brightness simulation and measurement, we could obtain micro-focused electron beam with higher electron emission current for large area, high resolution imaging.

9:30 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-2] Electron Beam Lithography of PMMA Film Using Direct Growth CNT Cold Cathode Emitter

*Ok Jung Hwang¹, Ha Rim Lee¹, Kyu Chang Park¹ (1. University of Kyunghee (Korea))

Keywords: carbon nanotube (CNT), electron beam(e-beam) lithography, VACNTs

We have developed on electron beam (e-beam) lithography system with novel electron source using vertically aligned carbon nanotubes (VACNTs). After the beam was exposed, the PMMA film on ITO glass was developed in MIBK: IPA developer (MIBK: IPA=1:3). As a result, we observed lithography pattern less than 100 um without electric and magnetic lens. This cold cathode emitter is differentiated from the previous electron source for e-beam lithography.

9:50 AM - 10:10 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-3] SOURCE 2D Simulation for High Resolution Carbon Nanotube Cold Cathode Fabrication

*Da Woon Kim¹, Ha Rim Lee¹, Boklae Cho², Kyu Chang Park¹ (1. University of Kyung Hee (Korea), 2. Korea Research Institute for Science and Standard (Korea))

Keywords: Carbon Nanotube (CNT), High resolution, Beam divergence, Electron beam

High-resolution electron microscopy requires an electron source with high brightness and resolution. We simulated and fabricated the carbon nanotube (CNT) cold cathode with high resolution. For the simulation, we used SOURCE 2D simulator and fabricated self-focused CNT based electron beam. The beam

shows micron scale resolution with optimized self-focused CNT beam design. The beam spot size depends on the various parameters, such as depth, width and driving conditions.

10:10 AM - 10:30 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-4] Effects on X-ray Imaging Quality by Manipulation of Cold Cathode Emitter Density

*Jisoo Oh¹, Yi Yin Yu¹, Kyu Chang Park¹ (1. Kyung Hee University (Korea))

Keywords: x-ray source, x-ray resolution, cold cathode emitters, field emission

The relationship between the density of electron emitters and x-ray image quality has been investigated. Under diode mode, x-ray images have been successfully acquired even under 30kV of bias. The electron emitters were selectively patterned VACNTs. With respect to the inter-emitter pitch, even at the same electrical energy, different patterns showed different image qualities. By optimizing the CNT pattern, we expect that we can develop a high-resolution x-ray source without using additional focusing components.

Oral Presentation

[MEET2] EL Quantum Dots Technologies

Special Topics of Interest on Quantum Dot Technologies

Chair: Frank Yan (Fuzhou University)

Co-Chair: Jang Hyuk Kwon (Kyung Hee University)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall (1F)

[MEET2-1(Invited)] Quantum Dot Electroluminescence to Achieve Saturated Colours for REC2020 Compatibility

*Poopathy Kathirgamanathan¹, Muttulingam Kumaravel¹ (1. Brunel University London (UK))

5:20 PM - 5:40 PM

[MEET2-3(Invited)] Ultra-Bright Quantum-Dot Light-Emitting Diodes

*Shuming Chen¹ (1. Southern University of Science and Technology (China))

6:00 PM - 6:20 PM

[MEET2-4(Invited)] Efficient and Stable Light Emitting Diodes Based on Luminescent Nanocrystals

*Kai Wang¹, Xiangtian Xiao^{1,2}, Zhaojin Wang¹, Taikang Ye¹ (1. Southern University of Science and Technology (China), 2. The University of Hong Kong (China))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-1(Invited)] Quantum Dot Electroluminescence to Achieve Saturated Colours for REC2020 Compatibility

*Poopathy Kathirgamanathan¹, Muttulingam Kumaravel¹ (1. Brunel University London (UK))

Keywords: Electroluminescent quantum dots, Cd Free Quantum Dots, InP/ZnS QDs, CdSe/ZnSe/ZnS QDs, QLEDs

Using solvent based surface engineering of sol-gel derived ZnO electron injector, red QLEDs with a current efficiency of

32.6 cdA⁻¹ and a power efficiency of 18.6 lmW⁻¹ at 1000 cdm⁻² for Cd based QDs. We also report dark red electroluminescent InP/ZnS QDs (x,y = 0.672, 0.325)) with a maximum current and power efficiency of 3.6 cdA⁻¹ and 4.7 lmW⁻¹ respectively.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-3(Invited)] Ultra-Bright Quantum-Dot Light-Emitting Diodes

*Shuming Chen¹ (1. Southern University of Science and Technology (China))

Keywords: quantum dot, light-emitting diodes, device structures, ultra-bright, thermal management

Thermal stability of quantum dots (QDs) and thermal management of QD light-emitting diodes (QLEDs) could significantly affect the performance, especially the efficiency roll-off behaviors of QLEDs. With effective thermal management, the efficiency roll-off is significantly suppressed and consequently our developed green QLEDs exhibit an unprecedented high brightness of over 10⁶ cd/m² at a current density of J=3500 mA/cm² and a external quantum efficiency of ~10%, which is an order of magnitude higher than that of all reported QLEDs.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-4(Invited)] Efficient and Stable Light Emitting Diodes Based on Luminescent Nanocrystals

*Kai Wang¹, Xiangtian Xiao^{1,2}, Zhaojin Wang¹, Taikang Ye¹ (1. Southern University of Science and Technology (China), 2. The University of Hong Kong (China))

Keywords: Perovskite, Quantum dot, Light emitting diode, Stability

Efficiencies of electroluminescence perovskite LEDs were enhanced significantly by lowering surface defects and balancing charge injection. Moreover, optical and thermal stabilities of photoluminescence quantum dot LEDs and perovskite LEDs were also improved greatly by introducing the Quantum Dot Luminescent Micro-Sphere (QLuMiS) technology.

Oral Presentation

[FMC4/LCT4] Micro LED Display

Special Topics of Interest on Micro/Mini LEDs

Chair: K Kälantär (Global Optical Solutions)

Co-Chair: Seiji Shibahara (Sony Home Entertainment & Sound Products Inc.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A (1F)

[FMC4/LCT4-1(Invited)] High-Resolution (1,000 to over 3,000 ppi) Full-Color "Silicon Display" for Augmented and Mixed Reality

*Hidenori Kawanishi¹, Hiroaki Onuma¹, Masumi Maegawa¹, Takashi Kurisu², Takashi Ono², Shigeyuki Akase¹, Shinji Yamaguchi¹, Naoto Momotani², Yusuke Fujita¹, Yuhei Kondo², Kentaro Kubota², Toshimi Yoshida¹, Yuta Ikawa¹, Tsuyoshi Ono², Hiroyoshi Higashisaka², Yasuaki Hirano², Shinsuke Anzai¹ (1. Sharp Fukuyama Semiconductor Co., Ltd. (Japan), 2. Sharp Fukuyama Laser Co., Ltd (Japan))

9:00 AM - 9:20 AM

[FMC4/LCT4-2(Invited)] A new generation of HDR display with super multi-zones mini LED

*Jianping Zheng¹, Zhuo Deng¹, Ling Wu¹, Poping Shen¹, Junyi Li¹, Jianmou Huang¹ (1. XiaMen Tianma Microelectronics Company, Ltd. (China))

9:20 AM - 9:40 AM

[FMC4/LCT4-3(Invited)] Monolithic Integration of GaN-micro-LED and Si-MOSFET for Bio-application

*Hiroto Sekiguchi^{1,2}, Hiroki Yasunaga¹, Kazuaki Tsuchiyama¹, Keisuke Yamane¹, Hiroshi Okada¹, Akihiro Wakahara¹ (1. Toyohashi University of Technology (Japan), 2. PRESTO, JST (Japan))

9:40 AM - 10:00 AM

[FMC4/LCT4-4] An Active Matrix Mini-LEDs Backlight based on a-Si

*Bin Liu^{1,2}, quansheng liu², jia li², yongyuan qiu², junling liu², yong yang², hongyuan xu², Juncheng Xiao², feng zhu², hang zhou¹, Xin Zhang² (1. Peking University Shenzhen Graduate School (China), 2. China Star Optoelectronics Technology (China))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

**[FMC4/LCT4-1(Invited)] High-Resolution (1,000 to over 3,000 ppi)
Full-Color "Silicon Display" for Augmented
and Mixed Reality**

*Hidenori Kawanishi¹, Hiroaki Onuma¹, Masumi Maegawa¹, Takashi Kurisu², Takashi Ono², Shigeyuki Akase¹, Shinji Yamaguchi¹, Naoto Momotani², Yusuke Fujita¹, Yuhei Kondo², Kentaro Kubota², Toshimi Yoshida¹, Yuta Ikawa¹, Tsuyoshi Ono², Hiroyoshi Higashisaka², Yasuaki Hirano², Shinsuke Anzai¹ (1. Sharp Fukuyama Semiconductor Co., Ltd. (Japan), 2. Sharp Fukuyama Laser Co., Ltd (Japan))

Keywords: microdisplay, colour-converted micro-LED, near to eye, quantum dot, high brightness

We present the status of III-nitride micro-LED display bonded onto silicon backplane. 0.38-inch full-colour display with a resolution of 1,053 ppi has been successfully demonstrated. Progress toward higher resolution is also described. We believe our "Silicon Display" is ideally suited for near-to-eye displays for augmented and mixed reality.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

**[FMC4/LCT4-2(Invited)] A new generation of HDR display with super
multi-zones mini LED**

*Jianping Zheng¹, Zhuo Deng¹, Ling Wu¹, Poping Shen¹, Junyi Li¹, Jianmou Huang¹ (1. XiaMen Tianma Microelectronics Company, Ltd. (China))

Keywords: HDR Display, LCD, Super multi-zones, mini LED

We propose a new generation of HDR display with active matrix mini-LED backlight for LCD. The display enables super multi-zones display by using new type of backlight drive, which achieved better contrast and less halo defect. Through both instrument test and perception experiments, we evaluated the performance of HDR LCD.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

**[FMC4/LCT4-3(Invited)] Monolithic Integration of GaN-micro-LED and
Si-MOSFET for Bio-application**

*Hiroto Sekiguchi^{1,2}, Hiroki Yasunaga¹, Kazuaki Tsuchiyama¹, Keisuke Yamane¹, Hiroshi Okada¹, Akihiro Wakahara¹ (1. Toyohashi University of Technology (Japan), 2. PRESTO, JST (Japan))

Keywords: MicroLED, Optogenetics, GaN, wafer bonding

A micro light-emitting diodes (LED) has been attention as an optical stimulation tool for optogenetics. In this study, a needle-type microLED probe was fabricated for neuroscience. In addition, the monolithic integration of microLED and Si-MOSFET using wafer bonding technique was challenged toward the realization of multifunctional devices.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

[FMC4/LCT4-4] An Active Matrix Mini-LEDs Backlight based on a-Si

*Bin Liu^{1,2}, quansheng liu², jia li², yongyuan qiu², junling liu², yong yang², hongyuan xu², Juncheng Xiao², feng zhu², hang zhou¹, Xin Zhang² (1. Peking University Shenzhen Graduate School (China), 2. China Star Optoelectronics Technology (China))

Keywords: Mini-LEDs, A-Si TFT, Backlight

In this work, we fabricate an active matrix mini-LEDs backlight based on a-Si. The driving mechanism with 2T1C and process flow are discussed in detail. IR-drop is analyzed and improved. The gray scale is controlled by PWM method with the number of 64 (6 bit), and the maximum brightness is up to 20,000nits.

Oral Presentation

[VHF5] Physiological and Psychophysical Factors

Chair: Hiroyasu Ujike (AIST)

Co-Chair: Masamitsu Harasawa (NHK)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A (1F)

[VHF5-1(Invited)] A Modeling Approach to Investigate the Relationship Between Motion Sickness Severity and Visual Motion

*Akira Tanaka¹, Norihiro Sugita², Makoto Yoshizawa², Tomoyuki Yambe² (1. Fukushima University (Japan), 2. Tohoku University (Japan))

5:20 PM - 5:45 PM

[VHF5-4L] Blue Light Promotes Heart Rate Recovery After Exercise

*Emi Yuda¹, Yutaka Yoshida², Kento Yamamoto³, Junichiro Hayano⁴ (1. Tohoku University Graduate School of Engineering (Japan), 2. Nagoya City University Graduate School of Art and Engineering (Japan), 3. University of Tsukuba Graduate School of Sports Medicine (Japan), 4. Nagoya City University Graduate School of Medical Sciences (Japan))

5:45 PM - 6:00 PM

[VHF5-3] Immanent Dichromatic in Trichromatic Observer: Based on MDS Analyses of R-G Neutral- and Y-B Only Changed- Stimuli Observation Results

*Shoko Hira¹, Asuka Sako¹, Ryusuke Uto¹, Kota Kanari², Minoru Ohkoba², Tomoharu Ishikawa², Miyoshi Ayama², Sakuichi Ohtsuka¹ (1. Kagoshima University (Japan), 2. Utsunomiya University (Japan))

6:05 PM - 6:25 PM

[VHF5-5L] Effects of motion sickness on driving tasks

*Daisuke Sugiyama¹ (1. Niigata University (Japan))

6:25 PM - 6:40 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

[VHF5-1(Invited)] A Modeling Approach to Investigate the Relationship Between Motion Sickness Severity and Visual Motion

*Akira Tanaka¹, Norihiro Sugita², Makoto Yoshizawa², Tomoyuki Yambe² (1. Fukushima University (Japan), 2. Tohoku University (Japan))

Keywords: Motion sickness, Autonomic nervous system, Nonlinear modeling, Video global motion

In this study, dynamic characteristics between image motion and severity of visually induced motion sickness (VIMS) was modeled as a Hammerstein model, which consists of a static nonlinear function followed by a linear system. The results indicate the change in subjective VIMS score may be estimated from image motions.

5:45 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

[VHF5-4L] Blue Light Promotes Heart Rate Recovery After Exercise

*Emi Yuda¹, Yutaka Yoshida², Kento Yamamoto³, Junichiro Hayano⁴ (1. Tohoku University Graduate School of Engineering (Japan), 2. Nagoya City University Graduate School of Art and Engineering (Japan), 3. University of Tsukuba Graduate School of Sports Medicine (Japan), 4. Nagoya City University Graduate School of Medical Sciences (Japan))

Keywords: Organic Light Emitting Diode (OLED), Exercise, Recovery, Heart rate

Today, various sports and competitions are performed under artificial lighting, whether indoors or outdoors. We studied if the color of the lighting affects athletic ability. Comparing orange light that did not contain melanopsin stimulating component, blue light rich in melanopsin stimulating components prompted heart rate (HR) recovery after submaximal exercise.

6:05 PM - 6:25 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

[VHF5-3] Immanent Dichromatic in Trichromatic Observer: Based on MDS Analyses of R-G Neutral- and Y-B Only Changed- Stimuli Observation Results

*Shoko Hira¹, Asuka Sako¹, Ryusuke Uto¹, Kota Kanari², Minoru Ohkoba², Tomoharu Ishikawa², Miyoshi Ayama², Sakuichi Ohtsuka¹ (1. Kagoshima University (Japan), 2. Utsunomiya University (Japan))

Keywords: Color development, Evolution, Immanent dichromatic, Color vision deficiency, MDS

Immanent dichromatic in color normal observers is investigated by MDS (Multidimensional-Scaling). The results show that (1) color-constellations yielded when observing R-G neutral- and Y-B only changed-stimuli strongly evidence concave-shaped like dichromatic, whereas (2) those gained when observing Y-B

neutral- and R-G only changed-stimuli evidence oval-shape of saturation-brightness.

6:25 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

[VHF5-5L] Effects of motion sickness on driving tasks

*Daisuke Sugiyama¹ (1. Niigata University (Japan))

Keywords: self-driving, visual induced motion sickness, driving tasks

We investigated how the effect of motion sickness on the succession of the driving tasks of the car by conducting two experiments. The results of experiment 1 suggested that the seriousness of motion sickness in no driving tasks condition was higher than that in driving tasks condition.

Oral Presentation

[AMD4] Emerging TFTs

Chair: Hyun Jae Kim (Yonsei Univ.)

Co-Chair: Yosei Shibata (Tohoku Univ.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B (1F)

[AMD4-1(Invited)] Active-Matrix Driven Flexible mini-LED Displays based on High-Performance Organic Single-Crystal TFTs

*Jun Takeya^{1,2} (1. The University of Tokyo (Japan), 2. Organo-Circuit Inc. (Japan))

9:00 AM - 9:25 AM

[AMD4-2(Invited)] Printing of 3D Electronic Circuits and Organic Thin-Film Transistors

*Takeo Minari¹, Qingqing Sun¹, Wanli Li¹, Xuying Liu², Masayuki Kanehara³ (1. National Institute for Materials Science (NIMS) (Japan), 2. Zhengzhou University (China), 3. C-INK Co., Ltd. (Japan))

9:25 AM - 9:50 AM

[AMD4-4L] Integrated Polycrystalline Silicon Photomask Technology for Low-Temperature Polycrystalline Silicon (LTPS) TFTs

*Jia-Hong Ye¹, Ching-Liang Huang¹, Kuo-Yu Huang¹, Maw-Song Chen¹, Wen-Ching Tsai¹, Wei-Ming Huang¹, Yang-An Wu¹ (1. AUO (Taiwan))

9:50 AM - 10:05 AM

[AMD4-5L] Improving Performances of Oxide Phototransistors Using a Mechano-Chemically Treated Porous Structure as The Visible Light Absorption Layer

*I Sak Lee¹, Bennet Nii Akwei Brown², Dongwoo Kim¹, Sujin Jung¹, Byung Ha Kang¹, Hyun Jae Kim¹ (1. Yonsei University (Korea), 2. Columbia University (United States of America))

10:05 AM - 10:20 AM

9:00 AM - 9:25 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

[AMD4-1(Invited)] Active-Matrix Driven Flexible mini-LED Displays based on High-Performance Organic Single-Crystal TFTs

*Jun Takeya^{1,2} (1. The University of Tokyo (Japan), 2. Organo-Circuit Inc. (Japan))

Keywords: Flexible LED display, Organic active matrix, Organic TFT, Large-area display

A newly developed technologies of flexible active-matrix mini-LED displays are presented. The backplane is based on high-performance organic single-crystal TFTs laminated on screen-printed large-area plastic substrates. The devices are suited to the application for large-area signages.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

[AMD4-2(Invited)] Printing of 3D Electronic Circuits and Organic Thin-Film Transistors

*Takeo Minari¹, Qingqing Sun¹, Wanli Li¹, Xuying Liu², Masayuki Kanehara³ (1. National Institute for Materials Science (NIMS) (Japan), 2. Zhengzhou University (China), 3. C-INK Co., Ltd. (Japan))

Keywords: Printed Electronics, Organic thin-film transistors, Metal nanoparticles

We propose a large-scale fabrication method of electronic devices based on solution-processed coating and printing. This method relies on bottom-up printing processes using soluble metal nanoparticles and organic semiconductors, resulting in thin-film electronic devices to be printed at room temperature without application of heat. We successfully fabricated high-performance organic thin-film transistors on plastic and paper substrates. In addition, the printing technique with 1-micron line width and space was also achieved. Our fabrication method is very promising for low-cost fabrication of high-resolution flexible electronics.

9:50 AM - 10:05 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

[AMD4-4L] Integrated Polycrystalline Silicon Photomask Technology for Low-Temperature Polycrystalline Silicon (LTPS) TFTs

*Jia-Hong Ye¹, Ching-Liang Huang¹, Kuo-Yu Huang¹, Maw-Song Chen¹, Wen-Ching Tsai¹, Wei-Ming Huang¹, Yang-An Wu¹ (1. AUO (Taiwan))

Keywords: LTPS TFTs, Hybrid Backplane, LTPO

A novel Four-Photomask complementary metal oxide semiconductor (CMOS) technology for low temperature polycrystalline silicon (poly-Si) thin film transistors (LTPS TFTs) was proposed in the first time. The combination of poly-Si layer and P plus (P+) region definitions within one lithography process was realized by a half-tone photomask. In this paper, the characteristics of TFTs within a half-tone Poly-Si Photomask of lithography processes were reported and compared with electrical characteristics of typical Six-Photomask lithography processes. The Integrated Poly-Si Photomask Technology can be applied to reduce the numbers of photomask of making an IGZO and LTPS Hybrid TFTs Array.

10:05 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

[AMD4-5L] Improving Performances of Oxide Phototransistors Using a Mechano-Chemically Treated Porous Structure as The Visible Light Absorption Layer

*I Sak Lee¹, Bennet Nii Akwei Brown², Dongwoo Kim¹, Sujin Jung¹, Byung Ha Kang¹, Hyun Jae Kim¹ (1. Yonsei University (Korea), 2. Columbia University (United States of America))

Keywords: Oxide TFT, Photosensor, Visible light, Mechano-chemical treatment

In this research, we suggest indium gallium zinc oxide (IGZO) thin film transistors (TFTs) for detection of visible light using a porous oxide layer (POL) resulting from mechano-chemical treatment. When compared with conventional IGZO TFT, the IGZO TFT with the POL exhibits photoresponsivity of 341.32 A/W, photosensitivity of 1.10×10^6 , and detectivity of 4.54×10^{10} Jones under 532 nm light illumination.

Oral Presentation

[FLX2] Stretchable and Flexible Devices

Chair: Manabu Ito (Toppan Printing Co.)

Co-Chair: Mitsuru Nakata (NHK)

Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B (1F)

[FLX2-1(Invited)] Development of Flexible / Stretchable Epoxy Film with High Thermal Stability, Especially Suitable for Versatile Printed Electronics Applications

*Noriyasu Yamane¹, Kenta Yamamoto¹, Kotaro Nozawa¹, Takashi Komori¹, Tomohide Murase¹, Takayoshi Hirai¹ (1. Mitsubishi Chemical Corporation (Japan))

5:20 PM - 5:45 PM

[FLX2-2(Invited)] High Performance IGTO Transistors with Stretchable Gate Dielectric Layer

*Jae Kyeong Jeong¹, Jae Seok Hur¹, Jeong Oh Kim¹ (1. Hanyang University (Korea))

5:45 PM - 6:10 PM

[FLX2-3] Study on Top-Gate Self-Aligned InGaZnO TFTs on PI Substrate

*Nian Liu¹, Huafei Xie², Macai Lu¹, Xueru Mei¹, Lei Wen¹, Shujiah Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

6:10 PM - 6:30 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

[FLX2-1(Invited)] Development of Flexible / Stretchable Epoxy Film with High Thermal Stability, Especially Suitable for Versatile Printed Electronics Applications

*Noriyasu Yamane¹, Kenta Yamamoto¹, Kotaro Nozawa¹, Takashi Komori¹, Tomohide Murase¹, Takayoshi Hirai¹
(1. Mitsubishi Chemical Corporation (Japan))

Keywords: flexible and stretchable epoxy films, excellent thermal stability and physical properties, printability of conductive inks with no surface treatment, high optical transparency with low retardation, recommended substrate for FHE, 3D wirings, flexible displays, wearable sensors or medical electronics

Authors developed two types of novel epoxy films with excellent printability for conductive or dielectric inks without surface treatments. High flexible type shows high durability against repeated folding. Stretchable type shows high elongation and recovery. These are recommendable for substrates of FHE, foldable displays or lighting devices, stretchable/wearable sensors, etc.

5:45 PM - 6:10 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

[FLX2-2(Invited)] High Performance IGT0 Transistors with Stretchable Gate Dielectric Layer

*Jae Kyeong Jeong¹, Jae Seok Hur¹, Jeong Oh Kim¹ (1. Hanyang University (Korea))

Keywords: Stretchable Electronics, Polymer Dielectric, TFT, Bendable, IGT0

Flexible/stretchable active-matrix electronics strongly demand the design of new concept material, which should have the good electrical properties and mechanical durability. In this paper, we will address the design of hybrid dielectric film, which consists of the polymer-based backbone and high permittivity additive. By virtue of smart cross linker selection, we are able to achieve the high performance oxide transistor with the hybrid polymer gate dielectric film. The fabricated transistors can withstand the 100 times mechanical bending stress under an extremely small curvature radius of 1mm. Simultaneously, they exhibit the high mobility of $>20 \text{ cm}^2/\text{Vs}$ and $I_{\text{ON/OFF}}$ ratio of $>10^7$, indicating that this approach can be one of the ways for the highly mechanically stable electronics.

6:10 PM - 6:30 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

[FLX2-3] Study on Top-Gate Self-Aligned InGaZnO TFTs on PI Substrate

*Nian Liu¹, Huafei Xie², Macai Lu¹, Xueru Mei¹, Lei Wen¹, Shujih Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

Keywords: IGZO, Flexible Display, Polyimide, Thin-Film Transistor, Micro LED

We discussed the effect of polyimide substrate on TFTs, the water from polyimide diffused into IGZO which deteriorated device characteristic. By reducing hydrogen content in GI we optimized device characteristic, and GI 1step deposition is more stable. Finally, we did the static bending and dynamic test, TFTs keep good stability.

Oral Presentation

[EP2/DES4] Advanced Electronic Paper Displays and Systems

Chair: Norihisa Kobayashi (Chiba Univ.)

Co-Chair: Haruhiko Okumura (Toshiba)

Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107 (1F)

[EP2/DES4-5L(Invited)] High-Performance and Low-Power Full Color Reflective LCD for New Applications

*Hiroyuki Hakoi¹, Ming Ni¹, Junichi Hashimoto¹, Takashi Sato¹, Shinji Shimada¹, Kiyoshi Minoura¹, Akiko Itoh¹, Kohei Tanaka¹, Hiroshi Matsukizono¹, Masashi Otsubo¹ (1. SHARP Corporation (Japan))

9:00 AM - 9:20 AM

[EP2/DES4-2(Invited)] Reflective Electro-Wetting Displays for Out Of Home Display Applications

*Doeke J Oostra¹ (1. Etulipa (Netherlands))

9:25 AM - 9:50 AM

[EP2/DES4-3(Invited)] Specification for Color E-paper

*Alex Henzen^{1,2}, Guofu Zhou^{1,2,3} (1. South China Normal University (China), 2. Liquid Light Ltd. (China), 3. Shenzhen Guohua Optoelectronics (China))

9:50 AM - 10:15 AM

[EP2/DES4-4] The Driving System of Electrowetting Display Based on Multi-Gray Dynamic Symmetry Driving Waveform

*shanling Lin¹, Mingyong Qian¹, Zhixian Lin¹, Tailiang Guo¹ (1. Fuzhou University (China))

10:15 AM - 10:35 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

[EP2/DES4-5L(Invited)] High-Performance and Low-Power Full Color Reflective LCD for New Applications

*Hiroyuki Hakoi¹, Ming Ni¹, Junichi Hashimoto¹, Takashi Sato¹, Shinji Shimada¹, Kiyoshi Minoura¹, Akiko Itoh¹, Kohei Tanaka¹, Hiroshi Matsukizono¹, Masashi Otsubo¹ (1. SHARP Corporation (Japan))

Keywords: reflective LCD, VA, MRS, IGZO, 1Hz drive

We have developed a reflective LCD with full color video image and low power consumption. 22-inch and 11-inch prototype have achieved excellent optical properties and flicker-less 1Hz driving by a new twisted VA-LC mode, reliable materials, an optimal electrode design with micro reflective structure (MRS), and IGZO-TFT technology.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

[EP2/DES4-2(Invited)] Reflective Electro-Wetting Displays for Out Of Home Display Applications

*Doeke J Oostra¹ (1. Etulipa (Netherlands))

Keywords: reflective displays, electro-wetting display technology, digital out of home displays, sunlight readability, energy consumption

Etulipa develops reflective digital displays for out of home advertisement using electro-wetting display technology. The black and white character application for electronic changeable copy boards is tested in the field. A matrix panel has been developed for full color displays. The panel has been designed for a seamless experience.

9:50 AM - 10:15 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

[EP2/DES4-3(Invited)] Specification for Color E-paper

*Alex Henzen^{1,2}, Guofu Zhou^{1,2,3} (1. South China Normal University (China), 2. Liquid Light Ltd. (China), 3. Shenzhen Guohua Optoelectronics (China))

Keywords: e-paper , color , specification , gamut , subtractive

E-paper has been approached as a "normal" display, and measurements are based on measurements as used for emissive displays, or at the very best reflective monochrome LCD. This may be adequate for grayscale e-paper displays, but as soon as color is added, these metrics are no longer suitable. This paper introduces a better way to evaluate color e-paper displays.

10:15 AM - 10:35 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

[EP2/DES4-4] The Driving System of Electrowetting Display Based on Multi-Gray Dynamic Symmetry Driving Waveform

*shanling Lin¹, Mingyong Qian¹, Zhixian Lin¹, Tailiang Guo¹ (1. Fuzhou University (China))

Keywords: electrowetting display, driving system, driving waveform

In order to play video in real time of electrowetting display, a display driving system which included a DVI video codec system and FPGA timing control system was designed. The paper also proposed an improved multi-gray scales dynamic symmetrical driving waveform, which improved the oil-splitting phenomenon and suppressed the charge-trapping phenomenon while increasing the gray level.

Oral Presentation

[EP3] Electrochromic Devices

Chair: Shuichi Maeda (Tokai University)

Co-Chair: Yoshihiko Hotta (Ricoh)

Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107 (1F)

[EP3-1L] Nature-Inspired Flexible Electrochromic Devices

*Masayoshi Higuchi¹, Yukio Fijii¹, Shigeki Kuroiwa², Keishi Ohashi², Yoshiharu Hamada³, Akihiko Kubota³ (1. National Institute for Materials Science (Japan), 2. Waseda University (Japan), 3. Tama Art University (Japan))

5:20 PM - 5:35 PM

[EP3-2L] Optimization of Prussian Blue Modified Counter Electrode in Ag Deposition-based Electrochromic Device

*Shunsuke Kimura¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

5:35 PM - 5:50 PM

[EP3-3L] Relationship of Thickness of ITO Particle-modified Counter Electrode into Electrochromic Properties of 10-methylphenothiazine

*Zhuang Liang¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

5:50 PM - 6:05 PM

[EP3-4L] Ultrahigh Cycle Stability in an Electrochromic Device with Fe(II)-Based Metallo-Supramolecular Polymer

*SANJOY MONDAL¹, MASAYOSHI HIGUCHI¹ (1. Electronic Functional Macromolecules Group, National Institute for Materials Science (NIMS), (Japan))

6:05 PM - 6:20 PM

5:20 PM - 5:35 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

[EP3-1L] Nature-Inspired Flexible Electrochromic Devices

*Masayoshi Higuchi¹, Yukio Fijii¹, Shigeki Kuroiwa², Keishi Ohashi², Yoshiharu Hamada³, Akihiko Kubota³
(1. National Institute for Materials Science (Japan), 2. Waseda University (Japan), 3. Tama Art University (Japan))

Keywords: metallo-supramolecular polymer, electrochromic device, product design, nature-inspiration

Nature-inspired flexible electrochromic devices have been fabricated using electrochromic metallo-supramolecular polymer for the first time in the world. The use of Ru(II)-based polymer, which changes the color between red and green, and the multi-layer coating method have enabled to reproduce the nature of a real fallen leaf by the devices.

5:35 PM - 5:50 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

[EP3-2L] Optimization of Prussian Blue Modified Counter Electrode in Ag Deposition-based Electrochromic Device

*Shunsuke Kimura¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

Keywords: Electrochromism, Silver, Electrodeposition, Smart window, Electronic paper

Prussian blue modified electrode was introduced into Ag deposition-based electrochromic (EC) device as the counter-reaction material for charge compensation of Ag redox. We discuss the bi-stability of the optical states and desirable features of Prussian blue film for metal deposition based EC device.

5:50 PM - 6:05 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

[EP3-3L] Relationship of Thickness of ITO Particle-modified Counter Electrode into Electrochromic Properties of 10-methylphenothiazine

*Zhuang Liang¹, Kazuki Nakamura¹, Norihisa Kobayashi¹ (1. Chiba University (Japan))

We have already reported a novel multicolor electrochromism in a single device by introducing a porous counter electrode having high capacitance. In this paper, we investigated the effect of capacitance properties of the counter electrode into coloration properties of 10-methylphenothiazine molecule.

6:05 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

[EP3-4L] Ultrahigh Cycle Stability in an Electrochromic Device with Fe(II)-Based Metallo-Supramolecular Polymer

*SANJOY MONDAL¹, MASAYOSHI HIGUCHI¹ (1. Electronic Functional Macromolecules Group, National Institute for Materials Science (NIMS), (Japan))

Keywords: Electrochromic device, Metallo-supramolecular polymer, Low voltage , Cyclic stability

Ultrahigh cycle stability more than 100,000 cycles has been achieved in an electrochromic device with an Fe(II)-based metallo-supramolecular polymer layer and a modified counter electrode layer. The reversible color change between bluish-violet and colorless occurred at low applied voltages and the transmittance change reached >60%.

Oral Presentation

[PRJ2] Optical Components

Chair: Hidekazu Hatanaka (USHIO)

Co-Chair: Juiwei Pan (Chiao Tung Univ.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108 (1F)

[PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes

*Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiisa Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyoda Gosei Co., Ltd. (Japan))

9:00 AM - 9:20 AM

[PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays

Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway (Norway))

9:20 AM - 9:40 AM

[PRJ2-3] Achromatic Total Internal Reflection Prism in DLP Projection System

*Ya-Chi Lu¹, Jhong-Syuan Li¹, Kao-Der Chang², Shie-Chang Jeng¹, Jui-Wen Pan¹ (1. National Chiao Tung University (Taiwan), 2. Industrial Technology Research Institute (Taiwan))

9:40 AM - 10:00 AM

[PRJ2-4] High Power Red Laser Diode for Projector Light Source

*Masato Hagimoto¹, Shintaro Miyamoto¹, Yuki Kimura¹, Haruki Fukai¹, Manabu Hashizume¹, Satoshi Kawanaka¹ (1. USHIO OPTO SEMICONDUCTORS, INC. (Japan))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes

*Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiisa Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyoda Gosei Co., Ltd. (Japan))

Keywords: Visible laser diodes, High power, GaN, Projector

Visible laser diodes have recently attracted a great deal of attention as light sources for various display and lighting applications. In this paper, recent progress in green and blue lasers developed at Sony, which realize watt-class output power, are reported.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays

Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway (Norway))

Keywords: speckle reduction, focus tunable lens, angular diversity, spatial diversity

We propose a laser speckle reduction method using a fast focus tunable lens (FTL). Different laser beams are generated after modulating the FTL. Thus, when the laser beams are used to illuminate a diffuser, various speckle images are obtained, and the summed speckle images yield a speckle image with reduced speckle contrast ratio.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-3] Achromatic Total Internal Reflection Prism in DLP Projection System

*Ya-Chi Lu¹, Jhong-Syuan Li¹, Kao-Der Chang², Shie-Chang Jeng¹, Jui-Wen Pan¹ (1. National Chiao Tung University (Taiwan), 2. Industrial Technology Research Institute (Taiwan))

Keywords: DLP Projection System, Large Area Displays, Total Internal Reflection Prism

Two different types of the achromatic TIR prism set are designed to mini projector. Type1 prism set is the first prism with a small Abbe number material stacked with the second prism with a large Abbe number material. Type2 prism set is an opposite design to Type1 prism set.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-4] High Power Red Laser Diode for Projector Light Source

*Masato Hagimoto¹, Shintaro Miyamoto¹, Yuki Kimura¹, Haruki Fukai¹, Manabu Hashizume¹, Satoshi Kawanaka¹
(1. USHIO OPTO SEMICONDUCTORS, INC. (Japan))

Keywords: red laser, laser projector, speckle reduction, wall plug efficiency, tensile strain

We developed 638nm and 642nm red laser diodes with 3.5W pulse / 2.4W CW operation. The 3.5W pulsed operation and wall plug efficiency of 43% are the world's highest in 638nm to the best of our knowledge. The lineups of multiple wavelengths are ideal as red light sources for projector.

Oral Presentation

[PRJ3] Image Quality and Display Devices

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Andrés Vásquez Quintero (University of Ghent)

Co-Chair: Tetsuji Suzuki (JVC KENWOOD)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108 (1F)

[PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications

*Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))

5:20 PM - 5:40 PM

[PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology

*Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))

5:40 PM - 6:00 PM

[PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module

*Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))

6:00 PM - 6:20 PM

[PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects

*Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications

*Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))

Keywords: Liquid crystal on silicon, spatial light modulator, holography, virtual and augmented reality display

A 0.7-inch, 4K2K LCoS-SLM with full 2π radians phase modulation to cover depth-focus image was developed. The full phase modulation was found 0.9 and 1.5 ms under the digital driving scheme with $DV = 1.75$ V at $T=45$ °C. A 200 mm depth of 3D reconstruction holographic image was demonstrated.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology

*Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))

Keywords: Liquid Crystal on Silicon (LCoS), Spatial Light Modulator (SLM), Holographic Display, 4K2K

High resolution, full phase modulation, small pixel pitch, high aperture ratio, and fast response time are the requirements to enhance the quality of holographic display by using the LCoS-SLM. In this paper, we develop a 3D floating holographic display and to increase the angle of view as 36.67 degree with high resolution phase-only 4K2K LCoS-SLM.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module

*Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))

Keywords: laser module, color speckle, far field pattern, fiber, laser display

Temperature dependence of color speckle of the projected image of a fiber-out white laser beam from a laser module with red, green, blue laser diodes was measured. Larger temperature dependence of the red laser diode was found to greatly affect the performance of the white beam and color-speckle.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects

*Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

Keywords: Head-mounted displays, ergonomics, Optical properties, Standardization

As novel display devices, head-mounted displays (HMD) are getting popular. These devices have unique characteristics. Because of those, there are immediate requirements of having standards to evaluate those HMDs to avoid unwanted impacts to viewers. In order to answer those, ISO TC 159/SC4/WG2 and WG12 started developing standards for HMDs.

Oral Presentation

[3DSA5/3D5] Light Field 2

Chair: Jung-Young Son (Konyang Univ.)

Co-Chair: Munekazu Date (NTT)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall (2F)

[3DSA5/3D5-1] An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom

*Sangwoon Kwak¹, Joungil Yun¹, Won-Sik Cheong¹, Jeongil Seo¹ (1. ETRI (Korea))

5:20 PM - 5:40 PM

[3DSA5/3D5-2] GPU-Accelerated Interactive Virtual View Synthesis from Light Field Images

*Hyeonjin Jung¹, Joungil Yun², Won-Sik Cheong², Youngmin Yi¹ (1. University of Seoul (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

5:40 PM - 6:00 PM

[3DSA5/3D5-3] Accommodation Response to a Super-Multiview Display Based on Time-Division Multiplexing Parallax Barrier

*Yuta Watanabe¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:00 PM - 6:20 PM

[3DSA5/3D5-4] An Autostereoscopic Display with Time-Multiplexed Directional Backlight Using a Curved Lens Array

*Garimagai Borjigin¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-1] An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom

*Sangwoon Kwak¹, Joungil Yun¹, Won-Sik Cheong¹, Jeongil Seo¹ (1. ETRI (Korea))

Keywords: View Synthesis, Light Field, Virtual Reality, 6DoF

In this paper, virtual view synthesis of sparse light field images is considered. We analyze the patch-wise 3D warping and blending methods of the conventional view synthesis, and propose an improved algorithm for supporting 6DoF. We suggest an enhancement for the super-pixel and additional blending weights, and present experimental results using multi-view contents of MPEG.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-2] GPU-Accelerated Interactive Virtual View Synthesis from Light Field Images

*Hyeonjin Jung¹, Joungil Yun², Won-Sik Cheong², Youngmin Yi¹ (1. University of Seoul (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

Keywords: Light Field, View Synthesis, GPU, CUDA

We present a GPU based acceleration of a virtual view synthesis from multiple Light Field images. For the synthesis of a 2K virtual view from 24 images of the same resolution, we achieved 21.31 FPS using four Titan V GPUs with algorithmic optimizations, which corresponds 923 times of speedup.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-3] Accommodation Response to a Super-Multiview Display Based on Time-Division Multiplexing Parallax Barrier

*Yuta Watanabe¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Time-division parallax barrier, Super-multiview, Accommodation response

We have measured the focal accommodation response of viewers to a dense light field generated by time-division sextuplexing parallax barriers. We have confirmed that focal accommodation in front of or behind the display screen is induced as expected.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-4] An Autostereoscopic Display with Time-Multiplexed Directional Backlight Using a Curved Lens Array

*Garimagai Borjigin¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Autostereoscopy, Curved Lens array, Crosstalk level, Time-division multiplexing, Directional light

We propose an autostereoscopic display with a curved directional backlight unit. The proposed backlight unit composed of a curved lens array and dot-matrix light sources suppresses the influence of filed curvature. Thus the crosstalk level is reduced without adding an additional layer of lens.

Oral Presentation

[3D4/VHF4/3DSA4] Illusion

Chair: Sumio Yano (Shimane University)

Co-Chair: Yuzo Hisatake (Shizuoka Univ.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall (2F)

[3D4/VHF4/3DSA4-1(Invited)] Innovative mobile force display: Buru-Navi

*Hiroaki Gomi¹, Sho Ito¹, Ryoma Tanase¹ (1. NTT Communication Science Labs. (Japan))

9:00 AM - 9:20 AM

[3D4/VHF4/3DSA4-2(Invited)] Displaying Deformation of Virtual Objects Using Visuo-Haptic Interaction

*Yuki Ban¹ (1. The University of Tokyo (Japan))

9:20 AM - 9:40 AM

[3D4/VHF4/3DSA4-3(Invited)] Real-World Implementations of Visual Illusions by Using Augmented Reality Techniques

*Takahiro Kawabe¹ (1. NTT Communication Science Laboratories (Japan))

9:40 AM - 10:00 AM

[3D4/VHF4/3DSA4-4] Gloss Enhancement beyond Projector Performance using the Glare Illusion

*Shinji Nagata¹, Toshiyuki Amano¹ (1. Wakayama University (Japan))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-1(Invited)] Innovative mobile force display: Buru-Navi

*Hiroaki Gomi¹, Sho Ito¹, Ryoma Tanase¹ (1. NTT Communication Science Labs. (Japan))

Keywords: tactile navigation, directional sensation, virtual reality, multisensory integration, force feedback

Humans capture the environmental world not only by vision but also by somatosensory information. Here we introduce several types of mobile force-display gadgets 'Buru-Navi' recently developed, and showcase some application trials for pedestrian navigation and for enhancing immersive sensation along a video scene.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-2(Invited)] Displaying Deformation of Virtual Objects Using Visuo-Haptic Interaction

*Yuki Ban¹ (1. The University of Tokyo (Japan))

Keywords: Visuo-haptic Interaction, Object Deforming, Virtual Reality

We developed the visuo-haptic shape display system with which users can deform virtual objects dynamically. Our system senses how the force is applied to the grasping object, and deforms the virtual grasping object and the virtual hands according to the direction and size of the force.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-3(Invited)] Real-World Implementations of Visual Illusions by Using Augmented Reality Techniques

*Takahiro Kawabe¹ (1. NTT Communication Science Laboratories (Japan))

Keywords: Human vision, Illusion, Information presentation technique, Cast shadow, Motion perception

Visual illusions refer to perceptual experiences wherein the appearance of objects and scenes is distorted. By taking advantage of the illusion which is often interpreted as undesired elements in perception, our technique can offer visual experiences which are not produced on the basis of the previous techniques.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-4] Gloss Enhancement beyond Projector Performance using the Glare Illusion

*Shinji Nagata¹, Toshiyuki Amano¹ (1. Wakayama University (Japan))

Keywords: Glare illusion, Spatial augmented reality, Gloss, Projector

The glare illusion is a well-known illusory perception in which a region appears brighter than its actual luminance when surrounded by a gradation of luminance. We propose a method of enhancing gloss beyond projector performance using this glare illusion. The effectiveness of the proposed method is confirmed by comparing it with the proposed and conventional method.

Oral Presentation

[OLED4] QD Material & Devices

Special Topics of Interest on Quantum Dot Technologies

Chair: Takeo Wakimoto (Merck Performance Materials)

Co-Chair: Toshiaki Ikuta (JNC Corp.)

Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204 (2F)

[OLED4-1(Invited)] Anion Exchange Perovskite Quantum-Dots for Highly Efficient Light Emitting Devices

*Takayuki Chiba¹, Junji Kido¹ (1. Yamagata University (Japan))

9:00 AM - 9:20 AM

[OLED4-2(Invited)] Efficient Perovskite Light-Emitting Diodes Enabled by Synergetic Device Architecture

Yanqing Li¹, Yang Shen¹, *Jianxin Tang¹ (1. Soochow University (China))

9:20 AM - 9:40 AM

[OLED4-3] "Efficient Indium Phosphate based Quantum Dot Light Emitting Diode using Sol-gel processed Electron Transfer Layer"

*Ji Eun Yeom¹, Dong Hyun Shin¹, Mude Nagarjuna Naik¹, Raju Lampande¹, Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

9:40 AM - 10:00 AM

[OLED4-4] Ambient Contrast Ratio Study of QD-OLED Devices

*SU PAN¹ (1. Shenzhen China Star Optoelectronics Display Technology Co.,Ltd (China))

10:00 AM - 10:20 AM

[OLED4-5L] Solution-Processed Indium-Gallium-Nitride (InGaN) Blue Light-Emitting Diodes (LEDs)

*TADAHIKO HIRAI¹, TETSUO TSUCHIYA² (1. CSIRO (Australia), 2. AIST (Japan))

10:20 AM - 10:35 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-1(Invited)] Anion Exchange Perovskite Quantum-Dots for Highly Efficient Light Emitting Devices

*Takayuki Chiba¹, Junji Kido¹ (1. Yamagata University (Japan))

Keywords: Perovskite, Quantum-dots, Ligand exchange, Anion-exchange, LED

Perovskites quantum dots have attracted much attention for used in display and lighting applications, owing to their narrow band emission with high photoluminescence quantum yields, color tunability, and solution processability. Here, we demonstrate ligand-exchange and anion-exchange perovskite quantum dots using ammonium salts for use in highly efficient light-emitting devices.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-2(Invited)] Efficient Perovskite Light-Emitting Diodes Enabled by Synergetic Device Architecture

Yanqing Li¹, Yang Shen¹, *Jianxin Tang¹ (1. Soochow University (China))

Keywords: Perovskite light-emitting diodes, CsPbBr₃, light outcoupling, moth-eye nanostructures

In this work, we demonstrated a facile route was realized by combining bioinspired moth-eye nanostructures and half-ball lens to enhance light outcoupling. As a result, the maximum external quantum efficiency of green perovskite light-emitting diodes was improved to 28.2%, which represented a substantial step toward achieving practical applications of PeLEDs.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-3] " Efficient Indium Phosphate based Quantum Dot Light Emitting Diode using Sol-gel processed Electron Transfer Layer"

*Ji Eun Yeom¹, Dong Hyun Shin¹, Mude Nagarjuna Naik¹, Raju Lampande¹, Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

Keywords: QLED, Quantum dot, Inverted structure, InP-QD

Here, we report an efficient indium phosphate (InP) based inverted red Quantum Dot-Light Emitting Diodes (QLEDs) by incorporating a sol-gel processed Mg-doped ZnO layer. The red InP-QLED with our sol-gel processed Mg:ZnO layer reveals a maximum EQE of 7.7% , which is significantly higher than the ZnO and Mg:ZnO nanoparticles layers. These results suggest that the sol-gel processed Mg-doped ZnO layer is relatively efficient in terms of performances.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-4] Ambient Contrast Ratio Study of QD-OLED Devices

*SU PAN¹ (1. Shenzhen China Star Optoelectronics Display Technology Co.,Ltd (China))

Keywords: Ambient Contrast Ratio, Quantum dot, Circular polarizer

Quantum dots are promising color conversion materials to achieve high resolution full color display with wide color gamut and low cost. In this work, we studied the ambient contrast ratio of QD-OLED devices and demonstrated an optimal structure to realize high contrast displays

10:20 AM - 10:35 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-5L] Solution-Processed Indium-Gallium-Nitride (InGaN) Blue Light-Emitting Diodes (LEDs)

*TADAHIKO HIRAI¹, TETSUO TSUCHIYA² (1. CSIRO (Australia), 2. AIST (Japan))

Keywords: InGaN, Light Emitting Diode (LED), Organic LED (OLED), Quantum Dots (QDs), Blue

A soluble form of InGaN was synthesized, producing a solution that exhibited blue photo-luminescence (PL) upon UV light exposure. This solution was used in the fabrication of a blue light-emitting diode (LED) that was produced using solution processable methods, a world first for an InGaN-base LED. The PL properties of the solution and the electro-luminescence (EL) and device characteristics of the LED are presented.

Oral Presentation

[OLED5] OLED Optical Design

Chair: Yasunori Kijima (Huawei Technologies Japan K. K.)

Co-Chair: kengo Kishino (idemitsu Kosan Co, Ltd.)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204 (2F)

[OLED5-1(Invited)] Self assembled cathode patterning for AMOLED

*Michael G. Helander¹, Zhibin Wang¹, Jacky Qiu¹, Yilu Chang¹, Qi Wang¹, Yingjie Zhang¹ (1. OTI Lumionics Inc. (Canada))

5:20 PM - 5:40 PM

[OLED5-2] Thermal evaporation process based organic/Ag/ organic transparent conducting electrode for flexible optoelectronic applications

*Subin Lee¹, Hyeong Woo Bae¹, Jang Hyuk Kwon¹, Jun Sik Oh¹ (1. Kyung Hee University (Korea))

5:40 PM - 6:00 PM

[OLED5-3] Design of Color Filter based on Metallic Nanostructure and Color Conversion Material for White OLED Display

*Hye-Bin Yang¹, Wonrea Kim², Younghoon Kim², Musun Kwak², Young-Joo Kim¹ (1. Yonsei University (Korea), 2. LG Display (Korea))

6:00 PM - 6:20 PM

[OLED5-4] Light Extraction and Viewing Angle Characteristics of Nano-structure embedded Top-emitting OLEDs fabricated by Vacuum Deposition Processes

*Doo-Hee Cho¹, Young-Sam Park¹, Hyunsu Cho¹, Kang Me Lee¹, Hye Jin Yun¹, Seung-Youl Kang¹, Seong-Deok Ahn¹, Hyunkoo Lee¹ (1. ETRI (Korea))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

[OLED5-1(Invited)] Self assembled cathode patterning for AMOLED

*Michael G. Helander¹, Zhibin Wang¹, Jacky Qiu¹, Yilu Chang¹, Qi Wang¹, Yingjie Zhang¹ (1. OTI Lumionics Inc. (Canada))

Keywords: AMOLED, Cathode, Patterning, Transparent, Under Display Sensor

Patterning of the cathode layer in top-emission AMOLED displays has been a technological barrier to realize both large area top emission AMOLED displays, and high transparency AMOLED displays. Using ConducTorr(TM) Electrode materials we demonstrate the first mass production ready cathode patterning process in a high-resolution OLED using self-assembly.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

[OLED5-2] Thermal evaporation process based organic/Ag/ organic transparent conducting electrode for flexible optoelectronic applications

*Subin Lee¹, Hyeong Woo Bae¹, Jang Hyuk Kwon¹, Jun Sik Oh¹ (1. Kyung Hee University (Korea))

Keywords: ITO free, Transparent electrode, Thermal evaporation

Herein, we report a new organic/Ag/organic (OAO) multilayer flexible transparent electrode fabricated a thermal evaporation process. This OAO electrode showed superior optical and electrical characteristics of which transmittance of 81.34% at 550 nm wavelength and low sheet resistance of 9.51 Ω/sq . Its flexible reliability is also very excellent as sheet resistance variation at the radius of curvature of 5 mm with bending cycles of 2,000 is negligible. Fabricated green phosphorescent organic light emitting diodes with this OAO electrode showed high current efficiency of 75.1 cd/A.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

[OLED5-3] Design of Color Filter based on Metallic Nanostructure and Color Conversion Material for White OLED Display

*Hye-Bin Yang¹, Wonrea Kim², Younghoon Kim², Musun Kwak², Young-Joo Kim¹ (1. Yonsei University (Korea), 2. LG Display (Korea))

Keywords: Metallic Nanostructure, Color Filter, White OLED, Color Conversion Material (CCM)

We have designed and optimized the geometric parameters of metallic nanostructure with color conversion material as a color filter for whiteOLED display to enhance the optical efficiency. Optical intensity of red and green light in whiteOLED was increased by 73.0% and 29.1%, respectively after applying metallic nanostructure with quantum-dot materials.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

[OLED5-4] Light Extraction and Viewing Angle Characteristics of Nano-structure embedded Top-emitting OLEDs fabricated by Vacuum Deposition Processes

*Doo-Hee Cho¹, Young-Sam Park¹, Hyunsu Cho¹, Kang Me Lee¹, Hye Jin Yun¹, Seung-Youl Kang¹, Seong-Deok Ahn¹, Hyunkoo Lee¹ (1. ETRI (Korea))

Keywords: light extraction, viewing angle, TEOLED

We fabricated the nano-structure applicable for a highly efficient and color stable TEOLED by using thermal evaporation and organic vapor phase deposition, respectively. The nano-structure integrated TEOLEDs showed efficiency increase by 12% (thermal evaporation) and 32% (OVPD), respectively. The $\Delta(u' v')$ from normal direction to 30° were 0.06 and 0.03, respectively.

Oral Presentation

[INP3] Haptic Technologies (1)

Special Topics of Interest on Automotive Displays

Chair: Makoto Sato (Tokyo Institute of Technology)

Co-Chair: Nobuyuki Hashimoto (Citizen)

Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206 (2F)

[INP3-1(Invited)] Widespread Hapbeat: Tension Based Necklace Type Haptic Display

*Yusuke Yamazaki¹, Hironori Mitake¹, Akihiko Shirai², Shoichi Hasegawa¹ (1. Tokyo Institute of Technology (Japan), 2. GREE, Inc. (Japan))

9:00 AM - 9:25 AM

[INP3-2(Invited)] Comptics: A system for making and sharing haptic experience

*Toshiki Wada¹, Hiroyoshi Togo¹ (1. NTT (Japan))

9:25 AM - 9:50 AM

[INP3-3(Invited)] Buttock Skin Stretch Devices for Enhancing Driving Experience

*Masashi Konyo¹ (1. Tohoku University (Japan))

9:50 AM - 10:15 AM

9:00 AM - 9:25 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

[INP3-1(Invited)] Widespread Hapbeat: Tension Based Necklace Type Haptic Display

*Yusuke Yamazaki¹, Hironori Mitake¹, Akihiko Shirai², Shoichi Hasegawa¹ (1. Tokyo Institute of Technology (Japan), 2. GREE, Inc. (Japan))

Keywords: Haptic Display, Wearable Device, Hapbeat, Music Listening, Virtual Reality

Hapbeat is a wearable haptic device which can easily enhance the immersion of digital contents such as VR, gaming, music, movie, etc. In this paper, I explain a basic mechanism of Hapbeat and a series of challenges to widespread it into the public.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

[INP3-2(Invited)] Comptics: A system for making and sharing haptic experience

*Toshiki Wada¹, Hiroyoshi Togo¹ (1. NTT (Japan))

Keywords: Haptics, User experience, Wearable computing, Interaction design

We have developed a haptic system, Comptics, that enables easy and rapid making, playing, and sharing of haptic experience. Comptics is composed of a haptic stimulation device, wearable user interface, and design and communication protocols (DCP) on a computer that uses unhearable signals.

9:50 AM - 10:15 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

[INP3-3(Invited)] Buttock Skin Stretch Devices for Enhancing Driving Experience

*Masashi Konyo¹ (1. Tohoku University (Japan))

Keywords: Haptic feedback, Skin stretch device, Driving Simulator

A new concept of buttock skin stretch to induce the perception of shear forces while sitting is reported. The buttock skin stretch is suitable for a driving simulator to enhance the whole-body experiences such as the centrifugal force of the car and the inclination of the car body in driving.

Oral Presentation

[INP4] Haptic Technologies (2)

Special Topics of Interest on Automotive Displays

Chair: Masashi Konyo (Tohoku University)

Co-Chair: Vibol Yem (Tokyo Metropolitan University)

Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206 (2F)

[INP4-1(Invited)] Sensory Illusion beyond Real Haptics

*Norio Nakamura^{1,2} (1. AIST (Japan), 2. Miraisens, Inc. (Japan))

5:20 PM - 5:45 PM

[INP4-2(Invited)] Wearable Tactile Device for Fingertip Interaction with Virtual World

*Vibol Yem¹ (1. Tokyo Metropolitan University (Japan))

5:45 PM - 6:10 PM

[INP4-3(Invited)] Input and Output Interaction Technologies for Flexible Touch Panels

*Ki-Uk Kyung¹ (1. KAIST (Korea))

6:10 PM - 6:35 PM

[INP4-4L] 8.4" Tactile Touch Display using Segmented-electrode array as both tactile pixels and touch sensors

*Takuya Asai¹, Hiroshi Haga¹, Shin Takeuchi¹, Harue Sasaki¹, Koji Shigemura¹
(1. Tianma Japan (Japan))

6:35 PM - 6:50 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

[INP4-1(Invited)] Sensory Illusion beyond Real Haptics

*Norio Nakamura^{1,2} (1. AIST (Japan), 2. Miraisens, Inc. (Japan))

Keywords: Haptic, Illusion, Neuro Science, Design, VR

'DigitalHaptics™' is the world first invention of illusionary haptics technology, developed originally by AIST based on Neuro Science. It realized many miracle haptics such as Pushing, Pulling, Texture, and Softness in the Air, and theoretically enables the almost all kinds of haptic feeling, as same as visual composition of RGB.

5:45 PM - 6:10 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

[INP4-2(Invited)] Wearable Tactile Device for Fingertip Interaction with Virtual World

*Vibol Yem¹ (1. Tokyo Metropolitan University (Japan))

Keywords: Tactile device, Fingertip, Wearable device, Virtual world

Author developed a wearable tactile device mounted to the fingertips for interaction with objects in the virtual environment. The device can provide sensations of pressure, low-frequency vibration and forward-flexion illusionary force in thumb, index and middle fingers by electrical stimulation; and high-frequency vibration and skin deformation by mechanical stimulation.

6:10 PM - 6:35 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

[INP4-3(Invited)] Input and Output Interaction Technologies for Flexible Touch Panels

*Ki-Uk Kyung¹ (1. KAIST (Korea))

Keywords: sensor, flexible, actuator, EAP, haptic

This talk will introduce recent technologies for polymer based sensors and actuators. Polymer based tactile sensors support functions of detecting multiple contact forces as well as touch positions. Flexible actuators may provide haptic cues to users.

6:35 PM - 6:50 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

[INP4-4L] 8.4" Tactile Touch Display using Segmented-electrode array as both tactile pixels and touch sensors

*Takuya Asai¹, Hiroshi Haga¹, Shin Takeuchi¹, Harue Sasaki¹, Koji Shigemura¹ (1. Tianma Japan (Japan))

Keywords: tactile display, electrostatic, segmented-electrode, free-shaped tactile sensation

We developed an electrostatic-tactile touch display using a segmented-electrode array as both tactile pixels and touch sensors. This structure allows presenting real localized tactile textures in any shape. A driving scheme in which the tactile strength is independent of the grounding state of the human body was also demonstrated.

Oral Presentation

[MEET3] Emerging Quantum Dots and Nanotechnologies (1)

Special Topics of Interest on Quantum Dot Technologies

Chair: Christophe Martinez (CEA LETI)

Co-Chair: Haizheng Zhong (Beijing Institute of Technology)

Fri. Nov 29, 2019 9:00 AM - 10:20 AM Conference Hall (1F)

[MEET3-1(Invited)] Developing Cd-free QLEDs for Display Applications

*Zhuo Chen¹, Dong Li¹, Boris Kristal¹, Jingwen Feng¹, Zhigao Lu¹, Gang Yu¹,
Yanzhao Li¹, Xinguo Li¹, Xiaoguang Xu¹ (1. BOE Technology Group Co., Ltd.
(China))

9:00 AM - 9:20 AM

[MEET3-2(Invited)] Horizontally Oriented Exciton Dipoles in Solution-Processed Quantum Dot Solids

*Chih-Jen Shih¹, Jakub Jagielski¹, Simon Solari¹, Sudhir Kumar¹ (1. ETH
Zurich, Switzerland (Switzerland))

9:20 AM - 9:40 AM

[MEET3-3(Invited)] Controlling Charge Injection Properties of Quantum Dot Light-Emitting Diodes

*Jeonghun Kwak¹, Seunghyun Rhee¹, Taesoo Lee¹, Guen-Woo Baek¹, Kyunghwan Kim¹,
Yeseul Park¹ (1. Seoul National University (Korea))

9:40 AM - 10:00 AM

[MEET3-4(Invited)] High Efficiency Cadmium-free Red Quantum Dot-Light Emitting Diodes

*Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Conference Hall)

[MEET3-1(Invited)] Developing Cd-free QLEDs for Display Applications

*Zhuo Chen¹, Dong Li¹, Boris Kristal¹, Jingwen Feng¹, Zhigao Lu¹, Gang Yu¹, Yanzhao Li¹, Xinguo Li¹, Xiaoguang Xu¹ (1. BOE Technology Group Co., Ltd. (China))

Keywords: Cd-free quantum dots, Quantum dots Light emitting diodes, Display

In this study, we investigated the effect of magnesium (Mg) doping in ZnO nanoparticles, in balancing the charge transfer in InP-based QLED devices. Through optimizing QD structures and devices, red InP QLEDs with the current efficiencies as high as 11.6 cd/A were fabricated.

9:20 AM - 9:40 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Conference Hall)

[MEET3-2(Invited)] Horizontally Oriented Exciton Dipoles in Solution-Processed Quantum Dot Solids

*Chih-Jen Shih¹, Jakub Jagielski¹, Simon Solari¹, Sudhir Kumar¹ (1. ETH Zurich, Switzerland (Switzerland))

Keywords: Quantum Dots, Perovskites, Light-Emitting Diodes

It is well-known that the horizontally oriented exciton transition dipole moments in thin films of quantum emitters can direct radiation perpendicular to the substrate, maximizing the light outcoupling efficiency. Exciton orientation control has been reported in many thermally evaporated organic molecular thin films but has not yet been realized in solution-processed quantum dots films. Here, we demonstrate that excitons in solution-processed thin films comprised of colloidal quantum wells (CQWs) of lead trihalide perovskites are horizontally oriented, with thin-film photoluminescent quantum yields of up to 90%.

9:40 AM - 10:00 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Conference Hall)

[MEET3-3(Invited)] Controlling Charge Injection Properties of Quantum Dot Light-Emitting Diodes

*Jeonghun Kwak¹, Seunghyun Rhee¹, Taesoo Lee¹, Guen-Woo Baek¹, Kyunghwan Kim¹, Yeseul Park¹ (1. Seoul National University (Korea))

Keywords: Quantum dots, Ligand exchange, Charge Injection, Light-emitting diodes

Efficient charge carrier injection is one of the most important factors to achieve high performance quantum dot (QD) light-emitting diodes (QLEDs). Here, we investigated the effects of charge carrier injection properties on the QLED performance by modifying the surface ligands of QDs and by adopting an interlayer between the QD layer and the charge transport layer.

10:00 AM - 10:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Conference Hall)

[MEET3-4(Invited)] High Efficiency Cadmium-free Red Quantum Dot-Light Emitting Diodes

*Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

Keywords: Cadmium-free QDs, Inverted QD-LED, aging, high efficiency

We report a high efficiency inverted red indium phosphide (InP) based quantum dot-light emitting diode (QD-LED) by optimizing InP-QD properties as well as interfacial contact between electron transport layer and emissive QDs, and applying self-aging approach. Our QD-LED exhibits substantial improvement in the external quantum efficiency from 4.42 to 10.2% after several days of self-aging.

Oral Presentation

[MEET4] Emerging Quantum Dots and Nanotechnologies (2)

Special Topics of Interest on Quantum Dot Technologies

Chair: Shuming Chen (Southern University of Science and Technology)

Co-Chair: Zhaojun Liu (Southern University of Science and Technology)

Fri. Nov 29, 2019 10:40 AM - 11:40 AM Conference Hall (1F)

[MEET4-1(Invited)] In-situ Fabricated Perovskite Quantum Dots for Display Applications

*Haizheng Zhong¹ (1. Beijing Institute of Technology (China))

10:40 AM - 11:00 AM

[MEET4-3(Invited)] Hybrid Colloidal Quantum Dot Photonic Devices

*Chien-chung Lin^{1,2} (1. National Chiao Tung University (Taiwan), 2. Industrial Technology Research Institute (Taiwan))

11:20 AM - 11:40 AM

10:40 AM - 11:00 AM (Fri. Nov 29, 2019 10:40 AM - 11:40 AM Conference Hall)

[MEET4-1(Invited)] In-situ Fabricated Perovskite Quantum Dots for Display Applications

*Haizheng Zhong¹ (1. Beijing Institute of Technology (China))

Keywords: quantum dots, display , perovskite, LCD backlights, electroluminescence

Halide perovskite quantum dots exhibit desired photoluminescence properties with high quantum yields, wide wavelength tunability, and ultra-narrow emissions, which are suitable for display technology. Here we describe the in-situ fabrication of perovskite quantum dots and their use in prototype devices and display system.

11:20 AM - 11:40 AM (Fri. Nov 29, 2019 10:40 AM - 11:40 AM Conference Hall)

[MEET4-3(Invited)] Hybrid Colloidal Quantum Dot Photonic Devices

*Chien-chung Lin^{1,2} (1. National Chiao Tung University (Taiwan), 2. Industrial Technology Research Institute (Taiwan))

Keywords: colloidal quantum dots, package for photonic devices, light emitting diodes, solar cells

In recent years, colloidal quantum dots (CQDs) have been the focus of attention due to their highly efficient illumination, narrow linewidth emission, and widely tunable emission wavelength. Various types of devices have been implemented for the photonic devices to incorporate these novel materials. Both photon generation and absorption can be accomplished by CQDs and the corresponding light emitting diodes and solar cells can be designed to utilize their special characteristics. In this talk, we will provide our latest progress on such devices and the past experience we had in our lab. The highly reliable CQD package will play a crucial rule for the next generation photonic devices.

 Oral Presentation

[MEET5] Micro/NanoDisplays and Nanotechnology Application (1)

Special Topics of Interest on Micro/Mini LEDs

Chair: Poopathy Kathirgamanathan (Brunel University London)

Co-Chair: Kyu Chang Park (KyungHee University)

Fri. Nov 29, 2019 1:20 PM - 2:40 PM Conference Hall (1F)

[MEET5-1(Invited)] Design Considerations for Holographic Retinal Projection Display
*Christophe Martinez¹, Fabian Rainouard¹, Basile Meynard¹ (1. CEA Leti (France))

1:20 PM - 1:40 PM

[MEET5-2(Invited)] Highly Efficient Stack Quantum-dot Light Emitting Diodes using Charge Generation Junctions
*Jin Jang¹, Suihui Lee¹, Hyo-min Kim¹, Yuanfeng Chen¹ (1. Advanced Display Research Center, Kyung Hee University (Korea))

1:40 PM - 2:00 PM

[MEET5-3(Invited)] Investigation of Temperature-dependent Behaviors of Micro-LED Displays
*Zhaojun Liu¹, Bo Lu¹, Minggang Liu², Yong Fan², Jiayu Lee², Yan Wang¹, Hao-Chung Kuo³, Xiaowei Sun¹ (1. Southern University of Science and Technology (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China), 3. National Chiao Tung University (Taiwan))

2:00 PM - 2:20 PM

[MEET5-4(Invited)] Towards High Resolution Active-Matrix GaN μ -LED Based Micro Displays
Junyang Nie^{2,1}, Zhijie Ke³, Yongai Zhang¹, Xiongtu Zhou¹, Tailiang Guo¹, Congyan Lu⁵, Yiren Chen⁵, Zhangxu Pan⁶, Ling Li⁴, Di Geng⁴, Hang Song⁵, Zheng Gong⁶, *Jie Sun¹, Qun Yan^{1,2} (1. Fuzhou University (China), 2. Xi'an Jiaotong University (China), 3. Xiamen Changelight Co. Ltd. (China), 4. Institute of Microelectronics, Chinese Academy of Sciences (China), 5. Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science, China (China), 6. Guangdong Institute of Semiconductor Industry Technology, Guangdong Academy of Sciences (China))

2:20 PM - 2:40 PM

1:20 PM - 1:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Conference Hall)

[MEET5-1(Invited)] Design Considerations for Holographic Retinal Projection Display

*Christophe Martinez¹, Fabian Rainouard¹, Basile Meynard¹ (1. CEA Leti (France))

Keywords: retinal display, augmented reality, near eye display, diffraction

We present design considerations for the development of a retinal projection display based on the association of a photonic integrated circuit and a pixelated hologram. Unexpected behavior concerning the randomness distribution of the emitting elements in our display is highlighted.

1:40 PM - 2:00 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Conference Hall)

[MEET5-2(Invited)] Highly Efficient Stack Quantum-dot Light Emitting Diodes using Charge Generation Junctions

*Jin Jang¹, Suihui Lee¹, Hyo-min Kim¹, Yuanfeng Chen¹ (1. Advanced Display Research Center, Kyung Hee University (Korea))

Keywords: Micro-LED, LTPS TFT, Oxide TFT, TFT Backplane

We review here the LTPS and oxide TFT technologies for micro-LED displays. We have developed BLA of a-Si for LTPS TFTs, exhibiting a high field-effect mobility over 150cm²/Vs for p-channel device. On the other hand, oxide TFTs using bulk-accumulation (BA) mode exhibits an effective field effect mobility over 50 cm²/Vs. The BLA TFT backplane was applied to drive a micro-LED displays using digital driving. Oxide TFT backplane was used for micro-LED with high contrast ratio. The LTPO technology and QD color conversion technology will be explained for micro-LED displays.

2:00 PM - 2:20 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Conference Hall)

[MEET5-3(Invited)] Investigation of Temperature-dependent Behaviors of Micro-LED Displays

*Zhaojun Liu¹, Bo Lu¹, Minggang Liu², Yong Fan², Jiayu Lee², Yan Wang¹, Hao-Chung Kuo³, Xiaowei Sun¹ (1. Southern University of Science and Technology (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China), 3. National Chiao Tung University (Taiwan))

Keywords: Micro-LED Display, Mini-LEDs, Temperature-dependent

Micro-LED display consist of arrays of Micro-LEDs and driving backplane with bonding technologies. As the size of LED get smaller, the amount of LED chips becomes a huge number. The thermal issue of Mini/Micro-LEDs needs to be considered. We report a 32x32 flexible Mini-LEDs array with driving current of 10mA under applied bias of 2.6V. The result of testing temperature distribution in different brightness shows that the Mini-LED array satisfy the requirement of thermal stability.

2:20 PM - 2:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Conference Hall)

[MEET5-4(Invited)] Towards High Resolution Active-Matrix GaN μ -LED Based Micro Displays

Junyang Nie^{2,1}, Zhijie Ke³, Yongai Zhang¹, Xiongtu Zhou¹, Tailiang Guo¹, Congyan Lu⁵, Yiren Chen⁵, Zhangxu Pan⁶, Ling Li⁴, Di Geng⁴, Hang Song⁵, Zheng Gong⁶, *Jie Sun¹, Qun Yan^{1,2} (1. Fuzhou University (China), 2. Xi'an Jiaotong University (China), 3. Xiamen Changelight Co. Ltd. (China), 4. Institute of Microelectronics, Chinese Academy of Sciences (China), 5. Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science, China (China), 6. Guangdong Institute of Semiconductor Industry Technology, Guangdong Academy of Sciences (China))

Keywords: Micro LED, μ -LED, Micro display, active-matrix, 2D material

We focus on the design/fabrication of active matrix 0.55 inch 1323 ppi micro displays based on GaN μ -LED arrays with Si CMOS driver prepared by flip-chip bonding. The process is optimized for manufacturing. A pioneer work of integrating 2D material transistors with GaN μ -LEDs is also discussed.

Oral Presentation

[MEET6] Micro/NanoDisplays and Nanotechnology Application (2)

Special Topics of Interest on Micro/Mini LEDs

Chair: Chih-Jen Shih (ETH Zurich, Switzerland)

Co-Chair: Jeonghun Kwak (Seoul National University)

Fri. Nov 29, 2019 3:00 PM - 4:20 PM Conference Hall (1F)

[MEET6-1(Invited)] Toward for Ultimate Displays with MicroLED by PixeLED Display Technology

*Ying-Tsang (Falcon) Liu¹, Kuan-Yung Liao¹, Yun-Li Li¹ (1. PlayNitride Inc. (Taiwan))

3:00 PM - 3:20 PM

[MEET6-2(Invited)] Impressive Technologies for MicroLED Displays

*Zine Bouhamri¹, Eric Virey¹ (1. Yole Developpement (France))

3:20 PM - 3:40 PM

[MEET6-3] 17.3-in Mini-LEDs halo effect and human factor study for high-end notebook application

*Hao-Hao Wu¹, Jenn-Jia Su¹, Chun-Sheng Li¹, Han-Ping Kuo¹, Yu-Hsiu Chang¹, Chia-En Fuh¹, Bo-Yuan Su¹ (1. AU Optronics Corporation (Taiwan))

3:40 PM - 4:00 PM

[MEET6-4L] In-situ EUV Irradiation for Etching Residual Removal of AM Mini-LED

YONG DENG¹, JUNLING LIU¹, *MINLI TAN¹, MIN XIONG¹, LIANGYI CAI¹, WENBO LIU¹, QUANSHENG LIU¹, YIFENG YANG¹, RUI ZHAO¹, WEIMIN ZHANG¹ (1. Shenzhen China Star Optoelectronic Technology Company, Ltd. (China))

4:00 PM - 4:20 PM

3:00 PM - 3:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Conference Hall)

[MEET6-1(Invited)] Toward for Ultimate Displays with MicroLED by PixeLED Display Technology

*Ying-Tsang (Falcon) Liu¹, Kuan-Yung Liao¹, Yun-Li Li¹ (1. PlayNitride Inc. (Taiwan))

Keywords: MicroLED, Emissive Display, Transparent Display

MicroLED display is an emerging technology with high brightness, wide color gamut, and high aperture ratio. Based on our PixeLED[®] display technology to build MicroLED display, and SMAR·Tech[™] to build defect free panel, we are heading to mass production for MicroLED display.

3:20 PM - 3:40 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Conference Hall)

[MEET6-2(Invited)] Impressive Technologies for MicroLED Displays

*Zine Bouhamri¹, Eric Virey¹ (1. Yole Developpement (France))

Keywords: microLED, emissive display, yield, GaN, consumer

MicroLED is a promising display technology. There are however still many technical challenges that need to be tackled before it is ready for consumer products. Mass transfer of the microLED chips is the elephant in the room, but many others could prove as challenging and possibly derail the microLED roadmap.

3:40 PM - 4:00 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Conference Hall)

[MEET6-3] 17.3-in Mini-LEDs halo effect and human factor study for high-end notebook application

*Hao-Hao Wu¹, Jenn-Jia Su¹, Chun-Sheng Li¹, Han-Ping Kuo¹, Yu-Hsiu Chang¹, Chia-En Fuh¹, Bo-Yuan Su¹
(1. AU Optronics Corporation (Taiwan))

Keywords: Mini-LEDs, HDR display, Local dimming, Halo effect, Human factor

Local dimming technology could increase contrast. Most of halo effect study is based on face-view. This paper would indicate performance and halo effect at different viewing angle. Finally, we proposed a 17.3-inch Mini-LEDs notebook module that can reach HDR1000 specification and less suffer from low contrast at different viewing angle.

4:00 PM - 4:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Conference Hall)

[MEET6-4L] In-situ EUV Irradiation for Etching Residual Removal of AM Mini-LED

YONG DENG¹, JUNLING LIU¹, *MINLI TAN¹, MIN XIONG¹, LIANGYI CAI¹, WENBO LIU¹, QUANSHENG LIU¹, YIFENG YANG¹, RUI ZHAO¹, WEIMIN ZHANG¹ (1. Shenzhen China Star Optoelectronic Technology Company, Ltd. (China))

Keywords: Mini-LED, EUV, Porous Structure, Etching Residual

Given the demand of high current drive, AM Mini-LED backplane usually uses dense plum-blossom-type design to optimize hole lapping. However, this porous design leads to a serious M2 etching residual issue. By using in-situ EUV irradiation, the infiltration of etchant to porous structure can be increased and the etching residual can be removed without affecting electrical characteristics of the device.

Oral Presentation

[LCT5/FMC5] High Performance 8K LCDs

Chair: Koichi Miyachi (JSR)

Co-Chair: Toshimitsu Tsuzuki (NHK)

Fri. Nov 29, 2019 9:00 AM - 10:35 AM Mid-sized Hall A (1F)

[LCT5/FMC5-1(Invited)] Novel Liquid Crystal Display mode "UV²A II" with Photo Alignment Technology for a Large-Screen 8K Display

*Shinichi Terashita¹, Kouichi Watanabe¹, Fumikazu Shimoshikiryo¹ (1. Sharp Corporation (Japan))

9:00 AM - 9:25 AM

[LCT5/FMC5-2(Invited)] Novel Pixel Structure for the Improving Optical Performances of 8K LCD Panel

*Kwangsoo Bae¹, Minjoeng Oh¹, Beomsoo Park¹, Young Je Cho¹, Sang Hwan Cho¹, Dong Hwan Kim¹ (1. Samsung Display (Korea))

9:25 AM - 9:50 AM

[LCT5/FMC5-3(Invited)] 17-inch Laser Backlight LCD with 8K, 120-Hz Driving and BT.2020 Color Gamut

Yoichi Asakawa¹, Ken Onoda¹, Hiroaki Kijima¹, *Shinichi Komura¹ (1. Japan Display Inc. (Japan))

9:50 AM - 10:15 AM

[LCT5_FMC5-4L] 55" High Contrast Ratio Panel Produced by Pixel Level Local Dimming Technology

*Chun-chi Chen¹, Yan-Xue Wang¹, Young-Yuan Qiu¹, Gang Yu¹, Chung-Yi Chiu¹, Bin Zhao¹, Xin Zhang¹ (1. China Star Optoelectronics Technology Company, Ltd. (China))

10:15 AM - 10:35 AM

9:00 AM - 9:25 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Mid-sized Hall A)

[LCT5/FMC5-1(Invited)] Novel Liquid Crystal Display mode "UV²A II" with Photo Alignment Technology for a Large-Screen 8K Display

*Shinichi Terashita¹, Kouichi Watanabe¹, Fumikazu Shimoshikiryoh¹ (1. Sharp Corporation (Japan))

Keywords: LCD, 8K, Photo alignment, UV2A II

We have developed a new liquid crystal display mode UV²A II which is suitable for a large screen 8K display and commercialized as the 80" 8K TV. UV²A II has brought large superiority that are 1.3 times higher transmittance, 35% faster response, and wider viewing angle property to compare with UV²A.

9:25 AM - 9:50 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Mid-sized Hall A)

[LCT5/FMC5-2(Invited)] Novel Pixel Structure for the Improving Optical Performances of 8K LCD Panel

*Kwangsoo Bae¹, Minjoeng Oh¹, Beomsoo Park¹, Young Je Cho¹, Sang Hwan Cho¹, Dong Hwan Kim¹ (1. Samsung Display (Korea))

Keywords: QUHD, 8K, LCD panel, High transmittance, suppressed gamma distortion

We report on novel pixel architecture for improving the transmittance and reducing the gamma distortion to minimize the color shift in a 8K QUHD LCD panel with the hG-2D technology. This technology has the excellent transmittance by matching the LC distortions on the vertical electrode and two data lines which is asymmetrically positioned. Besides, by shielding the LC distortion line at the oblique viewing angle, the gamma distortion can be effectively suppressed. Through the QUHD panel with our structure, superior performances to normal LCD could be clearly demonstrated.

9:50 AM - 10:15 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Mid-sized Hall A)

[LCT5/FMC5-3(Invited)] 17-inch Laser Backlight LCD with 8K, 120-Hz Driving and BT.2020 Color Gamut

Yoichi Asakawa¹, Ken Onoda¹, Hiroaki Kijima¹, *Shinichi Komura¹ (1. Japan Display Inc. (Japan))

Keywords: BT.2020, LCD, Laser backlight

We succeeded in prototyping a 17-inch 8K liquid crystal display satisfying the BT.2020 specification. The pixel density of the display is 510 ppi, while its color gamut covers 98% of that of BT.2020. The liquid crystal response time is 5 ms, which is sufficient for 120-Hz driving.

10:15 AM - 10:35 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Mid-sized Hall A)

[LCT5_FMC5-4L] 55" High Contrast Ratio Panel Produced by Pixel Level Local Dimming Technology

*Chun-chi Chen¹, Yan-Xue Wang¹, Young-Yuan Qiu¹, Gang Yu¹, Chung-Yi Chiu¹, Bin Zhao¹, Xin Zhang¹ (1. China Star Optoelectronics Technology Company, Ltd. (China))

Keywords: High contrast ratio, Dual cell, Pixel level local dimming

The contrast ratio is a important index for the LCD optics. The higher contrast ratio, the picture quality reconstructed by LCD is better. LCD module is constructed by back light and optical switch. And the LC is not an ideal optical switch, so the contrast ratio of LCD is lower than OLED. We use dual cell which can use pixel level local dimming to improve the contrast ratio, and it can make the contrast ratio from 5000:1 to 200000:1.

Oral Presentation

[LCT6] New LC Applications

Chair: Hideo Ichinose (Merck Performance Materials Ltd.)

Co-Chair: Fumito Araoka (RIKEN)

Fri. Nov 29, 2019 10:40 AM - 12:10 PM Mid-sized Hall A (1F)

[LCT6-1(Invited)] Transport of Ions, Electrons and Molecules in Nanostructured Liquid Crystals for Their New Applications

*Takashi Kato¹ (1. The University of Tokyo (Japan))

10:40 AM - 11:05 AM

[LCT6-2(Invited)] Cellulose Derivatives for Color Imaging Applications

*Seiichi Furumi¹ (1. Tokyo University of Science (Japan))

11:05 AM - 11:30 AM

[LCT6-4L] Dye-doped liquid crystal light shutter fabricated by thermally-induced phase separation

*Yeongyu Choi¹, Seung-Won Oh¹, Tae-Hoon Yoon¹ (1. Pusan National University (Korea))

11:30 AM - 11:50 AM

[LCT6-5L] High Performance Liquid Crystal on Silicon Spatial Light Modulator (LCOS-SLM) and Flicker Noise Reduction of Multiple Spots

*Hiroshi Tanaka¹, Hiroto Sakai¹, Munenori Takumi¹, Haruyoshi Toyoda¹ (1. Hamamatsu photonics K.K. (Japan))

11:50 AM - 12:10 PM

10:40 AM - 11:05 AM (Fri. Nov 29, 2019 10:40 AM - 12:10 PM Mid-sized Hall A)

[LCT6-1(Invited)] Transport of Ions, Electrons and Molecules in Nanostructured Liquid Crystals for Their New Applications

*Takashi Kato¹ (1. The University of Tokyo (Japan))

Keywords: Liquid crystal, Nanostructure, Ion transport, lithium ion batteries, Water Treatment

Here we present our recent approaches to use a variety of nanostructured liquid crystal materials forming smectic, columnar, and bicontinuous cubic structures for transport of ion, electron, and water molecules. They are applied to thin-film materials for electrolytes of lithium ion batteries and solar cells, and water treatment membranes.

11:05 AM - 11:30 AM (Fri. Nov 29, 2019 10:40 AM - 12:10 PM Mid-sized Hall A)

[LCT6-2(Invited)] Cellulose Derivatives for Color Imaging Applications

*Seiichi Furumi¹ (1. Tokyo University of Science (Japan))

Keywords: Cellulose, Cholesteric liquid crystals, Bragg reflection, Color

Cellulose is the most abundant organic compound on the earth, and has attracted considerable interest as one of sustainable materials. Cellulose derivatives are well-known to exhibit cholesteric liquid crystal (CLC) with visible reflection. This presentation reports on our research accomplishments of cellulose CLCs for full-color imaging and mechanical stress sensing.

11:30 AM - 11:50 AM (Fri. Nov 29, 2019 10:40 AM - 12:10 PM Mid-sized Hall A)

[LCT6-4L] Dye-doped liquid crystal light shutter fabricated by thermally-induced phase separation

*Yeongyu Choi¹, Seung-Won Oh¹, Tae-Hoon Yoon¹ (1. Pusan National University (Korea))

Keywords: Liquid crystal, Polymer, Light shutter, Phase separation

A dye-doped LC/polymer light shutter fabricated with the thermally-induced phase separation (TIPS) method is demonstrated. The TIPS method does not degrade the dye during the fabrication process. The fabricated LC cell exhibits excellent optical performance, which is suitable for a light shutter with superior black color. This fabrication method can be applied for the high visibility of see-through displays.

11:50 AM - 12:10 PM (Fri. Nov 29, 2019 10:40 AM - 12:10 PM Mid-sized Hall A)

[LCT6-5L] High Performance Liquid Crystal on Silicon Spatial Light Modulator (LCOS-SLM) and Flicker Noise Reduction of Multiple Spots

*Hiroshi Tanaka¹, Hiroto Sakai¹, Munenori Takumi¹, Haruyoshi Toyoda¹ (1. Hamamatsu photonics K.K. (Japan))

Keywords: Phase modulation, Spatial light modulator, LCOS-SLM, multiple spots, flicker noise

We developed LCOS-SLM as a spatial light modulator for precise pure phase control. Generation of stable multiple spot patterns (MSPs) is important in laser processing, microscopy. We proposed flicker noise reduction method of the MSPs which generated by the LCOS-SLM and confirmed reduction of noise from 2% to 0.5%.

Oral Presentation

[VHF6] Ergonomics for Display Applications I

Chair: Nobuyuki Hiruma (NHK-ES)

Co-Chair: Gosuke Ohashi (Shizuoka University)

Fri. Nov 29, 2019 1:20 PM - 2:45 PM Mid-sized Hall A (1F)

[VHF6-1(Invited)] Trends in Human-Centric Office Design

*Michihiko Okamoto¹, Takao Kiyoshige¹, Toru Ohkawa¹, Taishirou Iwasaki¹,
Yousuke Shimoda¹ (1. Takenaka Corporation (Japan))

1:20 PM - 1:45 PM

[VHF6-2(Invited)] Development and IEC Standardization of Electronic Display for Elevator and Escalator

*Junkai Li¹, Huixun Li², Weixiang Xue³ (1. Zhejiang Usenc Technology Co.,Ltd (China), 2. CANNY ELEVATOR CO.,LTD (China), 3. Otis Electric Elevator Co., Ltd (China))

1:45 PM - 2:10 PM

[VHF6-3] Educational Effectiveness and Learner Behavior When Using Desktop-Style VR System

*Takashi Shibata¹, Erika Drago², Takayuki Araki³, Tatsuya Horita⁴ (1. Tokyo University of Social Welfare (Japan), 2. Musashino University Chiyoda High School (Japan), 3. Musashino University (Japan), 4. Tohoku University (Japan))

2:10 PM - 2:30 PM

[VHF6-4L] Cylindrical Transparent Display with Hologram Screen

*Tomoharu Nakamura¹, Akira Tanaka¹, Tsuyoshi Kaneko¹, Masanori Iwasaki¹,
Takayuki Kurihara¹, Noriyuki Kato¹, Koji Kuramoto¹, Hidehiko Takanashi¹, Yuji Nakahata¹ (1. Sony Corporation (Japan))

2:30 PM - 2:45 PM

1:20 PM - 1:45 PM (Fri. Nov 29, 2019 1:20 PM - 2:45 PM Mid-sized Hall A)

[VHF6-1(Invited)] Trends in Human-Centric Office Design

*Michihiko Okamoto¹, Takao Kiyoshige¹, Toru Ohkawa¹, Taishirou Iwasaki¹, Yousuke Shimoda¹ (1. Takenaka Corporation (Japan))

Keywords: Human-Centric, ABW, Wellness, Biophilia

Recently, many companies have dramatically changed workstyle and workplace of their office workers. Specially for achieving high productivity, providing high value, and employing talented people. Hot keywords are Human-Centric, ABW (Activity Based Working), wellness of employees and biophilia. Takenaka Corporation introduce the latest office trends.

1:45 PM - 2:10 PM (Fri. Nov 29, 2019 1:20 PM - 2:45 PM Mid-sized Hall A)

[VHF6-2(Invited)] Development and IEC Standardization of Electronic Display for Elevator and Escalator

*Junkai Li¹, Huixun Li², Weixiang Xue³ (1. Zhejiang Usenc Technology Co.,Ltd (China), 2. CANNY ELEVATOR CO.,LTD (China), 3. Otis Electric Elevator Co., Ltd (China))

Keywords: display, elevator, escalator, standardization

This paper introduces the industry application status of electronic display for elevator and escalator. The issues of current technology and developing trend are discussed. The latest standardization status in ISO, CEN, CEA and IEC TC110 will also be introduced.

2:10 PM - 2:30 PM (Fri. Nov 29, 2019 1:20 PM - 2:45 PM Mid-sized Hall A)

[VHF6-3] Educational Effectiveness and Learner Behavior When Using Desktop-Style VR System

*Takashi Shibata¹, Erika Drago², Takayuki Araki³, Tatsuya Horita⁴ (1. Tokyo University of Social Welfare (Japan), 2. Musashino University Chiyoda High School (Japan), 3. Musashino University (Japan), 4. Tohoku University (Japan))

Keywords: virtual reality, stereoscopic 3D images, education, school, viewing distance

An experimental class using a desktop-style virtual reality system was conducted in a school to examine the educational effectiveness and learner's behavior. The results show that sharing educational materials in 3D promotes discussion in group work.

2:30 PM - 2:45 PM (Fri. Nov 29, 2019 1:20 PM - 2:45 PM Mid-sized Hall A)

[VHF6-4L] Cylindrical Transparent Display with Hologram Screen

*Tomoharu Nakamura¹, Akira Tanaka¹, Tsuyoshi Kaneko¹, Masanori Iwasaki¹, Takayuki Kurihara¹, Noriyuki Kato¹, Koji Kuramoto¹, Hidehiko Takanashi¹, Yuji Nakahata¹ (1. Sony Corporation (Japan))

Keywords: 360-degree, transparent screen, hologram, high-speed camera, motion parallax image

We have developed a hologram screen with higher transparency and higher diffraction efficiency compared to conventional transparent screens. We have applied this screen to a cylindrical transparent display, and propose a display system creating a feeling of "actually there" reality to 2D images with the combination of sensing technology using multiple high-speed cameras.

Oral Presentation

[VHF7] Ergonomics for Display Applications II

Chair: Nobuyuki Hiruma (NHK-ES)

Co-Chair: Shin-ichi Uehara (AGC)

Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall A (1F)

[VHF7-1(Invited)] Standardization of ergonomics requirements for 'Dynamics Sign' in ISO

*Hiroshi Watanabe¹, Hiroyasu Ujike¹, Nana Itoh¹, Ken Sagawa¹, Reiko Sakata², Akiko Imahashi², Naoki Furuhata², Masami Aikawa² (1. AIST (Japan), 2. Mitsubishi Elec. (Japan))

3:00 PM - 3:25 PM

[VHF7-4L(Invited)] Development of an 8K-class 3D Shooting System for Microscopic Surgery and the World's First Shooting

*Taiichiro Kurita¹ (1. NHK Technologies, Inc. (Japan))

3:25 PM - 3:50 PM

[VHF7-3] Computational Classification of Texture Contents in the Shitsukan Research Database

*Norifumi Kawabata¹ (1. Tokyo University of Science (Japan))

3:50 PM - 4:10 PM

[VHF7-5L] Advanced Reflectionless Technology for Reflected Glare Reduction

*Yu Hung Chen¹, Kai Chieh Chang¹ (1. AU Optronics Corporation (Taiwan))

4:10 PM - 4:25 PM

3:00 PM - 3:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall A)

[VHF7-1(Invited)] Standardization of ergonomics requirements for 'Dynamics Sign' in ISO

*Hiroshi Watanabe¹, Hiroyasu Ujike¹, Nana Itoh¹, Ken Sagawa¹, Reiko Sakata², Akiko Imahashi², Naoki Furuhashi², Masami Aikawa² (1. AIST (Japan), 2. Mitsubishi Elec. (Japan))

Keywords: Dynamic sign, ISO, visibility, virtual reality, effect of aging

Dynamic signs are a developing technology that provide warning and guidance information using images that change spatially and temporally depending on the situation. We introduce our ISO-related efforts toward standardization of dynamic signs from the viewpoint of visibility based on the results of ergonomics studies.

3:25 PM - 3:50 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall A)

[VHF7-4L(Invited)] Development of an 8K-class 3D Shooting System for Microscopic Surgery and the World's First Shooting

*Taichiro Kurita¹ (1. NHK Technologies, Inc. (Japan))

Keywords: 8K, 3D, shooting, microscopic surgery, medical

An 8K-class 3D shooting system for microscopic surgery is developed. The system equips two small UHD cameras with 5120 (H) x 4320 (V) pixels and 59.94 Hz frame rate. The world's first shooting using the system was conducted and fine 8K3D video of the surgery is successfully displayed after editing.

3:50 PM - 4:10 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall A)

[VHF7-3] Computational Classification of Texture Contents in the Shitsukan Research Database

*Norifumi Kawabata¹ (1. Tokyo University of Science (Japan))

Keywords: Texture, HEVC, Texture Features, Gray-Level Co-Occurrence Matrix, Support Vector Machine

In this paper, we used the Shitsukan Research Database from Web for free of charge. First, we generated texture evaluation images by H.265/HEVC. We assessed the generated images by texture analysis, and discussed results. Next, based on experimental results, we considered for classification method of texture types by SVM.

4:10 PM - 4:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall A)

[VHF7-5L] Advanced Reflectionless Technology for Reflected Glare Reduction

*Yu Hung Chen¹, Kai Chieh Chang¹ (1. AU Optronics Corporation (Taiwan))

Keywords: Ambient contrast ratio, Gamut keeping ratio, Reflected glare, Surface treatment

In this paper, we propose the new surface treatment technology (A.R.T.) that can increase ACR and GKR significantly under complex illumination. A subjective experiment of visual performance is executed that the difference of subjective rating results of new and commonly surface treatments of legibility and comfort are significant under specular illumination.

Oral Presentation

[AMD5] Oxide TFT: Device Fundamentals

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Hideya Kumomi (Tokyo Tech.)

Fri. Nov 29, 2019 9:00 AM - 10:30 AM Mid-sized Hall B (1F)

[AMD5-1(Invited)] Switching Characteristic Enhancement of P-type Cu₂O TFTs

Dongwoo Kim¹, I Sak Lee¹, Sujin Jung¹, Sung Min Rho¹, *Hyun Jae Kim¹ (1. Yonsei University (Korea))

9:00 AM - 9:25 AM

[AMD5-2(Invited)] High Mobility Metal-Oxide Devices for Display SoP and 3D Brain-Mimicking IC

*Albert Chin¹, Te Jui Yen¹, Cheng Wei Shih¹, You-Da Chen¹ (1. National Chiao Tung University (Taiwan))

9:25 AM - 9:50 AM

[AMD5-3] High Mobility Oxide TFT Based on In-rich In-Ga-Sn-O Semiconductors with Nanocrystalline Structures

*XUERU MEI², HUA FEI XIE¹, NIAN LIU², MACAI LU², Lei Wen², Shujhih Chen², Shengdong Zhang², Chiayu Lee², Xin Zhang² (1. Peking University (China), 2. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd (China))

9:50 AM - 10:10 AM

[AMD5-4] Simulation Study of Self-Heating and Edge Effects on Oxide-Semiconductor TFTs: Channel-Width Dependence

*Katsumi Abe¹, Kazuki Ota¹, Takeshi Kuwagaki¹ (1. Silvaco Japan Co., Ltd. (Japan))

10:10 AM - 10:30 AM

9:00 AM - 9:25 AM (Fri. Nov 29, 2019 9:00 AM - 10:30 AM Mid-sized Hall B)

[AMD5-1(Invited)] Switching Characteristic Enhancement of P-type Cu_2O TFTs

Dongwoo Kim¹, I Sak Lee¹, Sujin Jung¹, Sung Min Rho¹, *Hyun Jae Kim¹ (1. Yonsei University (Korea))

Keywords: Oxide TFT, p-type semiconductor, Copper oxide

We propose three methods to enhance switching characteristics of p-type Cu_2O thin film transistors (TFTs) by passivating the copper oxide TFTs with silicon dioxide (SiO_2) using sputtering, oxidizing the back channel of copper oxide with hypochlorous acid (HClO), and doping gallium into the Cu_2O film.

9:25 AM - 9:50 AM (Fri. Nov 29, 2019 9:00 AM - 10:30 AM Mid-sized Hall B)

[AMD5-2(Invited)] High Mobility Metal-Oxide Devices for Display SoP and 3D Brain-Mimicking IC

*Albert Chin¹, Te Jui Yen¹, Cheng Wei Shih¹, You-Da Chen¹ (1. National Chiao Tung University (Taiwan))

Keywords: metal-oxide transistor, monolithic 3D integration, 3D brain-mimicking IC architecture

Owing to fast technology evolution, the n-type SnO_2 thin-film transistor (TFT) can reach high mobility of $238 \text{ cm}^2/\text{Vs}$ and p-type SnO TFT has high hole mobility of $7.6 \text{ cm}^2/\text{Vs}$. These high mobility complementary TFTs is the enabling technology for display system-on-panel and the ultra-fast three-dimensional brain-mimicking IC.

9:50 AM - 10:10 AM (Fri. Nov 29, 2019 9:00 AM - 10:30 AM Mid-sized Hall B)

[AMD5-3] High Mobility Oxide TFT Based on In-rich In-Ga-Sn-O Semiconductors with Nanocrystalline Structures

*XUERU MEI², HUA FEI XIE¹, NIAN LIU², MACAI LU², Lei Wen², Shujhih Chen², Shengdong Zhang², Chiayu Lee², Xin Zhang² (1. Peking University (China), 2. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd (China))

Keywords: In-Rich In-Ga-Sn-O, Top-Gate Self-Aligned (TGSA), Nanocrystalline Structure, High Mobility

In-rich In-Ga-Sn-O film with nanocrystalline structure was prepared as the active layer for high mobility TFT. The prepared top-gate self-aligned TFTs using the IGT0 film deposited at low O_2 gas ratio and low power exhibited excellent transfer characteristics with high mobility of $25.33 \text{ cm}^2/\text{Vs}$, ss of 0.33 V/decade , threshold voltage of 0.98 V .

10:10 AM - 10:30 AM (Fri. Nov 29, 2019 9:00 AM - 10:30 AM Mid-sized Hall B)

[AMD5-4] Simulation Study of Self-Heating and Edge Effects on

Oxide-Semiconductor TFTs: Channel-Width Dependence

*Katsumi Abe¹, Kazuki Ota¹, Takeshi Kuwagaki¹ (1. Silvaco Japan Co., Ltd. (Japan))

Keywords: Oxide-semiconductor, Thin-film transistor, Self-heating, Edge effect, Device simulation

We studied the channel-width dependence of oxide-semiconductor TFTs via a device simulator. The results show that the ON-current is affected by two factors: self-heating and edge effects. The former increases the current with a rise in temperature, while the latter produces the high edge current-density caused by its strong electric-field.

Oral Presentation

[AMD6] Oxide TFT: Device Application

Chair: Chuan Liu (Sun Yat-sen University)

Co-Chair: Susumu Horita (JAIST)

Fri. Nov 29, 2019 10:40 AM - 12:15 PM Mid-sized Hall B (1F)

[AMD6-1(Invited)] High Performance Short Channel Oxide TFTs for Transparent Top Emission OLED TVs

*Chanki Ha¹, Eunah Heo¹, Wonbeom Yoo¹, Heungjo Lee¹, Keun-Yong Ban¹, Jonguk Bae¹, Jongwoo Kim¹ (1. LG Display (Korea))

10:40 AM - 11:05 AM

[AMD6-2(Invited)] Development of high mobility top gate IGZO-TFT for Automotive OLED display.

*Yujiro Takeda¹, Aman Mehadi¹, Shogo Murashige¹, Kazuatsu Ito¹, Izumi Ishida¹, Shinji Nakajima¹, Hiroshi Matsukizono¹, Naoki Makita¹ (1. SHARP Corporation (Japan))

11:05 AM - 11:30 AM

[AMD6-3(Invited)] Top-Gate Oxide TFTs with Ion-Implanted Source/Drain Regions in Advanced LTPS Technology

*Isao Suzumura¹, Toshihide Jinnai¹, Hajime Watakabe¹, Akihiro Hanada¹, Ryo Onodera¹, Tomoyuki Ito¹ (1. Japan Display Inc. (Japan))

11:30 AM - 11:55 AM

[AMD6-4] Fabrication of Top-Gate Self-Aligned Amorphous InGaSnO TFTs with High Mobility

*Nian Liu¹, Huafei Xie², Xueru Mei¹, Macai Lu¹, Lei Wen¹, Shujhih Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

11:55 AM - 12:15 PM

10:40 AM - 11:05 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Mid-sized Hall B)

[AMD6-1(Invited)] High Performance Short Channel Oxide TFTs for Transparent Top Emission OLED TVs

*Chanki Ha¹, Eunah Heo¹, Wonbeom Yoo¹, Heungjo Lee¹, Keun-Yong Ban¹, Jonguk Bae¹, Jongwoo Kim¹ (1. LG Display (Korea))

Keywords: Oxide TFT, Short Channel Device, Transparent Top Emission OLED TV

High performance TFTs with a short channel and good uniformity are required to mass-produce transparent top emission OLED TV. The uniformity of V_{th} and I_{on} are improved by controlling effective channel length. Negative V_{th} shift under NBTiS conditions is improved by optimizing light shield and buffer layers.

11:05 AM - 11:30 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Mid-sized Hall B)

[AMD6-2(Invited)] Development of high mobility top gate IGZO-TFT for Automotive OLED display.

*Yujiro Takeda¹, Aman Mehadi¹, Shogo Murashige¹, Kazuatsu Ito¹, Izumi Ishida¹, Shinji Nakajima¹, Hiroshi Matsukizono¹, Naoki Makita¹ (1. SHARP Corporation (Japan))

Keywords: Oxide-TFT, High mobility, Top gate, Reliability, OLED

High performance IGZO-TFT with top gate structure was developed for automotive OLED display backplane. By optimizing the process conditions, we achieved the mobility of 32 cm²/Vs with enhanced threshold voltage. The PBT/NBT/NBIT reliability are good enough to use in OLED application. The prototype 12.3" flexible automotive OLED display was successfully demonstrated.

11:30 AM - 11:55 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Mid-sized Hall B)

[AMD6-3(Invited)] Top-Gate Oxide TFTs with Ion-Implanted Source/Drain Regions in Advanced LTPS Technology

*Isao Suzumura¹, Toshihide Jinnai¹, Hajime Watakabe¹, Akihiro Hanada¹, Ryo Onodera¹, Tomoyuki Ito¹ (1. Japan Display Inc. (Japan))

Keywords: Top-gate, Self-aligned, Oxide TFT, Short channel length, Ion implantation

This study develops advanced LTPS TFT technology with top-gate self-aligned oxide TFTs using Generation 6 mother glass. Source and drain regions of the oxide TFTs are formed by ion implantation through a gate insulator with a gate metal mask. The optimized oxide TFTs demonstrates good short-channel performance.

11:55 AM - 12:15 PM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Mid-sized Hall B)

[AMD6-4] Fabrication of Top-Gate Self-Aligned Amorphous InGaSnO TFTs with High Mobility

*Nian Liu¹, Huafei Xie², Xueru Mei¹, Macai Lu¹, Lei Wen¹, Shujih Chen¹, Shengdong Zhang², Chiayu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., China (China), 2. School of Electronic and Computer Engineering, Peking University, Shenzhen, China (China))

Keywords: IGTO, High Mobility, Deposition Condition, top-gate self-aligned

The effect of deposition condition of dielectric layer on top-gate self-aligned amorphous InGaSnO TFT have been discussed, higher N_2O/SiH_4 gas ratio and medium power are better. The resulting a-IGTO TFT at Gen.4.5 glass exhibited good uniformity and high mobility of $28.57\text{cm}^2/\text{Vs}$, sweep swing of 0.27V/decade , threshold voltage of 0.53V

Oral Presentation

[AMD7] Oxide TFT: Fabrication Process

Chair: Toshiaki Arai (JOLED Inc.)

Co-Chair: Yujiro Takeda (Sharp)

Fri. Nov 29, 2019 1:20 PM - 2:40 PM Mid-sized Hall B (1F)

[AMD7-1(Invited)] Nanostructured IGZO thin-film transistors with remarkably enhanced current density and on-off ratio

Kairong Huang¹, *Chuan Liu¹ (1. Sun Yat-sen University (China))

1:20 PM - 1:45 PM

[AMD7-2] Effect of Lanthanum Doping on the Electrical Performance of Spray Coated ZnO Thin Film Transistor

*RAVINDRA NAIK BUKKE¹, NARENDRA NAIK MUDE, JEWEL KUMER SAHA, YOUNGOO KIM, JIN JANG (1. KYUNG HEE UNIVERSITY (Korea))

1:45 PM - 2:05 PM

[AMD7-3] Highly Stable High Mobility Top-gate Structured Oxide TFT by Supplying Optimized Oxygen and Hydrogen to Semiconductors

*Jong Beom Ko¹, Seung-Hee Lee¹, Sang-Hee Ko Park¹ (1. Korea Advanced Institute of Science and Technology (Korea))

2:05 PM - 2:25 PM

[AMD7-4L] Low-Temperature IGZO Technology on Transparent Plastic Foil by Atmospheric Spatial Atomic Layer Deposition

Corné Frijters^{1,2}, Roy Verbeek¹, Gerard de Haas¹, Tung Huei Ke³, Erwin Vandenplas³, Marc Ameys³, Jan-Laurens van der Steen¹, Gerwin Gelinck^{1,4}, Eric Meulenkamp¹, Paul Poodt^{1,2}, Auke Kronemeijer¹, *Ilias Katsouras¹ (1. TNO/Centre (Netherlands), 2. SALDtech B.V. (Netherlands), 3. imec (Belgium), 4. Eindhoven University of Technology (Netherlands))

2:25 PM - 2:40 PM

1:20 PM - 1:45 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Mid-sized Hall B)

[AMD7-1(Invited)] Nanostructured IGZO thin-film transistors with remarkably enhanced current density and on-off ratio

Kairong Huang¹, *Chuan Liu¹ (1. Sun Yat-sen University (China))

Keywords: Thin-film transistor, oxide semiconductor, nanostructures

We develop oxide TFTs with nanoscale and periodic degenerately doped heterostructures by using a strategy based on near-field nanolithography. These nanostructured TFTs remarkably enhanced in current density, compared with homogeneous IGZO TFTs. The on- off ratio was higher than 10^9 , with notably scaling effect with channel length.

1:45 PM - 2:05 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Mid-sized Hall B)

[AMD7-2] Effect of Lanthanum Doping on the Electrical Performance of Spray Coated ZnO Thin Film Transistor

*RAVINDRA NAIK BUKKE¹, NARENDRA NAIK MUDE, JEWEL KUMER SAHA, YOUNGOO KIM, JIN JANG (1. KYUNG HEE UNIVERSITY (Korea))

Keywords: Lanthanum, Solution-process, Spray pyrolysis, Thin-film transistor, ZnO

We studied the effect of lanthanum incorporation on the electrical properties of ZnO TFT fabricated by spray pyrolysis. The turn-on voltage (V_{ON}) shifts towards 0 V by La doping. Also, Subthreshold swing (SS) decreases significantly from 387 to 251 mV/dec, by incorporation of lanthanum in ZnO.

2:05 PM - 2:25 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Mid-sized Hall B)

[AMD7-3] Highly Stable High Mobility Top-gate Structured Oxide TFT by Supplying Optimized Oxygen and Hydrogen to Semiconductors

*Jong Beom Ko¹, Seung-Hee Lee¹, Sang-Hee Ko Park¹ (1. Korea Advanced Institute of Science and Technology (Korea))

Keywords: High mobility, Stability, Top-gate structure, oxide TFTs

Top-gate self-aligned structured TFT is appropriate for the high-end display. However, it is hard to realize highly stable high mobility characteristics, because GI deposition affects active surface in top-gate structure. Here we realize highly stable high mobility oxide TFTs by using thermal-ALD and oxygen sourcing plasma treatment for GI process.

2:25 PM - 2:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Mid-sized Hall B)

[AMD7-4L] Low-Temperature IGZO Technology on Transparent Plastic Foil by Atmospheric Spatial Atomic Layer Deposition

Corné Frijters^{1,2}, Roy Verbeek¹, Gerard de Haas¹, Tung Huei Ke³, Erwin Vandenplas³, Marc Ameys³, Jan-Laurens van der Steen¹, Gerwin Gelinck^{1,4}, Eric Meulen Kamp¹, Paul Poodt^{1,2}, Auke Kronemeijer¹, *Ilias Katsouras¹ (1. TNO/Centre (Netherlands), 2. SALDtech B.V. (Netherlands), 3. imec (Belgium), 4. Eindhoven University of Technology (Netherlands))

Keywords: spatial atomic layer deposition IGZO, display, thin-film transistors, large-area processing

We use sALD to deposit IGZO and Al₂O₃ layers in top-gated self-aligned TFTs, achieving a low-temperature process flow ($\leq 200^\circ\text{C}$). We attain mobility of 8 cm²/Vs and switch-on voltage of -0.1 V for transistors with channel lengths down to 1 μm , enabling a 200 ppi QVGA display on transparent PEN foil.

Oral Presentation

[AMD8] Advanced Driving Technology for High-quality Display

Chair: Masahide Inoue (Huawei Techs. Japan)

Co-Chair: Isao Suzumura (Japan Display Inc.)

Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall B (1F)

[AMD8-1(Invited)] High Performance Oxide TFT Technology for Med.-Large Size OLED Displays

*Toshiaki Arai¹ (1. JOLED Inc. (Japan))

3:00 PM - 3:25 PM

[AMD8-2] A 6T1C dynamic threshold voltage compensation IGZO-GOA circuit for 31-inch AMOLED display with slim border

*Yan Xue^{1,2}, Baixiang Han¹, Xian Wang¹, Shuai Zhou¹, Gary Chaw¹, Chun-Hsiung Fang¹, Yuan-Chun Wu¹ (1. CSOT (China), 2. Peiking university (China))

3:25 PM - 3:45 PM

[AMD8-3] New 3.5T2C Pixel Circuit with Symmetrical Structure for 3D AMOLED Displays

*Chieh-An Lin¹, Li-Jung Chen¹, Chia-Ling Tsai¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:45 PM - 4:05 PM

[AMD8-4] A Novel OLED Pixel Circuit with Controllable Threshold Voltage Compensation Time

*Jung Chul Kim¹, Seonghwan Hong¹, Sujin Jung¹, Mihee Sin², Jun Suk Yoo², Han Wook Hwang², Yong Min Ha², Hyun Jae Kim¹ (1. Yonsei University (Korea), 2. LG Display, Ltd. (Korea))

4:05 PM - 4:25 PM

3:00 PM - 3:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall B)

[AMD8-1(Invited)] High Performance Oxide TFT Technology for Med.-Large Size OLED Displays

*Toshiaki Arai¹ (1. JOLED Inc. (Japan))

Keywords: Oxide TFT, Self-aligned top-gate, AlO passivation, Printed OLED

We have developed highly reliable oxide TFT technology for the OLED displays. Even for the flexible displays or the gate driver integrated high resolution (~350 ppi) OLED displays, 10-years-lifetime is achieved. By combining OLED printing technology, we realize high productivity in middle-large size OLED display manufacturing.

3:25 PM - 3:45 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall B)

[AMD8-2] A 6T1C dynamic threshold voltage compensation IGZO-GOA circuit for 31-inch AMOLED display with slim border

*Yan Xue^{1,2}, Baixiang Han¹, Xian Wang¹, Shuai Zhou¹, Gary Chaw¹, Chun-Hsiung Fang¹, Yuan-Chun Wu¹ (1. CSOT (China), 2. Peiking university (China))

Keywords: 31-inch AMOLED display, GOA, slim border, Vth compensation

A simple 6T1C gate driver on array (GOA) circuit has been proposed to reduce border with in displays. In this circuit, the lifetime of GOA can be improved by introducing a dynamic Vth compensation system. Finally, the GOA circuit was placed in a 31-inch AMOLED display to testify the function

3:45 PM - 4:05 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall B)

[AMD8-3] New 3.5T2C Pixel Circuit with Symmetrical Structure for 3D AMOLED Displays

*Chieh-An Lin¹, Li-Jung Chen¹, Chia-Ling Tsai¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

Keywords: Active-matrix organic light-emitting diode, low-temperature poly silicon thin-film transistor, pixel circuit

This paper proposes the 3.5T2C pixel circuit compensating for threshold voltage (V_{th}) variation of LTPS-TFTs and preventing image flicker. Simulation results show that the relative current error rates under V_{th} variations are all below 4.37 %. Furthermore, OLEDs are turned off during the programming period, thereby achieving flicker-free images.

4:05 PM - 4:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:25 PM Mid-sized Hall B)

[AMD8-4] A Novel OLED Pixel Circuit with Controllable Threshold

Voltage Compensation Time

*Jung Chul Kim¹, Seonghwan Hong¹, Sujin Jung¹, Mihee Sin², Jun Suk Yoo², Han Wook Hwang², Yong Min Ha², Hyun Jae Kim¹ (1. Yonsei University (Korea), 2. LG Display, Ltd. (Korea))

Keywords: High frame frequency, Moving image quality, Compensation time

This paper proposes a novel pixel circuit that adopts low temperature polycrystalline silicon thin-film transistors (LTPS TFTs) to compensate deviation of threshold voltage (V_{TH}) of the driving TFTs (D-TFTs) and uses overlapping compensation times (T_{COM}) to extend the period of precise sensing V_{TH} variation of the D-TFTs in each pixel. Simulation and experimental results demonstrate the proposed pixel circuit under 120 Hz Ultra High Definition (UHD) driving condition has the same compensation performance as the 60 Hz Full HD (FHD) driving condition. Therefore, the proposed pixel circuit is suitable to be used in AMOLED display with high resolution and high-frame rate and can realize uniform OLED current (I_{OLED}) with high immunity to V_{TH} variation of the D-TFTs.

Oral Presentation

[DES5] Video Coding

Chair: Seishi Takamura (NTT)

Co-Chair: Haruhiko Okumura (Toshiba)

Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 107 (1F)

[DES5-1(Invited)] Emerging Technologies toward Future Video Coding

*Seishi Takamura¹ (1. NTT Corporation (Japan))

1:20 PM - 1:45 PM

[DES5-2(Invited)] Next Generation Video coding in 8K era - Versatile Video Coding and AI

*Tomohiro Ikai¹, Eiichi Sasaki¹, Yukinobu Yasugi¹, Tomonori Hashimoto¹, Tianyang Zhou¹, Takeshi Chujoh¹, Tomoko Aono¹, Norio Itoh¹ (1. Sharp Corporation (Japan))

1:45 PM - 2:10 PM

[DES5-3(Invited)] MPEG Point Cloud Compression; First Standard for Immersive Media

*Ohji Nakagami¹ (1. Sony Corporation (Japan))

2:10 PM - 2:35 PM

1:20 PM - 1:45 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 107)

[DES5-1(Invited)] Emerging Technologies toward Future Video Coding

*Seishi Takamura¹ (1. NTT Corporation (Japan))

Keywords: Video Coding, H.264/MPEG-4 AVC, H.265/MPEG-H HEVC, Versatile Video Coding

In this paper, we first overview the ever-advancing history of video coding technology and standardization activities as well as evolution of video communication traffic. Then we review latest standardization activity on video coding, and introduce two examples of our new approach, real-entity-oriented coding in particular, to further enhance visual quality and compression performance.

1:45 PM - 2:10 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 107)

[DES5-2(Invited)] Next Generation Video coding in 8K era - Versatile Video Coding and AI

*Tomohiro Ikai¹, Eiichi Sasaki¹, Yukinobu Yasugi¹, Tomonori Hashimoto¹, Tianyang Zhou¹, Takeshi Chujoh¹, Tomoko Aono¹, Norio Itoh¹ (1. Sharp Corporation (Japan))

Keywords: Versatile Video Coding, CNN, Video Super Resolution

Displays and video compression are key drivers in emerging 4K/8K and VR/AR video market. Versatile Video Coding (VVC), under development as the next generation video coding, inevitably changes our society in the 2020s. This paper shows VVC key components including simplification and improvement aspects and shows neural network's difficulty and significance in compressed video.

2:10 PM - 2:35 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 107)

[DES5-3(Invited)] MPEG Point Cloud Compression; First Standard for Immersive Media

*Ohji Nakagami¹ (1. Sony Corporation (Japan))

Keywords: Point cloud, Compression, MPEG, Standard

This paper introduces recent MPEG activity on Point Cloud Compression (PCC) standard planned to be released in 2020 as a part of ISO/IEC 23090 series. The paper explains two complementary technologies, Video-based PCC and Geometry-based PCC. The coding algorithm, the compression performance, and the use-cases are discussed.

Oral Presentation

[DES6/AIS4] Image Processing

Chair: Yuji Oyamada (Tottori University)

Co-Chair: Mutsumi Kimura (Ryukoku univ.)

Fri. Nov 29, 2019 3:00 PM - 4:10 PM Room 107 (1F)

[DES6/AIS4-1(Invited)] Deep Learning-based Image Processing Algorithms in 8K Era

*SukJu Kang¹ (1. Sogang University (Korea))

3:00 PM - 3:25 PM

[DES6/AIS4-2(Invited)] Omnidirectional/360-degree Image and Video Standardizations Status

*Junichi Hara¹ (1. RICOH Company, LTD. (Japan))

3:25 PM - 3:50 PM

[DES6/AIS4-3] An Advanced TV Program Logo Processing Algorithm for Preventing OLED TV Image Sticking

*Lin Cheng¹, Yang Rao¹, Yufeng Jin¹, Yin-Hung Chen¹, Ming-Jong Jou¹, Bin Zhao¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Technology Company (China))

3:50 PM - 4:10 PM

3:00 PM - 3:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:10 PM Room 107)

[DES6/AIS4-1(Invited)] Deep Learning-based Image Processing Algorithms in 8K Era

*SukJu Kang¹ (1. Sogang University (Korea))

Keywords: High dynamic range image, deep learning, inverse tone mapping

This paper presents the deep learning-based inverse tone mapping algorithms for high dynamic range imaging. Specifically, the technical contents of various deep learning-based inverse tone mapping techniques, which are currently being studied, are explained, and the performance of representative methods are compared.

3:25 PM - 3:50 PM (Fri. Nov 29, 2019 3:00 PM - 4:10 PM Room 107)

[DES6/AIS4-2(Invited)] Omnidirectional/360-degree Image and Video Standardizations Status

*Junichi Hara¹ (1. RICOH Company, LTD. (Japan))

Keywords: omnidirectional, 360-degree, JPEG 360, OMAF, immersive media

This presentation reports technical aspects of the omnidirectional/360-degree image and video standardizations; ISO/IEC 19566-6 *JPEG 360* and ISO/IEC 23090-2 *Omnidirectional Media Format (OMAF)* international standards. And this also introduces functions of these next version omnidirectional picture standards that now are discussed in standardization meetings, and discusses its applications.

3:50 PM - 4:10 PM (Fri. Nov 29, 2019 3:00 PM - 4:10 PM Room 107)

[DES6/AIS4-3] An Advanced TV Program Logo Processing Algorithm for Preventing OLED TV Image Sticking

*Lin Cheng¹, Yang Rao¹, Yufeng Jin¹, Yin-Hung Chen¹, Ming-Jong Jou¹, Bin Zhao¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Technology Company (China))

Keywords: OLED, TV program logo, image sticking

In this paper, a TV logo post-processing system is proposed to relieve the burn-in phenomenon on OLED TV. It contains generic logo detection algorithm and identification mechanism to adapt to video real-time processing and temporary channel change events. With the logo restrain function, OLED TV image-sticking phenomenon would be alleviated.

Oral Presentation

[FLX3] Printed TFT Technologies

Chair: Hiroki Meada (Dai Nippon Printing Co., Ltd.)

Co-Chair: Takashi Nagase (Osaka Prefecture University)

Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 107 (1F)

[FLX3-1(Invited)] Printed Thin Film Transistors using Semi-conductive Single Wall Carbon Nanotube-Polymer Complexes

*Seiichiro Murase¹, Kazuki Isogai¹, Takayoshi Hirai¹, Yasuhiro Kobayashi¹,
Kenta Noguchi¹, Hiroji Shimizu¹ (1. Toray Industries, Inc. (Japan))

9:00 AM - 9:25 AM

[FLX3-2(Invited)] Towards Ideal Printed Organic Transistors

Fuhua Dai¹, *Chuan Liu¹ (1. Sun Yat-sen University (China))

9:25 AM - 9:50 AM

[FLX3-3(Invited)] Development of High Performance Semiconductor Inks for Printed Field-Effect Transistors For Flexible Display

Huihui Zhu¹, Ao Liu¹, Dongseob Ji¹, *YONG-YOUNG NOH¹ (1. Pohang University of Science and Technology (POSTECH) (Korea))

9:50 AM - 10:15 AM

9:00 AM - 9:25 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 107)

[FLX3-1(Invited)] Printed Thin Film Transistors using Semi-conductive Single Wall Carbon Nanotube-Polymer Complexes

*Seiichiro Murase¹, Kazuki Isogai¹, Takayoshi Hirai¹, Yasuhiro Kobayashi¹, Kenta Noguchi¹, Hiroji Shimizu¹ (1. Toray Industries, Inc. (Japan))

Keywords: Carbon nanotube, CNT-TFT, Printed circuit

We have achieved high performance on printed TFTs with a mobility up to 155 cm²/Vs, which is world leading level performance as a printed TFT, using highly enriched semi-conductive single wall carbon nanotube (SWCNT) and semi-conductive polymer complexes. This technology can be applied to various IoT devices.

9:25 AM - 9:50 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 107)

[FLX3-2(Invited)] Towards Ideal Printed Organic Transistors

Fuhua Dai¹, *Chuan Liu¹ (1. Sun Yat-sen University (China))

Keywords: Organic transistor, charge transport, printed electronics

Many organic thin-film transistors (OTFTs) exhibit non-ideal current-voltage characteristics that deviate from the ideal field-effect transistor or TFTs. The physical origins include the Schottky contact injection, strong localization of carriers, interfacial dipolar disorders, and etc. To this end, we have developed theoretical understandings and various optimization method to overcome the above problems. The resulting transistors exhibit almost ideal current-voltage behaviors, featuring the high mobility values reaching 10 cm²/Vs.

9:50 AM - 10:15 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 107)

[FLX3-3(Invited)] Development of High Performance Semiconductor Inks for Printed Field-Effect Transistors For Flexible Display

Huihui Zhu¹, Ao Liu¹, Dongseob Ji¹, *YONG-YOUNG NOH¹ (1. Pohang University of Science and Technology (POSTECH) (Korea))

Keywords: perovskite, carbon nanotube, thin film transistors

Although organic-inorganic halide perovskites continue to generate considerable interest with the high potential to be widely applied in a variety of optoelectronic devices, there are some critical obstacles to practical applications such as the toxicity of lead, the relatively low field effect mobility and the strong hysteresis during operation. Here we develop a universal approach to significantly improve mobility and operational stability, and reduce the hysteresis of perovskite-based transistors simultaneously through coupling low-dimensional lead-free perovskite material (C₆H₅C₂H₄NH₃)₂SnI₄ (hereafter abbreviated as (PEA)₂SnI₄) with embedded conjugated polymers wrapped

semiconducting carbon nanotubes (semi-CNTs). In the $(\text{PEA})_2\text{SnI}_4$ /semi-CNTs hybrid systems, semi-CNTs can contribute as smooth tracks for carriers to transport with less scattering and trapping of perovskite grain boundaries. We also demonstrate the extraordinary performance of $(\text{PEA})_2\text{SnI}_4$ /semi-CNTs hybrid phototransistors with ultrahigh photoresponsivity and photosensitivity, which is found to be on a par with the best devices available to date.

Oral Presentation

[FLX4] Wearable Sensors and Devices

Chair: Yasuyoshi Mishima (National Institute of Advanced Industrial Science and Technology)

Co-Chair: Hiroyuki Endoh (NEC Corp.)

Fri. Nov 29, 2019 10:40 AM - 12:15 PM Room 107 (1F)

[FLX4-1(Invited)] Ultra-flexible organic imager and sensors

*Tomyouki Yokota¹, Takao Someya¹ (1. The University of Tokyo (Japan))

10:40 AM - 11:05 AM

[FLX4-2(Invited)] Organic TFT-based Biosensors Functionalized with Artificial Receptors

*Tsuyoshi Minami¹ (1. Institute of Industrial Science, The University of Tokyo (Japan))

11:05 AM - 11:30 AM

[FLX4-3(Invited)] Ultra-Conformable Biodevice for Advanced Medicine and Healthcare

*Toshinori Fujie¹ (1. Tokyo Institute of Technology (Japan))

11:30 AM - 11:55 AM

[FLX4-4] Polysilicon CMOS TFTs on Ultrathin and Flexible Stainless Steel Substrates

*Miki Trifunovic¹, Aditi Chandra¹, Mao Ito¹, Sarah Khoo¹, Arvind Kamath¹ (1. Thin Film Electronics Inc. (United States of America))

11:55 AM - 12:15 PM

10:40 AM - 11:05 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Room 107)

[FLX4-1(Invited)] Ultra-flexible organic imager and sensors

*Tomyouki Yokota¹, Takao Someya¹ (1. The University of Tokyo (Japan))

Keywords: Organic electronics, Photodetector, Flexible electronics

We have developed ultra-flexible and lightweight organic electronics and photonics devices with few micron substrates. Our organic imager has pixel pitches as small as 50 μ m, with resolutions of up to 262 ppi. Using our ultra-flexible organic imager, we succeed to measure the spatial photoplethysmography (PPG) mapping.

11:05 AM - 11:30 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Room 107)

[FLX4-2(Invited)] Organic TFT-based Biosensors Functionalized with Artificial Receptors

*Tsuyoshi Minami¹ (1. Institute of Industrial Science, The University of Tokyo (Japan))

Keywords: Organic thin-film transistors, biosensors, artificial receptors, molecular recognition

We have studied organic thin-film transistors (OTFTs) functionalized with artificial receptors as a new sensing platform for a variety of targets such as small ions and molecules, and biomacromolecules. Herein, the detection of biogenic amines by OTFT and real-time monitoring of glucose by OTFT integrated microfluidic system are demonstrated.

11:30 AM - 11:55 AM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Room 107)

[FLX4-3(Invited)] Ultra-Conformable Biodevice for Advanced Medicine and Healthcare

*Toshinori Fujie¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Polymeric nanosheet, Printed nanofilm, Skin-contact electronics, Implantable device

Ultra-conformable biodevices (namely "printed nanofilms") are developed by combining polymeric nanosheets and printing technologies with variety of unique inks. The printed nanofilms allowed for continuous monitoring of biosignals or directing biofunctions, represented by the measurement of surface electromyogram, analysis of neural activity, and wireless delivery of a light into tumors to perform phototherapy.

11:55 AM - 12:15 PM (Fri. Nov 29, 2019 10:40 AM - 12:15 PM Room 107)

[FLX4-4] Polysilicon CMOS TFTs on Ultrathin and Flexible Stainless Steel Substrates

*Miki Trifunovic¹, Aditi Chandra¹, Mao Ito¹, Sarah Khoo¹, Arvind Kamath¹ (1. Thin Film Electronics Inc. (United States of America))

Keywords: Polysilicon TFT, CMOS, Ultrathin, Flexible, Stainless Steel

CMOS polysilicon TFTs fabricated on flexible stainless steel substrates are thinned down to 5 μ m thickness. Bending tests show minimal change in TFT performance at 2.5 mm bending radius after 10,000 tensile bend cycles.

Oral Presentation

[PRJ4] Projection Mapping and Lighting

Chair: Shinsuke Shikama (Setsunan Univ.)

Co-Chair: Petra Aswendt (ViALUX GmbH)

Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108 (1F)

[PRJ4-1(Invited)] Projection and Large Area Displays of Artworks for Public Exhibits

*Naoko Tosa¹, Yang Qin¹, Ryohei Nakatsu¹ (1. Kyoto University (Japan))

9:00 AM - 9:20 AM

[PRJ4-2(Invited)] Perceptual Appearance Control by Projection-Induced Illusion

*Ryo Akiyama¹, Goshiro Yamamoto², Toshiyuki Amano³, Takafumi Taketomi¹, Alexander Plopski¹, Yuichiro Fujimoto¹, Masayuki Kanbara¹, Christian Sandor⁴, Hirokazu Kato¹ (1. Nara Institute of Science and Technology (Japan), 2. Kyoto University (Japan), 3. Wakayama University (Japan), 4. City University of Hong Kong (Hong Kong))

9:20 AM - 9:40 AM

[PRJ4-3(Invited)] New Concept Ultra Short Throw Projector for Consumer

*Ryutaro Otake¹, Misa Sakurai, Masakatsu Ito, Hiroshi Nakade, Yuuji Taniue, Masaru Matsumori (1. Panasonic Corporation (Japan))

9:40 AM - 10:00 AM

[PRJ4-4(Invited)] Industrial DLP Projection Technology

*Petra Aswendt¹, Roland Hoefling¹ (1. ViALUX GmbH (Germany))

10:00 AM - 10:20 AM

[PRJ4-5L] Laser Phosphor Light Source with Hot Spot for Intelligent Headlight using DMD for Ultra-High Beam Applications

*Kenneth Li¹, Y.P. Chang² (1. Optonomus Technologies Inc. (United States of America), 2. Taiwan Color Optics, Inc. (Taiwan))

10:20 AM - 10:35 AM

9:00 AM - 9:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108)

[PRJ4-1(Invited)] Projection and Large Area Displays of Artworks for Public Exhibits

*Naoko Tosa¹, Yang Qin¹, Ryohei Nakatsu¹ (1. Kyoto University (Japan))

Keywords: Media art, Fluid art, Projection mapping, Large-area display

Owing to the advance of projection and large area displays, art exhibition at public area became possible. We have various experiences of exhibiting our artworks in two ways; exhibition using projection mapping and one using large LED screens. Based on such experiences we discuss relevant ways of public art exhibition.

9:20 AM - 9:40 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108)

[PRJ4-2(Invited)] Perceptual Appearance Control by Projection- Induced Illusion

*Ryo Akiyama¹, Goshiro Yamamoto², Toshiyuki Amano³, Takafumi Taketomi¹, Alexander Plopski¹, Yuichiro Fujimoto¹, Masayuki Kanbara¹, Christian Sandor⁴, Hirokazu Kato¹ (1. Nara Institute of Science and Technology (Japan), 2. Kyoto University (Japan), 3. Wakayama University (Japan), 4. City University of Hong Kong (Hong Kong))

Keywords: projection, illusion, color constancy, augmented reality

When a projector displays images on real-world objects, result colors are affected by surface color and environmental light. Limited colors can be presented through projection because of these factors. We overcome this limitation by controlling projection color based on human perceived color.

9:40 AM - 10:00 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108)

[PRJ4-3(Invited)] New Concept Ultra Short Throw Projector for Consumer

*Ryutaro Otake¹, Misa Sakurai, Masakatsu Ito, Hiroshi Nakade, Yuuji Taniue, Masaru Matsumori (1. Panasonic Corporation (Japan))

Keywords: Ultra short throw, Projector, High brightness, huge screen, compact body

Flat panel TV gradually shifts to large screen size like 65" because the price of large screen TV goes down. However our living space doesn't enlarge. So flat TV influences on interior design much more. To solve such kind of problems we suggested a new concept projector for consumer.

10:00 AM - 10:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108)

[PRJ4-4(Invited)] Industrial DLP Projection Technology

*Petra Aswendt¹, Roland Hoefling¹ (1. ViALUX GmbH (Germany))

This paper provides a view on DLP micro-mirror technology outside of digital cinema and data projectors. It shows that these MEMS offer significant potential when driven by the high-performance industrial control chipset. The principle of operation and the architecture of a hardware/software co-design for an industrial programming environment are described. Selected use cases are highlighted.

10:20 AM - 10:35 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 108)

[PRJ4-5L] Laser Phosphor Light Source with Hot Spot for Intelligent Headlight using DMD for Ultra-High Beam Applications

*Kenneth Li¹, Y.P. Chang² (1. Optonomous Technologies Inc. (United States of America), 2. Taiwan Color Optics, Inc. (Taiwan))

Keywords: intelligent headlight, laser phosphor, dmd, autonomous vehicles, extreme high beam

An intelligent headlight using a single DMD and a laser pumped crystal phosphor plate producing a hot spot for extreme high beam has been designed and develop. Initial experiment results using a DMD projection engine will be presented

Oral Presentation

[PRJ5] Automotive Display

Special Topics of Interest on Automotive Displays

Chair: Kazuhiro Ohara (Marubun)

Co-Chair: Masayuki Takayama (Honda)

Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108 (1F)

[PRJ5-1(Invited)] Advanced Automotive Interior Lighting and Exterior Displays

*Karlheinz Blankenbach¹, Robert Isele², Mathias Roennfeldt³, Uli Hiller⁴ (1. Pforzheim University (Germany), 2. BMW (Germany), 3. Lightworks (Germany), 4. Osram Opto Semiconductors (Germany))

10:40 AM - 11:00 AM

[PRJ5-2(Invited)] Laser Crystal Phosphor Automobile Headlight Integrated with Beam Control and LiDAR

*Y. P. Chang^{1,2}, Alan Wang¹, Wood-Hi Cheng², Kenneth Li³ (1. Taiwan Color Optics, Inc. (Taiwan), 2. National Chun Hsing University (Taiwan), 3. Optonomous Technologies Inc. (United States of America))

11:00 AM - 11:20 AM

[PRJ5-3(Invited)] Laser Light Sources for Next Generation Automotive Lighting Applications

*MENG HAN¹, Julian Carey¹, Paul Rudy¹ (1. SLD Laser (United States of America))

11:20 AM - 11:40 AM

[PRJ5-4(Invited)] Augmenting Reality In Automobiles

*Jamieson Jamieson Christmas¹ (1. Envisics ltd (UK))

11:40 AM - 12:00 PM

[PRJ5-5] Development of Image Quality Simulation for Laser Scanning Projector using Microlens Screen

*Hiroyuki Tanabe¹ (1. Ricoh Industrial Solutions Inc (Japan))

12:00 PM - 12:20 PM

10:40 AM - 11:00 AM (Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108)

[PRJ5-1(Invited)] Advanced Automotive Interior Lighting and Exterior Displays

*Karlheinz Blankenbach¹, Robert Isele², Mathias Roennfeldt³, Uli Hiller⁴ (1. Pforzheim University (Germany), 2. BMW (Germany), 3. Lightworks (Germany), 4. Osram Opto Semiconductors (Germany))

Keywords: LED, lighting, automotive, display, ASIL

Autonomous driving has a huge impact on cars. We present advanced solutions for interior “pixelated” lighting and exterior displays. Examples are visualization of driving mode by the steering wheel and information for other road users. Calibrated RGB LED systems provide the best solution in terms of optical quality and safety.

11:00 AM - 11:20 AM (Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108)

[PRJ5-2(Invited)] Laser Crystal Phosphor Automobile Headlight Integrated with Beam Control and LiDAR

*Y. P. Chang^{1,2}, Alan Wang¹, Wood-Hi Cheng², Kenneth Li³ (1. Taiwan Color Optics, Inc. (Taiwan), 2. National Chun Hsing University (Taiwan), 3. Optonomous Technologies Inc. (United States of America))

Keywords: Intelligent Headlight, Crystal Phosphor, DMD, LiDAR, Autonomous vehicles

This paper describes the development of high performance crystal phosphor with applications to automobile headlights, smart headlights, and LiDAR such that many limitations are eliminated and through integration, which could lower the cost of the system. A patent pending design of a smart headlight integrated with a LiDAR sensor using a single DMD will be described.

11:20 AM - 11:40 AM (Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108)

[PRJ5-3(Invited)] Laser Light Sources for Next Generation Automotive Lighting Applications

*MENG HAN¹, Julian Carey¹, Paul Rudy¹ (1. SLD Laser (United States of America))

Keywords: Laser, Phosphor, Automotive Lighting, ADB, Laser scanner, MEMS

Progress in development of blue laser diodes and their integration with phosphors enabled a new category of solid state light sources for automotive lighting. In this paper, a dynamic laser light module consisting of blue laser diode, a MEMS scanner and remote phosphor for adaptive driving beam and future intelligent lighting will be introduced.

11:40 AM - 12:00 PM (Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108)

[PRJ5-4(Invited)] Augmenting Reality In Automobiles

*Jamieson Jamieson Christmas¹ (1. Envisics ltd (UK))

Keywords: Augmenteing Reality, Head up display, Holography, Spatial Light Modulator

AR-HUD offering a compelling safety case for the automotive market. Thus far HUD adoption has been impaired by the physical volume of the optical system required to create a wide field of view.

Envisics have developed revolutionary holographic technology that addresses these challenges while delivering class leading image metrics.

12:00 PM - 12:20 PM (Fri. Nov 29, 2019 10:40 AM - 12:20 PM Room 108)

[PRJ5-5] Development of Image Quality Simulation for Laser Scanning Projector using Microlens Screen

*Hiroyuki Tanabe¹ (1. Ricoh Industrial Solutions Inc (Japan))

Keywords: Laser scanning display, Image quality, Speckle reduction

Speckle can be reduced by using a scanning projector with microlens screen. However, the diffraction noises and the scanning-line-moire generated and degrades the image quality. To calculate these noises, the simulation was developed by integrating geometric and wave optics model. The simulation was validated by comparing with experimental result.

Oral Presentation

[PRJ6/AIS3] AI

Chair: Makio Kurashige (DNP)

Co-Chair: Satoshi Ouchi (Hitachi)

Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 108 (1F)

[PRJ6/AIS3-1(Invited)] Visual Illusions Expressed by Deep Neural Networks

*Taisuke Kobayashi¹, Eiji Watanabe^{1,2} (1. Japan/Aichi/National Institute for Basic Biology (Japan), 2. Japan/Aichi/The Graduate University for Advanced Studies (SOKENDAI) (Japan))

1:20 PM - 1:40 PM

[PRJ6/AIS3-2] Vertical View Human Action Recognition from Range Images

*Akinobu Watanabe¹, Keiichi Mitani¹ (1. Hitachi, Ltd. (Japan))

1:40 PM - 2:00 PM

[PRJ6/AIS3-3] High Efficiency Information Presentation Method for Head Mounted Display on Work Support

*Takuya Nakamichi¹, Chiyo Ohno¹, Shoji Yamamoto¹, Koji Yamasaki¹ (1. Hitachi, Ltd. (Japan))

2:00 PM - 2:20 PM

[PRJ6/AIS3-4L] High-Speed and High-Brightness Color Single-Chip DLP Projector Using High-Power LED-Based Light Sources

*Yoshihiro Watanabe^{1,2}, Masatoshi Ishikawa² (1. Tokyo Institute of Technology (Japan), 2. University of Tokyo (Japan))

2:20 PM - 2:35 PM

1:20 PM - 1:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 108)

[PRJ6/AIS3-1(Invited)] Visual Illusions Expressed by Deep Neural Networks

*Taisuke Kobayashi¹, Eiji Watanabe^{1,2} (1. Japan/Aichi/National Institute for Basic Biology (Japan), 2. Japan/Aichi/The Graduate University for Advanced Studies (SOKENDAI) (Japan))

Keywords: Predictive coding, Deep neural network, Optical illusion

The predictive coding theory, which is one of mathematical models of the visual information processing of the brain, were incorporated to deep neural networks. We found that the deep neural networks represented the motion for illusion images that were not moving physically, much like human visual perception.

1:40 PM - 2:00 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 108)

[PRJ6/AIS3-2] Vertical View Human Action Recognition from Range Images

*Akinobu Watanabe¹, Keiichi Mitani¹ (1. Hitachi, Ltd. (Japan))

Keywords: TOF, Posture, Tracking

We developed the human joints' position estimation technique and the person tracking technique from upward view range image of TOF sensor, and confirmed the correct prediction ratio of hands' position is 97%, and confirmed the person tracking error is reduced to 1/7.

2:00 PM - 2:20 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 108)

[PRJ6/AIS3-3] High Efficiency Information Presentation Method for Head Mounted Display on Work Support

*Takuya Nakamichi¹, Chiyo Ohno¹, Shoji Yamamoto¹, Koji Yamasaki¹ (1. Hitachi, Ltd. (Japan))

Keywords: Head Mounted Display, Information Presentation Method, Work Support

We developed an information presentation method for head mounted displays that does not interfere with the field worker. This method achieves low power consumption by a processing method that does not require a graphic processing unit and a camera for space recognition.

2:20 PM - 2:35 PM (Fri. Nov 29, 2019 1:20 PM - 2:35 PM Room 108)

[PRJ6/AIS3-4L] High-Speed and High-Brightness Color Single-Chip DLP Projector Using High-Power LED-Based Light Sources

*Yoshihiro Watanabe^{1,2}, Masatoshi Ishikawa² (1. Tokyo Institute of Technology (Japan), 2. University of Tokyo (Japan))

Keywords: Projector, Digital Mirror Device, LED, Augmented Reality, Projection Mapping

This paper proposes a high-speed and high-brightness color projector with a single-chip-DLP configuration that meets the demands for compactness and speed by introducing light sources based on luminescent concentration from LEDs and an optimized optical system. Furthermore, with the unique control circuit of the projector, it actualizes various projection functions.

Oral Presentation

[PRJ7/LCT8] Eyewear

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Dieter Cuypers (CMST)

Co-Chair: Subaru Kawasaki (JNC Korea)

Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 108 (1F)

[PRJ7/LCT8-1] LC Lens Fabricated by Photoalignment for AR/VR Systems

*Wei-Wei Chen¹, Jui-Wen Pan¹, Shie-Chang Jeng¹ (1. National Chiao Tung University (Taiwan))

3:00 PM - 3:20 PM

[PRJ7/LCT8-2] Effect of Processing Parameters on Visual Quality for Liquid Crystal Displays Compatible with Contact Lenses

*Andres Vasquez Quintero¹, Pablo Perez-Merino², Sudha Sudha¹, Lucas Oorlynck¹, Herbert De Smet¹ (1. Ghent University / imec, Centre for Microsystems Technology CMST (Belgium), 2. Instituto de Investigacion Sanitaria Fundacion Jimenez Diaz (Spain))

3:20 PM - 3:40 PM

[PRJ7/LCT8-3] Miniature Liquid Crystal Lens Optimizations

*Dieter Cuypers¹, Rik Verplancke¹, Herbert De Smet¹ (1. imec and Ghent University (Belgium))

3:40 PM - 4:00 PM

[PRJ7/LCT8-4] Ferroelectric Liquid Crystal Dammann Grating: for LiDAR Applications

*Zhengnan YUAN¹, Zhibo SUN¹, Abhishek K SRIVASTAVA¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

4:00 PM - 4:20 PM

3:00 PM - 3:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 108)

[PRJ7/LCT8-1] LC Lens Fabricated by Photoalignment for AR/VR Systems

*Wei-Wei Chen¹, Jui-Wen Pan¹, Shie-Chang Jeng¹ (1. National Chiao Tung University (Taiwan))

Keywords: Liquid crystal lens, Polarization-free, Augmented reality, Photoalignment

A concept for an electrically tunable liquid crystal (LC) lens using a hole-patterned electrode and the vertical alignment liquid crystal cell by circular photoalignment is demonstrated. The proposed LC lens is a polarizer-free negative lens(0D~-0.93D) by changing the driving voltage. The proposed LC lens can be applied for AR/VR applications.

3:20 PM - 3:40 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 108)

[PRJ7/LCT8-2] Effect of Processing Parameters on Visual Quality for Liquid Crystal Displays Compatible with Contact Lenses

*Andres Vasquez Quintero¹, Pablo Perez-Merino², Sudha Sudha¹, Lucas Oorlynck¹, Herbert De Smet¹ (1. Ghent University / imec, Centre for Microsystems Technology CMST (Belgium), 2. Instituto de Investigacion Sanitaria Fundacion Jimenez Diaz (Spain))

Keywords: ghest-host liquid crystal, wearable display, smart contact lens

This paper presents the effect of processing parameters on the contrast and optical quality of guest-host liquid crystal cells intended for smart contact lens applications. The effects were measured by means of cavity interferometry and model fitting. Optical quality was qualitatively assessed by means of target images.

3:40 PM - 4:00 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 108)

[PRJ7/LCT8-3] Miniature Liquid Crystal Lens Optimizations

*Dieter Cuypers¹, Rik Verplancke¹, Herbert De Smet¹ (1. imec and Ghent University (Belgium))

Keywords: liquid crystal, tunable lens, Fresnel

Small, switchable liquid crystal based polymer Fresnel lenses are discussed, considering design optimizations for performance.

4:00 PM - 4:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 108)

[PRJ7/LCT8-4] Ferroelectric Liquid Crystal Dammann Grating: for LiDAR Applications

*Zhengnan YUAN¹, Zhibo SUN¹, Abhishek K SRIVASTAVA¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

Keywords: Ferroelectric liquid crystals, Dammann grating, 3D-imaging, LiDAR

We propose a ferroelectric liquid crystal Dammann grating (FLCDG) based polarization modulated depth-mapping system. Innovatively, FLCDG is used as high-speed shutter in this system. The application of FLCDG enables LiDAR as one-shot capturing system instead of iterative scanning. Moreover, the proposed device shows a fast data-collection time period ($50\mu s$) for per 49 points that can be further increased depending on the damman grating, and provide low cost solution to the problem.

Oral Presentation

[3DSA7/3D7] Virtual Reality 1

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Tomohiro Tanikawa (The Univ. of Tokyo)

Co-Chair: Kenji Yamamoto (NICT)

Fri. Nov 29, 2019 10:40 AM - 12:00 PM Small Hall (2F)

[3DSA7/3D7-1(Invited)] Research and Development of Second Generation Virtual Reality

*Michitaka Hirose¹ (1. The University of Tokyo (Japan))

10:40 AM - 11:00 AM

[3DSA7/3D7-2(Invited)] Computer vision, AI, AR technology in various industries

*You-Kwang Wang^{1,2}, Hung-Ya Tsai², Chih-Hao Chuang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. OSENSE Technology Co. (Taiwan), 3. National Taiwan University (Taiwan))

11:00 AM - 11:20 AM

[3DSA7/3D7-3(Invited)] Impressive 3D CG technologies for automotive HUDs with wide FOV

*Haruhiko Okumura¹, Takashi Sasaki¹, Aira Hotta¹, Masahiro Sekine¹ (1. Toshiba Corp. (Japan))

11:20 AM - 11:40 AM

[3DSA7/3D7-4(Invited)] Air Floating Image based on a Dihedral Corner Reflector Array

*YUKI MAEDA¹ (1. Parity Innovations Co. Ltd. (Japan))

11:40 AM - 12:00 PM

10:40 AM - 11:00 AM (Fri. Nov 29, 2019 10:40 AM - 12:00 PM Small Hall)

[3DSA7/3D7-1(Invited)] Research and Development of Second Generation Virtual Reality

*Michitaka Hirose¹ (1. The University of Tokyo (Japan))

Keywords: Virtual Reality, Five Senses Info-Communication Technology, Service VR Trainer, Experience Media

Novel VR technology (second generation VR) is introduced. After short review of technological advances to date, the author discusses benefits of VR in the areas of education and training that are expected as major application of VR technology.

11:00 AM - 11:20 AM (Fri. Nov 29, 2019 10:40 AM - 12:00 PM Small Hall)

[3DSA7/3D7-2(Invited)] Computer vision, AI, AR technology in various industries

*You-Kwang Wang^{1,2}, Hung-Ya Tsai², Chih-Hao Chuang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. OSENSE Technology Co. (Taiwan), 3. National Taiwan University (Taiwan))

Keywords: Computer vision, Artificial Intelligence, Augmented Reality

AR technology is currently the most popular human-computer interaction interface. We get a spatial point cloud through computer vision and AI technology. And completed several projects according to different scene requirements.

11:20 AM - 11:40 AM (Fri. Nov 29, 2019 10:40 AM - 12:00 PM Small Hall)

[3DSA7/3D7-3(Invited)] Impressive 3D CG technologies for automotive HUDs with wide FOV

*Haruhiko Okumura¹, Takashi Sasaki¹, Aira Hotta¹, Masahiro Sekine¹ (1. Toshiba Corp. (Japan))

Keywords: Augmented Reality, HUD, 3D CG, Wide FOV, Automotive

We have applied various kinds of 3D CG technologies to increase the Field Of View (FOV) and visibility of displayed images for the monocular HUD. As a results, we successfully developed impressive 3D CG technologies for HUDs with wide FOV and high visibility

11:40 AM - 12:00 PM (Fri. Nov 29, 2019 10:40 AM - 12:00 PM Small Hall)

[3DSA7/3D7-4(Invited)] Air Floating Image based on a Dihedral Corner Reflector Array

*YUKI MAEDA¹ (1. Parity Innovations Co. Ltd. (Japan))

Keywords: Air floating image, Aerial image, Floating display, Imaging element, DCRA

An air floating image and its applications based on a dihedral corner reflector array are introduced in this paper. An observer can see the air floating image by the naked eye and manipulate it by touching the air floating image using finger sensor system.

Oral Presentation

[3DSA9/3D9] Data Compression

Chair: Hideaki Kimata (NTT)

Co-Chair: Miwa Katayama (NHK)

Fri. Nov 29, 2019 3:00 PM - 4:20 PM Small Hall (2F)

[3DSA9/3D9-1] Verification of Compression Architecture for 3DoF+ Immersive Video Delivery

*Gwangsoon Lee¹, Hong-Chang Hong¹, Homin Eum¹, Jeongil Seo¹ (1. ETRI (Korea))

3:00 PM - 3:20 PM

[3DSA9/3D9-2] FDM-based Global Motion Estimation for Dynamic 3D Point Cloud Compression

*SO MYUNG LEE¹, Li Cui¹, Tianyu Dong¹, Eun-Yong Chang², Jihun Cha², Euee S. JANG¹
(1. Hanyang University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

3:20 PM - 3:40 PM

[3DSA9/3D9-3] MPEG Video-based Point Cloud Coding based on JPEG

*Tianyu Dong¹, So Myung Lee¹, Euee S. Jang¹ (1. Hanyang University (Korea))

3:40 PM - 4:00 PM

[3DSA9/3D9-4] Fast calculation method for computer-generated holograms using saccade suppression by lowering the resolution based on Fresnel zone plate reduction

*WEI LINGJIE¹, Fumio Okuyama², Yuji Sakamoto¹ (1. Hokkaido University (Japan), 2. New Generation Medical Center (Japan))

4:00 PM - 4:20 PM

3:00 PM - 3:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Small Hall)

[3DSA9/3D9-1] Verification of Compression Architecture for 3DoF+ Immersive Video Delivery

*Gwangsoon Lee¹, Hong-Chang Hong¹, Homin Eum¹, Jeongil Seo¹ (1. ETRI (Korea))

Keywords: Immersive media, 360 video, motion parallax, 6DoF

This paper introduces a compression architecture for delivering 3DoF+ immersive video, which can be applied to existing video encoder. Specifically, this paper includes a pruning algorithm that can reduce the redundancy among multiple views while maintaining the higher image quality of rendered view.

3:20 PM - 3:40 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Small Hall)

[3DSA9/3D9-2] FDM-based Global Motion Estimation for Dynamic 3D Point Cloud Compression

*SO MYUNG LEE¹, Li Cui¹, Tianyu Dong¹, Eun-Yong Chang², Jihun Cha², Euee S. JANG¹ (1. Hanyang University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

Keywords: dynamic point cloud compression, global motion estimation, fast distortion measurement

In this paper, we propose a fast global motion estimation (GME) for dynamic 3D point cloud compression (PCC). We applied fast distortion measurement method(FDM) to replace and reduce the computational complexity of GME. The experimental results show that the proposed method is two times faster than MPEG V-PCC.

3:40 PM - 4:00 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Small Hall)

[3DSA9/3D9-3] MPEG Video-based Point Cloud Coding based on JPEG

*Tianyu Dong¹, So Myung Lee¹, Euee S. Jang¹ (1. Hanyang University (Korea))

Keywords: MPEG, V-PCC, JPEG, HEVC, Video Codec

In this paper, we proposed a method to design MPEG Video-based point cloud compression (V-PCC) based on JPEG. We chose JPEG for its simplicity, low computational complexity, and ubiquitous support of encoder and decoder. For performance evaluation, we compared the proposed method with the HEVC-based V-PCC reference software.

4:00 PM - 4:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Small Hall)

[3DSA9/3D9-4] Fast calculation method for computer-generated holograms using saccade suppression by lowering the resolution based on Fresnel zone plate reduction

*WEI LINGJIE¹, Fumio Okuyama², Yuji Sakamoto¹ (1. Hokkaido University (Japan), 2. New Generation Medical Center (Japan))

Keywords: Computer-Generated Hologram, Saccade, Fast Calculation

Saccade is a very rapid movement of our both eyes that transfer between two or more gazing center, with almost no sensitivity of visual information from the eyes to the brain. In this study, it is possible to reduce the computational complexity of CGH by lowering the resolution of the CGH when the saccade occurred.

Oral Presentation

[3D6/3DSA6] Distinguished Display

Chair: Hideki Kakeya (Univ. of Tsukuba)

Co-Chair: Yuki Maeda (Parity Innovations)

Fri. Nov 29, 2019 9:00 AM - 10:20 AM Small Hall (2F)

[3D6/3DSA6-1(Invited)] Importance of Continuous Motion Parallax in Monocular and Binocular 3D Perception

*Haruki Mizushima¹, Shiro Suyama¹ (1. Tokushima University (Japan))

9:00 AM - 9:20 AM

[3D6/3DSA6-2] Further Crosstalk Reduction Method with Eye-Tracking for Glasses-Free Stereoscopic Display in Both Portrait and Landscape Modes

*Yukiya Yamaguchi¹, Hiroyuki Nakamura¹, Goro Hamagishi¹, Kayo Yoshimoto¹, Takuya Matsumoto², Kaoru Kusafuka², Hideya Takahashi¹ (1. Osaka City University (Japan), 2. Kyocera Corporation (Japan))

9:20 AM - 9:40 AM

[3D6/3DSA6-3] Measurement of Moiré Patterns in 3D Display

*Hea In Jeong¹, Seo Young Choi², Young Ju Jeong¹ (1. Sookmyung Women's University (Korea), 2. Korea Institute of Lighting & ICT (Korea))

9:40 AM - 10:00 AM

[3D6/3DSA6-4] GPU Acceleration of Algorithm to Design Directional Volumetric Display for Real-time Processing

*Daiki Matsumoto¹, Ryuji Hirayama^{2,3}, Naoto Hoshikawa⁴, Hirotaka Nakayama⁵, Tomoyoshi Shimobaba¹, Tomoyoshi Ito¹, Atsushi Shiraki¹ (1. Chiba University (Japan), 2. Research Fellow of the Japan Society for the Promotion of Science (Japan), 3. Tokyo University of Science (Japan), 4. National Institute of Technology, Oyama College (Japan), 5. National Astronomical Observatory of Japan (Japan))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Small Hall)

[3D6/3DSA6-1(Invited)] Importance of Continuous Motion Parallax in Monocular and Binocular 3D Perception

*Haruki Mizushima¹, Shiro Suyama¹ (1. Tokushima University (Japan))

Keywords: Motion parallax, Depth perception, Anisometropia

Motion parallax is one of the cues of human depth perception. It provides sufficient depth information even in monocular viewing, and improves degradation of stereoscopic depth by visual acuity difference of both eyes. In this paper we demonstrate importance of continuous motion parallax in monocular and binocular depth perception.

9:20 AM - 9:40 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Small Hall)

[3D6/3DSA6-2] Further Crosstalk Reduction Method with Eye-Tracking for Glasses-Free Stereoscopic Display in Both Portrait and Landscape Modes

*Yukiya Yamaguchi¹, Hiroyuki Nakamura¹, Goro Hamagishi¹, Kayo Yoshimoto¹, Takuya Matsumoto², Kaoru Kusafuka², Hideya Takahashi¹ (1. Osaka City University (Japan), 2. Kyocera Corporation (Japan))

Keywords: glasses-free, stereoscopic, eye-tracking, crosstalk, portrait and landscape

We propose a crosstalk reduction method with an eye-tracking system for glass-free stereoscopic displays in both portrait and landscape modes. We can reduce crosstalk by dividing a screen into multiple areas and displaying black images on the subpixels observed simultaneously with both eyes in each divided area.

9:40 AM - 10:00 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Small Hall)

[3D6/3DSA6-3] Measurement of Moiré Patterns in 3D Display

*Hea In Jeong¹, Seo Young Choi², Young Ju Jeong¹ (1. Sookmyung Women's University (Korea), 2. Korea Institute of Lighting & ICT (Korea))

Keywords: 3D Display, Moiré, Fourier transform

The moiré pattern can be produced when developing 3D displays which can lead to a 3D quality degradation. A measurement algorithm is required to estimate how much moiré pattern has occurred. In this paper, we propose a measurement algorithm that can calculate the moiré artifact generated in displays.

10:00 AM - 10:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:20 AM Small Hall)

[3D6/3DSA6-4] GPU Acceleration of Algorithm to Design Directional

Volumetric Display for Real-time Processing

*Daiki Matsumoto¹, Ryuji Hirayama^{2,3}, Naoto Hoshikawa⁴, Hirotaka Nakayama⁵, Tomoyoshi Shimobaba¹, Tomoyoshi Ito¹, Atsushi Shiraki¹ (1. Chiba University (Japan), 2. Research Fellow of the Japan Society for the Promotion of Science (Japan), 3. Tokyo University of Science (Japan), 4. National Institute of Technology, Oyama College (Japan), 5. National Astronomical Observatory of Japan (Japan))

Keywords: GPU acceleration, Volumetric display, Directional image, Digital signage, Media art

In this study, we attempted GPU acceleration of an algorithm to design a directional volumetric display. As a result, the GPU implementation was up to 45 times faster than the CPU implementation. We also confirmed that the GPU implementation could cooperate with a person tracking system in real-time.

Oral Presentation

[3D8/3DSA8] Virtual Reality 2

Special Topics of Interest on AR/VR and Hyper Reality

Chair: You Kwang Wang (Osense Technology)

Co-Chair: Haruki Mizushima (Tokushima University)

Fri. Nov 29, 2019 1:20 PM - 2:40 PM Small Hall (2F)

[3D8/3DSA8-1(Invited)] Service VR Training System: VR Simulator of Man-to-Man Service with Mental/Emotional Sensing and Intervention
*TOMOHIRO TANIKAWA¹, Yuki Ban¹, Kazuma Aoyama¹, Eiji Shinbori², Shigeru Komatsubara², Michitaka Hirose¹ (1. The University of Tokyo (Japan), 2. Dai Nippon Printing Co., Ltd. (Japan))

1:20 PM - 1:40 PM

[3D8/3DSA8-2] A HMD for users with any interocular distance
*Jung-Young Son¹, Hyoung Lee¹, Jung Kim¹, Beom-Ryeol Lee², Wook-Ho Son², Tetiana Venkel³ (1. Konyang University (Korea), 2. Electronics and Telecommunication Research Institute (Korea), 3. Chernivtsi University (Ukraine))

1:40 PM - 2:00 PM

[3D8/3DSA8-5L] Proposal for Light Field Mirage
*Yoshiharu Momonoi^{1,2}, Koya Yamamoto², Yasuhiro Takaki² (1. Samsung R&D Institute Japan (Japan), 2. Tokyo University of Agriculture and Technology (Japan))

2:00 PM - 2:20 PM

[3D8/3DSA8-4] Accuracy verification of visual appearance acquisition device of non-metallic material based on Sparse SVBRDF
*Tsung-Lin Lu¹, Yu-Lun Liu¹, Yu-Cheng Hsieh¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

2:20 PM - 2:40 PM

1:20 PM - 1:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Small Hall)

[3D8/3DSA8-1(Invited)] Service VR Training System: VR Simulator of Man-to-Man Service with Mental/Emotional Sensing and Intervention

*TOMOHIRO TANIKAWA¹, Yuki Ban¹, Kazuma Aoyama¹, Eiji Shinbori², Shigeru Komatsubara², Michitaka Hirose¹
(1. The University of Tokyo (Japan), 2. Dai Nippon Printing Co., Ltd. (Japan))

In this paper, we introduce our concept and preliminary implementation of service VR training system. For training services, emotional skills are very important. Thus, our service VR simulator consist of mental/emotional sensing devices, estimating algorithm and intervention approaches.

1:40 PM - 2:00 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Small Hall)

[3D8/3DSA8-2] A HMD for users with any interocular distance

*Jung-Young Son¹, Hyoung Lee¹, Jung Kim¹, Beom-Ryeol Lee², Wook-Ho Son², Tetiana Venkel³ (1. Konyang University (Korea), 2. Electronics and Telecommunication Research Institute (Korea), 3. Chernivtsi University (Ukraine))

A prototype HMD which can automatically adjust interocular distance in the range of 55 mm to 75 mm in accordance with those of users. The main component of the HMD is a linear motor which shifts the modularized left and right eye's projection and camera optics in accordance with the measured interocular distance of a user. The total adjusting time of the distance is less than 10 seconds. The weight of the HMD is slightly less than 500 g and it is worn by a head belt. The HMD is somewhat heavy and unbalanced due to the distribution of the weight along the nose side but the head belt holds tightly the HMD on its place and it works well.

2:00 PM - 2:20 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Small Hall)

[3D8/3DSA8-5L] Proposal for Light Field Mirage

*Yoshiharu Momonoi^{1,2}, Koya Yamamoto², Yasuhiro Takaki² (1. Samsung R&D Institute Japan (Japan), 2. Tokyo University of Agriculture and Technology (Japan))

Keywords: Mirage, Light Field Display, 360-degree Display

Mirage, which consists of a pair of parabolic mirrors, is a well-known 360-degree display system. This study explored replacing the parabolic mirrors in Mirage with multiple flat-panel light field displays to realize "Light Field Mirage". Rays emitted from 3D objects are reconstructed for 360-degree viewing. Preliminary experiments were conducted.

2:20 PM - 2:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:40 PM Small Hall)

[3D8/3DSA8-4] Accuracy verification of visual appearance acquisition device of non-metallic material based on Sparse SVBRDF

*Tsung-Lin Lu¹, Yu-Lun Liu¹, Yu-Cheng Hsieh¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

Keywords: Visual appearance, Spatially Varying Bidirectional Reflectance Distribution Function, Cook-Torrance Model

In this paper, we proposed a visual appearance acquisition device comparing with commercial product. Our device is capable of restoring the visual appearance for non-metallic materials based on spatially varying bidirectional reflectance distribution function (SVBRDF). A benchmark comparing to commercial product Radiant Vision is carried out to verify the reliability of the proposed device.

Oral Presentation

[LCT7/FLX5] Flexible LCDs

Chair: Shinichiro Oka (Japan Display Inc.)

Co-Chair: Toshimasa Eguchi (Sumitomo Bakelite Co., Ltd.)

Fri. Nov 29, 2019 1:20 PM - 2:50 PM Room 204 (2F)

[LCT7/FLX5-1(Invited)] Flexible LCD with Colorless Polyimide

*Kaijun Wang¹, Chungue Yuan¹, Zhuhui Li¹, Li Zhang¹, Qiao Huang¹,
Linshuang Li¹, Shujih Chen¹, Chia-Yu Lee¹, Xin Zhang² (1. Shenzhen
China Star Optoelectronics Semiconductor Display Technology Co.Ltd.
(China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd.
(China))

1:20 PM - 1:45 PM

[LCT7/FLX5-2(Invited)] Ultra-high contrast OLED: Thin and light dual cell LCDs on plastic

*Paul A Cain¹, James Harding¹, William Reeves¹, May Wheeler¹ (1.
FlexEnable Ltd (UK))

1:45 PM - 2:10 PM

[LCT7/FLX5-3] Formation of polymer walls with a high aspect ratio on a plastic substrate

*Su Min Do¹, Tae Hoon Choi¹, Jae Won Huh¹, Yeongyu Choi¹, Tae Hoon Yoon¹
(1. Pusan National University (Korea))

2:10 PM - 2:30 PM

[LCT7_FLX5-4L] New Approach to Process Simplification for Flexible TFT-LCD

*Cheng-He Ruan¹, Chih-Yuan Hou¹, Chia-Jen Li¹, Shih-Min Chen¹, Min-Zi
Hong¹ (1. AU Optronics Corporation (Taiwan))

2:30 PM - 2:50 PM

1:20 PM - 1:45 PM (Fri. Nov 29, 2019 1:20 PM - 2:50 PM Room 204)

[LCT7/FLX5-1(Invited)] Flexible LCD with Colorless Polyimide

*Kaijun Wang¹, Chungue Yuan¹, Zhuhui Li¹, Li Zhang¹, Qiao Huang¹, Linshuang Li¹, Shujih Chen¹, Chia-Yu Lee¹, Xin Zhang² (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd. (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd. (China))

Keywords: Flexible, Colorless Polyimide, LCD

We successfully realized 14-inch flexible LCD using colorless polyimide(cPI) as substrate. The LCD panel has the thickness less than 0.3 mm, which is IPS mode with some special materials and designs for avoiding predictable risks and solving issues during process.

1:45 PM - 2:10 PM (Fri. Nov 29, 2019 1:20 PM - 2:50 PM Room 204)

[LCT7/FLX5-2(Invited)] Ultra-high contrast OLED: Thin and light dual cell LCDs on plastic

*Paul A Cain¹, James Harding¹, William Reeves¹, May Wheeler¹ (1. FlexEnable Ltd (UK))

Keywords: OTFT, OLED, Dual Cell, HDR Displays, Flexible Displays

We report on a breakthrough approach for creating dual cell LCDs on ultra-thin plastic films that can significantly reduce inter-cell separation, resulting in a simpler construction that avoids the need for compensation films and other trade-offs. The resulting structure is particularly suited to TVs, monitors and automotive displays.

2:10 PM - 2:30 PM (Fri. Nov 29, 2019 1:20 PM - 2:50 PM Room 204)

[LCT7/FLX5-3] Formation of polymer walls with a high aspect ratio on a plastic substrate

*Su Min Do¹, Tae Hoon Choi¹, Jae Won Huh¹, Yeongyu Choi¹, Tae Hoon Yoon¹ (1. Pusan National University (Korea))

Keywords: polymer wall, phase separation, plastic substrate

We formed polymer walls with a high aspect ratio on a plastic substrate. Polymer walls are formed without a photomask through the phase separation of liquid crystal/reactive mesogen mixture induced by a spatial difference of elastic energy and electric field intensity.

2:30 PM - 2:50 PM (Fri. Nov 29, 2019 1:20 PM - 2:50 PM Room 204)

[LCT7_FLX5-4L] New Approach to Process Simplification for Flexible TFT-LCD

*Cheng-He Ruan¹, Chih-Yuan Hou¹, Chia-Jen Li¹, Shih-Min Chen¹, Min-Zi Hong¹ (1. AU Optronics Corporation (Taiwan))

Keywords: AOC, PDLC, Low temperature process, PI alignment free

A new approach is proposed to fabricate flexible TFT-LCD with minimal process steps. Single substrate and without conventional cell process is obtained by introducing AOC and developed PDLC coating on the top of array without PI alignment process. The 4.99" 294ppi AOC prototype LCD on a single substrate was fabricated.

Oral Presentation

[PH1] Phosphors and Devices

Chair: Rong-Jun Xie (Xiamen University)

Co-Chair: Koutoku Ohmi (Tottori University)

Fri. Nov 29, 2019 10:40 AM - 11:55 AM Room 204 (2F)

[PH1-1(Invited)] Discovery of novel nitride phosphors by high throughput calculation

*Rong-Jun Xie¹, Shuxing Li¹, Zhenbin Wang², Shyue Ping Ong² (1. Xiamen University (China), 2. University of California, San Diego (United States of America))

10:40 AM - 11:00 AM

[PH1-2] Monolithic Full-color LED Micro-display Using Dual Wavelength LED Epilayers

*Peian Li¹, Xu Zhang¹, Yangfeng Li¹, Longheng Qi¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

11:00 AM - 11:20 AM

[PH1-3] Polarized Emitting qLEDs based on Aligned Quantum Rods as Active Material

Hendrik Schlicke¹, Christoph Schloen¹, Tobias Jochum¹, Sören Becker¹, Horst Weller^{1,2}, *Jan S Niehaus¹ (1. Fraunhofer CAN (Germany), 2. University of Hamburg (Germany))

11:20 AM - 11:40 AM

[PH1-4L] Development of (La,Y)₃Si₆N₁₁:Ce³⁺ Nitride Yellow Phosphors for High-Power Excitation

*Yuhei Inata¹, Shiho Takashina¹ (1. Mitsubishi Chemical Corp. (Japan))

11:40 AM - 11:55 AM

10:40 AM - 11:00 AM (Fri. Nov 29, 2019 10:40 AM - 11:55 AM Room 204)

[PH1-1(Invited)] Discovery of novel nitride phosphors by high throughput calculation

*Rong-Jun Xie¹, Shuxing Li¹, Zhenbin Wang², Shyue Ping Ong² (1. Xiamen University (China), 2. University of California, San Diego (United States of America))

Keywords: phosphor, white LEDs, high throughput calculation

Discovery of new phosphors with interesting properties is driven by rapid advances in lighting and displays. In this paper, we screened and searched for a super-broadband phosphor $\text{Sr}_2\text{AlSi}_2\text{NO}_6:\text{Eu}^{2+}$ by using high throughput calculations. The emission of the phosphor covered the whole range of the visible light, enabling to create super-high color rendition white light when pumped by a UV-LED chip.

11:00 AM - 11:20 AM (Fri. Nov 29, 2019 10:40 AM - 11:55 AM Room 204)

[PH1-2] Monolithic Full-color LED Micro-display Using Dual Wavelength LED Epilayers

*Peian Li¹, Xu Zhang¹, Yangfeng Li¹, Longheng Qi¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

Keywords: LED, Micro-display, Full color, Quantum dot

A passive-matrix InGaN LED full-color micro-display with 40×40 pixels (120×40 RGB subpixels) and subpixel pitch of $40 \mu\text{m} \times 120 \mu\text{m}$ was demonstrated. Full-color emission was realized by applying patterned red quantum dot color conversion layer onto a monolithic blue/green dual wavelength LED array.

11:20 AM - 11:40 AM (Fri. Nov 29, 2019 10:40 AM - 11:55 AM Room 204)

[PH1-3] Polarized Emitting qLEDs based on Aligned Quantum Rods as Active Material

Hendrik Schlicke¹, Christoph Schloen¹, Tobias Jochum¹, Sören Becker¹, Horst Weller^{1,2}, *Jan S Niehaus¹ (1. Fraunhofer CAN (Germany), 2. University of Hamburg (Germany))

Keywords: polarized emission, LED, quantum dot, quantum rod, qLED

In this contribution we present polarized emitting qLEDs based on aligned quantum rods as active materials, which are a promising candidate for future display generations requiring linearly polarized light. The achieved DOP values exceed the values of currently published devices.

11:40 AM - 11:55 AM (Fri. Nov 29, 2019 10:40 AM - 11:55 AM Room 204)

[PH1-4L] Development of $(\text{La,Y})_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$ Nitride Yellow Phosphors for High-Power Excitation

*Yuhei Inata¹, Shiho Takashina¹ (1. Mitsubishi Chemical Corp. (Japan))

Keywords: Nitride yellow phosphor, Color variation, White LED, Laser excitation

$(\text{La,Y})_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$ (LSN) phosphor has been used for white LEDs in back light units (BLUs). We have succeeded in developing LSN phosphors with wide color variations and excellent luminescence properties. We expect that LSN phosphors will be used not only in BLUs but also in other lighting and laser devices.

Oral Presentation

[OLED6] OLED Advanced Technologies

Chair: Yoshimasa Sakai (MITSUBISHI CHEMICAL)

Co-Chair: Sukekazu Aratani (Samsung Electronics)

Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 204 (2F)

[OLED6-1(Invited)] OLED/OPD-on-Silicon for Near-to-Eye Microdisplays and Sensing Applications

*Karsten Fehse¹, Dirk Schlebusch¹, Philipp Wartenberg¹, Steffen Ulbricht¹, Gerd Bunk¹, Stephan Brenner¹, Matthias Schober¹, Christian Schmidt¹, Bernd Richter¹, Uwe Vogel¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany))

9:00 AM - 9:20 AM

[OLED6-2] Ultra High Resolution Imaging Light Measurement Device for Subpixel Metrology of μ -LEDs and OLED-Displays

*Tobias Steinel¹, Thilo Gemeinhardt¹, Martin Wolf¹ (1. Instrument Systems GmbH (Germany))

9:20 AM - 9:40 AM

[OLED6-3] Enhanced Operational Stability of Quantum Dot based Light-Emitting Diodes by Improving Charge Injection Balance

*Seunghyun Rhee¹, Jun Hyuk Chang¹, Donghyo Hahm¹, Kyunghwan Kim¹, Hak June Lee¹, Kookheon Char¹, Changhee Lee¹, Wan Ki Bae², Jeonghun Kwak¹ (1. Seoul National University (Korea), 2. Sungkyunkwan University (Korea))

9:40 AM - 10:00 AM

[OLED6-4L(Invited)] Formation mechanism of spontaneous orientation polarization in evaporated films of organic light-emitting diode materials

*Yutaka Noguchi¹, Kohei Osada¹, Hisao Ishii² (1. Meiji University (Japan), 2. Chiba University (Japan))

10:00 AM - 10:15 AM

9:00 AM - 9:20 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 204)

[OLED6-1(Invited)] OLED/OPD-on-Silicon for Near-to-Eye

Microdisplays and Sensing Applications

*Karsten Fehse¹, Dirk Schlebusch¹, Philipp Wartenberg¹, Steffen Ulbricht¹, Gerd Bunk¹, Stephan Brenner¹, Matthias Schober¹, Christian Schmidt¹, Bernd Richter¹, Uwe Vogel¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany))

Keywords: OLED, CMOS, Microdisplay, Sensor

We present microdisplays designed for high resolution on the one as well as for low power usage scenarios on the other side. Further information on application of organic semiconductor and CMOS technology in sensor devices for fingerprint scanner, organic photodiodes for near infrared sensing and fluorescence sensors will be presented.

9:20 AM - 9:40 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 204)

[OLED6-2] Ultra High Resolution Imaging Light Measurement Device for Subpixel Metrology of μ -LEDs and OLED-Displays

*Tobias Steinel¹, Thilo Gemeinhardt¹, Martin Wolf¹ (1. Instrument Systems GmbH (Germany))

Keywords: μ -LED, subpixel metrology, ultra high resolution, display testing, light measurement device

We present ultra-high resolution measurements of (Micro-) OLED displays for subpixel metrology in display production and laboratories. A 150 megapixel camera merged with a high-end spectroradiometer allows for one-shot subpixel analysis of complete displays with spectroradiometric accuracy. An integrated pixel-shifter increases resolution to effectively 600 megapixels.

9:40 AM - 10:00 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 204)

[OLED6-3] Enhanced Operational Stability of Quantum Dot based Light-Emitting Diodes by Improving Charge Injection Balance

*Seunghyun Rhee¹, Jun Hyuk Chang¹, Donghyo Hahm¹, Kyunghwan Kim¹, Hak June Lee¹, Kookheon Char¹, Changhee Lee¹, Wan Ki Bae², Jeonghun Kwak¹ (1. Seoul National University (Korea), 2. Sungkyunkwan University (Korea))

Keywords: Quantum dot LED, Operational stability, Charge injection balance, Hole injection barrier

Charge injection balance is the key factor for high efficiency and lifetime of quantum dot light-emitting diodes (QLEDs). However, it is unidentified how the operational conditions affect lifetime of QLEDs. Herein, grounded on the quantitative assessment, the impact of electrical parameters to QLEDs performance and operational stability is identified.

10:00 AM - 10:15 AM (Fri. Nov 29, 2019 9:00 AM - 10:15 AM Room 204)

[OLED6-4L(Invited)] Formation mechanism of spontaneous orientation polarization in evaporated films of organic light-emitting diode materials

*Yutaka Noguchi¹, Kohei Osada¹, Hisao Ishii² (1. Meiji University (Japan), 2. Chiba University (Japan))

Keywords: orientation polarization, surface potential, permanent dipole moment, intermolecular interaction

Spontaneous orientation polarization (SOP) affects the device performance of OLEDs. To understand and control SOP, we have studied the formation mechanism. The SOP formation likely results from a balance between an electrostatic interaction of permanent dipole moment and van der Waals interaction on the film surface during deposition.

Oral Presentation

[FLX6] Advanced Process and Evaluation for Flexible Electronics

Chair: Tadahiro Furukawa (Yamagata University)

Co-Chair: Akira Nakazawa (AGC Inc.)

Fri. Nov 29, 2019 3:00 PM - 4:00 PM Room 204 (2F)

[FLX6-1(Invited)] Solution-Processing of Inorganic and Hybrid Materials for High Performance Flexible Electronics

*Myung-Gil Kim¹ (1. Sungkyunkwan University (Korea))

3:00 PM - 3:25 PM

[FLX6-2] Analysis and Design of Mechanical Stresses on Foldable Devices

*Nao Ando¹, Kei Hyodo¹, Hisao Sasaki¹, Yoshihito Ota¹, Tomoki Sasayama², Yoshihiko Iwao², Tomoya Tsuda², Nao Terasaki³ (1. YUASA SYSTEM (Japan), 2. Shimadzu Co. (Japan), 3. AIST (Japan))

3:25 PM - 3:45 PM

[FLX6-4L] To Make a Flexible Patch Type Photoelectric Pulse Wave Sensor Highly Sensitivity

*Mana Hashimoto¹, Kazuki Ihara¹, Hiroshi Kajitani¹, Hiroyuki Endo¹ (1. NEC Corporation. (Japan))

3:45 PM - 4:00 PM

3:00 PM - 3:25 PM (Fri. Nov 29, 2019 3:00 PM - 4:00 PM Room 204)

[FLX6-1(Invited)] Solution-Processing of Inorganic and Hybrid Materials for High Performance Flexible Electronics

*Myung-Gil Kim¹ (1. Sungkyunkwan University (Korea))

Keywords: Hybrid Material, Solution Processing, Thin-film Transistor, Metal Chalcogenide

To improve the electrical properties in solution-processed high-performance, large-area flexible electronics, we employed hybrid structures of a multifunctional organic-semiconductor/amorphous oxide semiconductor, nanomaterials/amorphous oxide semiconductors, and chalcogenide-gel. With the novel hybrid structures and new processing strategy, we could demonstrate enhancement of mobility, electrical stability, and exceptional mechanical stability.

3:25 PM - 3:45 PM (Fri. Nov 29, 2019 3:00 PM - 4:00 PM Room 204)

[FLX6-2] Analysis and Design of Mechanical Stresses on Foldable Devices

*Nao Ando¹, Kei Hyodo¹, Hisao Sasaki¹, Yoshihito Ota¹, Tomoki Sasayama², Yoshihiko Iwao², Tomoya Tsuda², Nao Terasaki³ (1. YUASA SYSTEM (Japan), 2. Shimadzu Co. (Japan), 3. AIST (Japan))

Keywords: Mechanical stresses, Foldable devices, Endurance test, Mechanoluminescent material

Knowledge of mechanical stresses on foldable devices is important to develop them. When you study stresses, you should control motion profile then study dynamic strain energy. In our study, we slightly adjusted each testing conditions to figure out effect from these difference and sensitivity of the analyzing method.

3:45 PM - 4:00 PM (Fri. Nov 29, 2019 3:00 PM - 4:00 PM Room 204)

[FLX6-4L] To Make a Flexible Patch Type Photoelectric Pulse Wave Sensor Highly Sensitivity

*Mana Hashimoto¹, Kazuki Ihara¹, Hiroshi Kajitani¹, Hiroyuki Endo¹ (1. NEC Corporation. (Japan))

Keywords: Flexible device, Patchable device, Emotion estimation

Recently, research about emotion estimation by using vital data was developed actively. In current type sensor, emotion estimation could be carried out slightly in motion-condition due to a gap between the skin and the device. A flexible patch type sensor could be acquired large amount of data even motion-condition.

Oral Presentation

[FMC6] Retardation Management

Chair: Takashi Sato (ZEON)

Co-Chair: Daisuke Ogomi (Nitto Denko Corporation)

Fri. Nov 29, 2019 10:40 AM - 11:40 AM Room 206 (2F)

[FMC6-2] New type 1/4-Wave Plate Film for OLED Panels

*Jiro Ishihara¹, Kenji Yoda¹, Shunsuke Takagi¹, Kazuhiro Osato¹, Yuji Shibata¹, Taku Hatano¹
(1. ZEON CORPORATION (Japan))

11:00 AM - 11:20 AM

[FMC6-3] Novel Chromakey Technology with Polarizer and Retardation Film

*Yoshiaki Asanoi¹, Muneo Kaneko², Kazuya Yoshimura¹, Katsunori Takada¹, Akinori Izaki¹ (1. Nitto Denko Corporation (Japan), 2. Kansai Televisiaion Co.Ltd. (Japan))

11:20 AM - 11:40 AM

11:00 AM - 11:20 AM (Fri. Nov 29, 2019 10:40 AM - 11:40 AM Room 206)

[FMC6-2] New type 1/4-Wave Plate Film for OLED Panels

*Jiro Ishihara¹, Kenji Yoda¹, Shunsuke Takagi¹, Kazuhiro Osato¹, Yuji Shibata¹, Taku Hatano¹ (1. ZEON CORPORATION (Japan))

Keywords: QWP, $\frac{1}{4}$ -wave plate, OLED, high contrast, low color shift

We will introduce a new type $\frac{1}{4}$ -wave plate film (QWP) for OLED displays. The QWP film consists of two layers with positive and negative intrinsic properties, which results in smaller reflectance and color shift than other type of conventional QWP on OLED. We have achieved mass-production by new production process.

11:20 AM - 11:40 AM (Fri. Nov 29, 2019 10:40 AM - 11:40 AM Room 206)

[FMC6-3] Novel Chromakey Technology with Polarizer and Retardation Film

*Yoshiaki Asanoi¹, Muneko Kaneko², Kazuya Yoshimura¹, Katsunori Takada¹, Akinori Izaki¹ (1. Nitto Denko Corporation (Japan), 2. Kansai Televisiaion Co.Ltd. (Japan))

Keywords: Chromakey, Polarizer, Retardation, Transparent hue

We have developed a novel chromakey technology with polarizer and retardation film. A fine greenish color which is required for image composing of chromakey can be produced by optimizing the retardation. It is superior with conventional method at various points.

Oral Presentation

[FMC7] Quantum Dot

Special Topics of Interest on Quantum Dot Technologies

Chair: Takao Tomono (Toppan Printing)

Co-Chair: Yukito Saitoh (FUJIFILM Corporation)

Fri. Nov 29, 2019 1:20 PM - 2:20 PM Room 206 (2F)

[FMC7-1(Invited)] Quantum Rod Enhancement Films for Modern LCDs

Swadesh Kumar Gupta¹, Maksym F Prodanov¹, Chengbin Kang¹, Cheng Chun Hin¹,
Valerii V Vashchenko¹, *Abhishek Kumar Srivastava¹ (1. hong kong university of
science and technology (Hong Kong))

1:20 PM - 1:40 PM

[FMC7-2] Wide Color Gamut Display Solution Using Hybrid-typed Perovskite Quantum Dots White LEDs

Chieh-Yu Kang¹, Chih-Hao Lin¹, *Chun-Lin Tsai¹, Chin-Wei Sher², Ting-zhu Wu³,
Po-Tsung Lee¹, Hao-Chung Kuo¹ (1. National Chiao Tung University (Taiwan), 2.
HKUST Fok Ying Tung Research Institute (China), 3. Xiamen University (China))

1:40 PM - 2:00 PM

[FMC7-3] A Novel Display Technology— Perovskite Quantum Dot Display with Blue OLEDs

*Miao Duan¹, Dongze Li¹, Zhiping Hu¹, Wenxiang Peng¹, Yongwei Wu¹, Yongming Yin¹
, Bo He¹, Pei Jiang¹, Feng Jiang², Lifu Shi², Haizheng Zhong², Shu-jhih Chen¹,
Chia-Yu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor
Display Technology Co., Ltd. (China), 2. Beijing Institute of Technology
(China))

2:00 PM - 2:20 PM

1:20 PM - 1:40 PM (Fri. Nov 29, 2019 1:20 PM - 2:20 PM Room 206)

[FMC7-1(Invited)] Quantum Rod Enhancement Films for Modern LCDs

Swadesh Kumar Gupta¹, Maksym F Prodanov¹, Chengbin Kang¹, Cheng Chun Hin¹, Valerii V Vashchenko¹,
 *Abhishek Kumar Srivastava¹ (1. hong kong university of science and technology (Hong Kong))

Keywords: Quantum rod enhancement films, ink-jet printing, Photoalignment, LCD

Quantum rod films, comprising the aligned quantum rods, emits polarized light that could potentially improve the efficiency of the LCD. In this talk, we will discuss about the High-quality alignment of the QRs showing a high polarization ratio for the PL. We developed these QREF containing red and green QRs, in the same films, for their application in LCD backlights. These films offer wider color gamut and almost two times higher optical efficiency (i.e. ~7.8%) for the conventional LCDs.

1:40 PM - 2:00 PM (Fri. Nov 29, 2019 1:20 PM - 2:20 PM Room 206)

[FMC7-2] Wide Color Gamut Display Solution Using Hybrid-typed Perovskite Quantum Dots White LEDs

Chieh-Yu Kang¹, Chih-Hao Lin¹, *Chun-Lin Tsai¹, Chin-Wei Sher², Ting-zhu Wu³, Po-Tsung Lee¹, Hao-Chung Kuo¹ (1. National Chiao Tung University (Taiwan), 2. HKUST Fok Ying Tung Research Institute (China), 3. Xiamen University (China))

Keywords: Perovskite, Quantum dots, Light emitting diodes

This study presents that hybrid-typed Perovskite WLED has higher luminous efficiency (85 lm/W) compared to solid-typed and good wide color gamut performance (123 % of NTSC and 92 % of Rec. 2020). Lower operation temperature and better reliability (over 500 hours) result have also been demonstrated under this design.

2:00 PM - 2:20 PM (Fri. Nov 29, 2019 1:20 PM - 2:20 PM Room 206)

[FMC7-3] A Novel Display Technology— Perovskite Quantum Dot Display with Blue OLEDs

*Miao Duan¹, Dongze Li¹, Zhiping Hu¹, Wenxiang Peng¹, Yongwei Wu¹, Yongming Yin¹, Bo He¹, Pei Jiang¹, Feng Jiang², Lifu Shi², Haizheng Zhong², Shu-jih Chen¹, Chia-Yu Lee¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd. (China), 2. Beijing Institute of Technology (China))

Keywords: Perovskite, Quantum dot, Color conversion, AMOLED, Inkjet printing

We fabricated 6.6-inch perovskite quantum dot display panel by inkjet printing technology, being cooperated with active matrix organic light emitting diodes. Here, 3-stack blue OLEDs with top-emission structure acted as backlight and green perovskite layer acted as color downconverter, which exhibited excellent performances such as high color purity.

Oral Presentation

[FMC8] Advanced Material

Chair: Atsuko Fujita (JNC Corporation)

Co-Chair: Seiki Ohara (AGC)

Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 206 (2F)

[FMC8-1(Invited)] Carrier Glass Substrates for Electronic Display Fabrication

*Kazutaka Hayashi¹ (1. AGC Inc. (Japan))

3:00 PM - 3:20 PM

[FMC8-2] Blackening of TFT wiring by depositing high durability film

*Keita Umemoto¹, Shin Okano, Yukiya Sugiuchi, Takeshi Ohtomo, Ichiro Shiono
(1. Mitsubishi Materials Corporation (Japan))

3:20 PM - 3:40 PM

[FMC8-5L] Transparent Flexible Electrode with Conductive Coating Induced by Proton Implantation of Emeraldine Polyaniline Covalently Functionalized on Polydimethylsiloxane

*Pen-Cheng Wang¹, Tsan-Feng Lu¹, Tzu-Hsiang Lin¹, Ching-Jung Lo², Ping-Ching Pai², Chen-Kan Tseng², Hui-Yu Tsai¹, Ming-Wei Lin¹, Tsung-Min Hung² (1. National Tsing Hua University (Taiwan), 2. Chang Gung Memorial Hospital (Taiwan))

3:40 PM - 3:55 PM

[FMC8-4] Photosensitive Materials with Zirconia Nanotechnology

*Hiroki Chisaka¹, Kouichi Misumi¹, Dai Shiota¹, Katsumi Ohmori¹, Lei Zheng², Robert J. Wiacek², Z. Serpil Gonen Williams² (1. Tokyo Ohka Kogyo Co., Ltd. (Japan), 2. Pixelligent Technologies LLC (United States of America))

4:00 PM - 4:20 PM

3:00 PM - 3:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 206)

[FMC8-1(Invited)] Carrier Glass Substrates for Electronic Display Fabrication

*Kazutaka Hayashi¹ (1. AGC Inc. (Japan))

Keywords: Flexible OLED, Carrier Glass Substrate, Non-alkali Glass

Non-alkali glass substrates are used as carrier substrates in various electronic device fabrication. In this paper, overview of the requirements for the carrier substrates are described. Thermal shrinkage, stiffness, optical transmittance and residual stress of the glass substrate are important to fabricate display devices, such as flexible OLED display.

3:20 PM - 3:40 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 206)

[FMC8-2] Blackening of TFT wiring by depositing high durability film

*Keita Umemoto¹, Shin Okano, Yukiya Sugiuchi, Takeshi Ohtomo, Ichiro Shiono (1. Mitsubishi Materials Corporation (Japan))

Keywords: TFT, Low reflectivity, Wiring, High durability

Blackening of TFT wiring enables higher resolution and improved design of various kinds of displays. In this paper, we will introduce the material design concept and properties of high durability thin film for blackening of TFT wiring.

3:40 PM - 3:55 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 206)

[FMC8-5L] Transparent Flexible Electrode with Conductive Coating Induced by Proton Implantation of Emeraldine Polyaniline Covalently Functionalized on Polydimethylsiloxane

*Pen-Cheng Wang¹, Tsan-Feng Lu¹, Tzu-Hsiang Lin¹, Ching-Jung Lo², Ping-Ching Pai², Chen-Kan Tseng², Hui-Yu Tsai¹, Ming-Wei Lin¹, Tsung-Min Hung² (1. National Tsing Hua University (Taiwan), 2. Chang Gung Memorial Hospital (Taiwan))

Keywords: Polyaniline, Polydimethylsiloxane, Proton Implantation, Transparent Electrode, MEMS

Transparent thin films of polyaniline covalently fabricated on flexible polydimethylsiloxane substrates by surface modification with *N*-(3-trimethoxysilylpropyl)aniline for robust aniline polymerization could alternatively be redoped by proton implantation without incorporating an undesired labile/hygroscopic dopant acid that tends to compromise operation of encapsulated modules or MEMS components developed for flexible display applications.

4:00 PM - 4:20 PM (Fri. Nov 29, 2019 3:00 PM - 4:20 PM Room 206)

[FMC8-4] Photosensitive Materials with Zirconia Nanotechnology

*Hiroki Chisaka¹, Kouichi Misumi¹, Dai Shiota¹, Katsumi Ohmori¹, Lei Zheng², Robert J. Wiacek², Z. Serpil Gonen Williams² (1. Tokyo Ohka Kogyo Co., Ltd. (Japan), 2. Pixelligent Technologies LLC (United States of America))

Keywords: High reflective index (HRI), Zirconia (ZrO₂), Flexible, Photo-patternenable, Inkjet

The combination of ZrO₂ nanocrystals and photosensitive technologies led to new photosensitive materials and inks with high refractive index and inkjet properties superior to conventional materials. Moreover, high resolution and high transparency was achieved even with thick films. This material is useful for next generation applications such as flexible displays.

Oral Presentation

[INP5] AR/VR Interactive Technologies

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Takamichi Nakamoto (Tokyo Institute of Technology)

Co-Chair: Shunsuke Yoshimoto (University of Tokyo)

Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 206 (2F)

[INP5-1(Invited)] Utilization or Elimination of Mona Lisa Effect for Eye Contact with Characters

*Hironori Mitake¹, Hsueh Han Wu¹, Taro Ichii¹, Kazuya Tateishi¹, Shoichi Hasegawa¹ (1. Tokyo Institute of Technology (Japan))

9:00 AM - 9:25 AM

[INP5-2(Invited)] Olfactory Display and its Application

*Takamichi Nakamoto¹ (1. Tokyo Institute of Technology (Japan))

9:25 AM - 9:50 AM

[INP5-3(Invited)] Electromechanical Impedance Tomography for Soft Tactile Sensor

*Shunsuke Yoshimoto¹ (1. The University of Tokyo (Japan))

9:50 AM - 10:15 AM

[INP5-4] An Interactive Holographic Light-Field Display Color-Aided 3D-touch User Interface

*Ivan Alexis Sanchez Salazar Chavarria¹, Tomoya Nakamura¹, Masahiro Yamaguchi¹ (1. Tokyo Institute of Technology (Japan))

10:15 AM - 10:35 AM

9:00 AM - 9:25 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 206)

[INP5-1(Invited)] Utilization or Elimination of Mona Lisa Effect for Eye Contact with Characters

*Hironori Mitake¹, Hsueh Han Wu¹, Taro Ichii¹, Kazuya Tateishi¹, Shoichi Hasegawa¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Mona Lisa Effect, Eye Contact, Layered Display, Multi View Display

Interactive characters as digital signage are becoming popular. Eye contact from the character in appropriate situation may cause sense of awareness from the character, and attract people attention. Also, widely used planar display cause Mona Lisa effect. We focused on positive and negative aspect of the effect, and created novel way to enable eye contact from characters to viewers, which is utilizing or eliminating the Mona Lisa effect.

9:25 AM - 9:50 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 206)

[INP5-2(Invited)] Olfactory Display and its Application

*Takamichi Nakamoto¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Olfactory VR, Wearable olfactory display, Multi-component odor blender, Micro dispenser, Surface Acoustic Wave device

An olfactory display is a device to present smells. We have studied multi-component olfactory display to generate a variety of smells. Our recent model consists of multiple micro dispensers and a surface acoustic wave atomizer. Both desktop-type and wearable type olfactory displays together with their contents were developed.

9:50 AM - 10:15 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 206)

[INP5-3(Invited)] Electromechanical Impedance Tomography for Soft Tactile Sensor

*Shunsuke Yoshimoto¹ (1. The University of Tokyo (Japan))

Keywords: Tactile Imaging, Tomography, Pressure Distribution, Touch Sensing, Haptics

This study introduces a tactile sensing technology based on a tomographic approach with conductors for imaging of pressure distribution. The proposed technology enabled designing the soft tactile sensor, characterized by high positional accuracy, adjustable sensitivity and range, and a relatively simple fabrication process.

10:15 AM - 10:35 AM (Fri. Nov 29, 2019 9:00 AM - 10:35 AM Room 206)

[INP5-4] An Interactive Holographic Light-Field Display Color-Aided 3D-touch User Interface

*Ivan Alexis Sanchez Salazar Chavarria¹, Tomoya Nakamura¹, Masahiro Yamaguchi¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Light-field, 3D-interaction, displays, holography, touchable-interface

The author' s group previously demonstrated a holographic light-field display with a 3D touch interface, based on the detection of scattered light by the user. That interface is now improved by realizing real-time interactivity and the implementation of 3D motion detection using the color information captured by an RGB sensor.