

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 Opttronics 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 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))

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: Tadahihiro 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

[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, Shujih 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: IGT0, 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 $(\text{PEA})_2\text{SnI}_4/\text{semi-CNTs}$ 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 $(\text{PEA})_2\text{SnI}_4/\text{semi-CNTs}$ 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 Damman 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 Optonics 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 chalclo-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 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, Muneko 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, Muneo 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)

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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.