

Thu. Nov 28, 2019

Conference Hall

Oral Presentation

[MEET1] Novel Materials, Fundamental Components and Process Technologies

Chair: Jin Jang (KyungHee University)

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

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

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

9:00 AM - 9:10 AM

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

9:10 AM - 9:30 AM

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

9:30 AM - 9:50 AM

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

9:50 AM - 10:10 AM

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

10:10 AM - 10:30 AM

Oral Presentation

[MEET2] EL Quantum Dots Technologies

Chair: Frank Yan (Fuzhou University)

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

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

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

5:20 PM - 5:40 PM

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

6:00 PM - 6:20 PM

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

6:20 PM - 6:40 PM

Mid-sized Hall A

Oral Presentation

[FMC4/LCT4] Micro LED Display

Chair: K Kälantär (Global Optical Solutions)

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

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

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

9:00 AM - 9:20 AM

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

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

9:20 AM - 9:40 AM

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

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

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

Oral Presentation

[VHF5] Physiological and Psychophysical Factors

Chair: Hiroyasu Ujike (AIST)

Co-Chair: Masamitsu Harasawa (NHK)

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

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

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

5:20 PM - 5:45 PM

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

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

(Japan))

5:45 PM - 6:00 PM

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

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

6:05 PM - 6:25 PM

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

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

6:25 PM - 6:40 PM

Mid-sized Hall B

Oral Presentation

[AMD4] Emerging TFTs

Chair: Hyun Jae Kim (Yonsei Univ.)

Co-Chair: Yosei Shibata (Tohoku Univ.)

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

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

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

9:00 AM - 9:25 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:05 AM

[AMD4-5L] Improving Performances of Oxide

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

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

10:05 AM - 10:20 AM

Oral Presentation

[FLX2] Stretchable and Flexbile Devices

Chair: Manabu Ito (Toppan Printing Co.)

Co-Chair: Mitsuru Nakata (NHK)

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

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

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

5:20 PM - 5:45 PM

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

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

5:45 PM - 6:10 PM

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

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

6:10 PM - 6:30 PM

Room 107

Oral Presentation

[EP2/DES4] Advanced Electronic Paper Displays and Systems

Chair: Norihisa Kobayashi (Chiba Univ.)

Co-Chair: Haruhiko Okumura (Toshiba)

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

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

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

9:00 AM - 9:20 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:15 AM

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

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

10:15 AM - 10:35 AM

Oral Presentation

[EP3] Electrochromic Devices

Chair: Shuichi Maeda (Tokai University)

Co-Chair: Yoshihiko Hotta (Ricoh)

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

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

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

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

5:20 PM - 5:35 PM

[EP3-2L] Optimization of Prussian Blue Modified

Counter Electrode in Ag Deposition-based Electrochromic Device

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

5:35 PM - 5:50 PM

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

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

5:50 PM - 6:05 PM

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

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

6:05 PM - 6:20 PM

Room 108

Oral Presentation

[PRJ2] Optical Components

Chair: Hidekazu Hatanaka (USHIO)

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

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

[PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes

*Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiro Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyota Gosei Co., Ltd. (Japan))

9:00 AM - 9:20 AM

[PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays

Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway

(Norway))

9:20 AM - 9:40 AM

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

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

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

Oral Presentation

[PRJ3] Image Quality and Display Devices

Chair: Andrés Vásquez Quintero (University of Ghent)

Co-Chair: Tetsuji Suzuki (JVC KENWOOD)

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

[PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications

*Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))

5:20 PM - 5:40 PM

[PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology

*Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))

5:40 PM - 6:00 PM

[PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module

*Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))

6:00 PM - 6:20 PM

[PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects

*Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

6:20 PM - 6:40 PM

Small Hall

Oral Presentation

[3DSA5/3D5] Light Field 2

Chair: Jung-Young Son (Konyang Univ.)

Co-Chair: Munekazu Date (NTT)

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

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

5:20 PM - 5:40 PM

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

5:40 PM - 6:00 PM

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

6:00 PM - 6:20 PM

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

6:20 PM - 6:40 PM

Oral Presentation

[3D4/VHF4/3DSA4] Illusion

Chair: Sumio Yano (Shimane University)

Co-Chair: Yuzo Hisatake (Shizuoka Univ.)

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

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

9:00 AM - 9:20 AM

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

9:20 AM - 9:40 AM

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

9:40 AM - 10:00 AM

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

10:00 AM - 10:20 AM

Room 204

Oral Presentation

[OLED4] QD Material & Devices

Chair: Takeo Wakimoto (Merck Performance Materials)

Co-Chair: Toshiaki Ikuta (JNC Corp.)

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

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

9:00 AM - 9:20 AM

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

9:20 AM - 9:40 AM

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

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

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

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

10:20 AM - 10:35 AM

Oral Presentation

[OLED5] OLED Optical Design

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

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

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

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

5:20 PM - 5:40 PM

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

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

5:40 PM - 6:00 PM

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

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

6:00 PM - 6:20 PM

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

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

6:20 PM - 6:40 PM

Room 206

Oral Presentation

[INP3] Haptic Technologies (1)

Chair: Makoto Sato (Tokyo Institute of Technology)

Co-Chair: Nobuyuki Hashimoto (Citizen)

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

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

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

9:00 AM - 9:25 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:15 AM

Oral Presentation

[INP4] Haptic Technologies (2)

Chair: Masashi Konyo (Tohoku University)

Co-Chair: Vibol Yem (Tokyo Metropolitan University)

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

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

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

5:20 PM - 5:45 PM

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

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

5:45 PM - 6:10 PM

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

*Ki-Uk Kyung¹ (1. KAIST (Korea))

6:10 PM - 6:35 PM

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

touch sensors

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

6:35 PM - 6:50 PM

 Oral Presentation

[MEET1] Novel Materials, Fundamental Components and Process Technologies

Chair: Jin Jang (KyungHee University)

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

Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall (1F)

- [MEET1-OP] Opening
 Masayuki Nakamoto¹ (1. Shizuoka University (Japan))
 9:00 AM - 9:10 AM
- [MEET1-1(Invited)] High Brightness Electron Beam with Carbon Nanotube (CNT) Cold Cathode
 *Kyu Chang Park¹, Ha Rim Lee¹, Boklae Cho² (1. KyungHee University (Korea),
 2. Korea Research Institute for Science and Standard (Korea))
 9:10 AM - 9:30 AM
- [MEET1-2] Electron Beam Lithography of PMMA Film Using Direct Growth CNT Cold Cathode Emitter
 *Ok Jung Hwang¹, Ha Rim Lee¹, Kyu Chang Park¹ (1. University of Kyunghee (Korea))
 9:30 AM - 9:50 AM
- [MEET1-3] SOURCE 2D Simulation for High Resolution Carbon Nanotube Cold Cathode Fabrication
 *Da Woon Kim¹, Ha Rim Lee¹, Boklae Cho², Kyu Chang Park¹ (1. University of Kyung Hee (Korea), 2. Korea Research Institute for Science and Standard (Korea))
 9:50 AM - 10:10 AM
- [MEET1-4] Effects on X-ray Imaging Quality by Manipulation of Cold Cathode Emitter Density
 *Jisoo Oh¹, Yi Yin Yu¹, Kyu Chang Park¹ (1. Kyung Hee University (Korea))
 10:10 AM - 10:30 AM

9:00 AM - 9:10 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-OP] Opening

Masayuki Nakamoto¹ (1. Shizuoka University (Japan))

9:10 AM - 9:30 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-1(Invited)] High Brightness Electron Beam with Carbon Nanotube (CNT) Cold Cathode

*Kyu Chang Park¹, Ha Rim Lee¹, Boklae Cho² (1. KyungHee University (Korea), 2. Korea Research Institute for Science and Standard (Korea))

Keywords: Carbon nanotube (CNT), Cold Cathode, high brightness

We fabricated high brightness electron beam with carbon nanotube (CNT) cold cathode. The beam brightness strongly depends on the virtual source size of CNT cold cathode. Based on the beam brightness simulation and measurement, we could obtain micro-focused electron beam with higher electron emission current for large area, high resolution imaging.

9:30 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-2] Electron Beam Lithography of PMMA Film Using Direct Growth CNT Cold Cathode Emitter

*Ok Jung Hwang¹, Ha Rim Lee¹, Kyu Chang Park¹ (1. University of Kyunghee (Korea))

Keywords: carbon nanotube (CNT), electron beam(e-beam) lithography, VACNTs

We have developed on electron beam (e-beam) lithography system with novel electron source using vertically aligned carbon nanotubes (VACNTs). After the beam was exposed, the PMMA film on ITO glass was developed in MIBK: IPA developer (MIBK: IPA=1:3). As a result, we observed lithography pattern less than 100 um without electric and magnetic lens. This cold cathode emitter is differentiated from the previous electron source for e-beam lithography.

9:50 AM - 10:10 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-3] SOURCE 2D Simulation for High Resolution Carbon Nanotube Cold Cathode Fabrication

*Da Woon Kim¹, Ha Rim Lee¹, Boklae Cho², Kyu Chang Park¹ (1. University of Kyung Hee (Korea), 2. Korea Research Institute for Science and Standard (Korea))

Keywords: Carbon Nanotube (CNT), High resolution, Beam divergence, Electron beam

High-resolution electron microscopy requires an electron source with high brightness and resolution. We simulated and fabricated the carbon nanotube (CNT) cold cathode with high resolution. For the simulation, we used SOURCE 2D simulator and fabricated self-focused CNT based electron beam. The beam

shows micron scale resolution with optimized self-focused CNT beam design. The beam spot size depends on the various parameters, such as depth, width and driving conditions.

10:10 AM - 10:30 AM (Thu. Nov 28, 2019 9:00 AM - 10:30 AM Conference Hall)

[MEET1-4] Effects on X-ray Imaging Quality by Manipulation of Cold Cathode Emitter Density

*Jisoo Oh¹, Yi Yin Yu¹, Kyu Chang Park¹ (1. Kyung Hee University (Korea))

Keywords: x-ray source, x-ray resolution, cold cathode emitters, field emission

The relationship between the density of electron emitters and x-ray image quality has been investigated. Under diode mode, x-ray images have been successfully acquired even under 30kV of bias. The electron emitters were selectively patterned VACNTs. With respect to the inter-emitter pitch, even at the same electrical energy, different patterns showed different image qualities. By optimizing the CNT pattern, we expect that we can develop a high-resolution x-ray source without using additional focusing components.

Oral Presentation

[MEET2] EL Quantum Dots Technologies

Special Topics of Interest on Quantum Dot Technologies

Chair: Frank Yan (Fuzhou University)

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

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall (1F)

[MEET2-1(Invited)] Quantum Dot Electroluminescence to Achieve Saturated Colours for REC2020 Compatibility

*Poopathy Kathirgamanathan¹, Muttulingam Kumaravel¹ (1. Brunel University London (UK))

5:20 PM - 5:40 PM

[MEET2-3(Invited)] Ultra-Bright Quantum-Dot Light-Emitting Diodes

*Shuming Chen¹ (1. Southern University of Science and Technology (China))

6:00 PM - 6:20 PM

[MEET2-4(Invited)] Efficient and Stable Light Emitting Diodes Based on Luminescent Nanocrystals

*Kai Wang¹, Xiangtian Xiao^{1,2}, Zhaojin Wang¹, Taikang Ye¹ (1. Southern University of Science and Technology (China), 2. The University of Hong Kong (China))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-1(Invited)] Quantum Dot Electroluminescence to Achieve Saturated Colours for REC2020 Compatibility

*Poopathy Kathirgamanathan¹, Muttulingam Kumaravel¹ (1. Brunel University London (UK))

Keywords: Electroluminescent quantum dots, Cd Free Quantum Dots, InP/ZnS QDs, CdSe/ZnSe/ZnS QDs, QLEDs

Using solvent based surface engineering of sol-gel derived ZnO electron injector, red QLEDs with a current efficiency of

32.6 cdA⁻¹ and a power efficiency of 18.6 lmW⁻¹ at 1000 cdm⁻² for Cd based QDs. We also report dark red electroluminescent InP/ZnS QDs (x,y = 0.672, 0.325)) with a maximum current and power efficiency of 3.6 cdA⁻¹ and 4.7 lmW⁻¹ respectively.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-3(Invited)] Ultra-Bright Quantum-Dot Light-Emitting Diodes

*Shuming Chen¹ (1. Southern University of Science and Technology (China))

Keywords: quantum dot, light-emitting diodes, device structures, ultra-bright, thermal management

Thermal stability of quantum dots (QDs) and thermal management of QD light-emitting diodes (QLEDs) could significantly affect the performance, especially the efficiency roll-off behaviors of QLEDs. With effective thermal management, the efficiency roll-off is significantly suppressed and consequently our developed green QLEDs exhibit an unprecedented high brightness of over 10⁶ cd/m² at a current density of J=3500 mA/cm² and a external quantum efficiency of ~10%, which is an order of magnitude higher than that of all reported QLEDs.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Conference Hall)

[MEET2-4(Invited)] Efficient and Stable Light Emitting Diodes Based on Luminescent Nanocrystals

*Kai Wang¹, Xiangtian Xiao^{1,2}, Zhaojin Wang¹, Taikang Ye¹ (1. Southern University of Science and Technology (China), 2. The University of Hong Kong (China))

Keywords: Perovskite, Quantum dot, Light emitting diode, Stability

Efficiencies of electroluminescence perovskite LEDs were enhanced significantly by lowering surface defects and balancing charge injection. Moreover, optical and thermal stabilities of photoluminescence quantum dot LEDs and perovskite LEDs were also improved greatly by introducing the Quantum Dot Luminescent Micro-Sphere (QLuMiS) technology.

Oral Presentation

[FMC4/LCT4] Micro LED Display

Special Topics of Interest on Micro/Mini LEDs

Chair: K Kälantär (Global Optical Solutions)

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

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A (1F)

[FMC4/LCT4-1(Invited)] High-Resolution (1,000 to over 3,000 ppi) Full-Color "Silicon Display" for Augmented and Mixed Reality

*Hidenori Kawanishi¹, Hiroaki Onuma¹, Masumi Maegawa¹, Takashi Kurisu², Takashi Ono², Shigeyuki Akase¹, Shinji Yamaguchi¹, Naoto Momotani², Yusuke Fujita¹, Yuhei Kondo², Kentaro Kubota², Toshimi Yoshida¹, Yuta Ikawa¹, Tsuyoshi Ono², Hiroyoshi Higashisaka², Yasuaki Hirano², Shinsuke Anzai¹ (1. Sharp Fukuyama Semiconductor Co., Ltd. (Japan), 2. Sharp Fukuyama Laser Co., Ltd (Japan))

9:00 AM - 9:20 AM

[FMC4/LCT4-2(Invited)] A new generation of HDR display with super multi-zones mini LED

*Jianping Zheng¹, Zhuo Deng¹, Ling Wu¹, Poping Shen¹, Junyi Li¹, Jianmou Huang¹ (1. XiaMen Tianma Microelectronics Company, Ltd. (China))

9:20 AM - 9:40 AM

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

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

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

**[FMC4/LCT4-1(Invited)] High-Resolution (1,000 to over 3,000 ppi)
Full-Color "Silicon Display" for Augmented
and Mixed Reality**

*Hidenori Kawanishi¹, Hiroaki Onuma¹, Masumi Maegawa¹, Takashi Kurisu², Takashi Ono², Shigeyuki Akase¹, Shinji Yamaguchi¹, Naoto Momotani², Yusuke Fujita¹, Yuhei Kondo², Kentaro Kubota², Toshimi Yoshida¹, Yuta Ikawa¹, Tsuyoshi Ono², Hiroyoshi Higashisaka², Yasuaki Hirano², Shinsuke Anzai¹ (1. Sharp Fukuyama Semiconductor Co., Ltd. (Japan), 2. Sharp Fukuyama Laser Co., Ltd (Japan))

Keywords: microdisplay, colour-converted micro-LED, near to eye, quantum dot, high brightness

We present the status of III-nitride micro-LED display bonded onto silicon backplane. 0.38-inch full-colour display with a resolution of 1,053 ppi has been successfully demonstrated. Progress toward higher resolution is also described. We believe our "Silicon Display" is ideally suited for near-to-eye displays for augmented and mixed reality.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

**[FMC4/LCT4-2(Invited)] A new generation of HDR display with super
multi-zones mini LED**

*Jianping Zheng¹, Zhuo Deng¹, Ling Wu¹, Poping Shen¹, Junyi Li¹, Jianmou Huang¹ (1. XiaMen Tianma Microelectronics Company, Ltd. (China))

Keywords: HDR Display, LCD, Super multi-zones, mini LED

We propose a new generation of HDR display with active matrix mini-LED backlight for LCD. The display enables super multi-zones display by using new type of backlight drive, which achieved better contrast and less halo defect. Through both instrument test and perception experiments, we evaluated the performance of HDR LCD.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

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

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

Keywords: MicroLED, Optogenetics, GaN, wafer bonding

A micro light-emitting diodes (LED) has been attention as an optical stimulation tool for optogenetics. In this study, a needle-type microLED probe was fabricated for neuroscience. In addition, the monolithic integration of microLED and Si-MOSFET using wafer bonding technique was challenged toward the realization of multifunctional devices.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall A)

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

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

Keywords: Mini-LEDs, A-Si TFT, Backlight

In this work, we fabricate an active matrix mini-LEDs backlight based on a-Si. The driving mechanism with 2T1C and process flow are discussed in detail. IR-drop is analyzed and improved. The gray scale is controlled by PWM method with the number of 64 (6 bit), and the maximum brightness is up to 20,000nits.

Oral Presentation

[VHF5] Physiological and Psychophysical Factors

Chair: Hiroyasu Ujike (AIST)

Co-Chair: Masamitsu Harasawa (NHK)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A (1F)

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

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

5:20 PM - 5:45 PM

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

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

5:45 PM - 6:00 PM

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

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

6:05 PM - 6:25 PM

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

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

6:25 PM - 6:40 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

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

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

Keywords: Motion sickness, Autonomic nervous system, Nonlinear modeling, Video global motion

In this study, dynamic characteristics between image motion and severity of visually induced motion sickness (VIMS) was modeled as a Hammerstein model, which consists of a static nonlinear function followed by a linear system. The results indicate the change in subjective VIMS score may be estimated from image motions.

5:45 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

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

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

Keywords: Organic Light Emitting Diode (OLED), Exercise, Recovery, Heart rate

Today, various sports and competitions are performed under artificial lighting, whether indoors or outdoors. We studied if the color of the lighting affects athletic ability. Comparing orange light that did not contain melanopsin stimulating component, blue light rich in melanopsin stimulating components prompted heart rate (HR) recovery after submaximal exercise.

6:05 PM - 6:25 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

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

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

Keywords: Color development, Evolution, Immanent dichromatic, Color vision deficiency, MDS

Immanent dichromatic in color normal observers is investigated by MDS (Multidimensional-Scaling). The results show that (1) color-constellations yielded when observing R-G neutral- and Y-B only changed-stimuli strongly evidence concave-shaped like dichromatic, whereas (2) those gained when observing Y-B

neutral- and R-G only changed-stimuli evidence oval-shape of saturation-brightness.

6:25 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Mid-sized Hall A)

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

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

Keywords: self-driving, visual induced motion sickness, driving tasks

We investigated how the effect of motion sickness on the succession of the driving tasks of the car by conducting two experiments. The results of experiment 1 suggested that the seriousness of motion sickness in no driving tasks condition was higher than that in driving tasks condition.

Oral Presentation

[AMD4] Emerging TFTs

Chair: Hyun Jae Kim (Yonsei Univ.)

Co-Chair: Yosei Shibata (Tohoku Univ.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B (1F)

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

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

9:00 AM - 9:25 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:05 AM

[AMD4-5L] Improving Performances of Oxide Phototransistors Using a Mechano-Chemically Treated Porous Structure as The Visible Light Absorption Layer

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

10:05 AM - 10:20 AM

9:00 AM - 9:25 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

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

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

Keywords: Flexible LED display, Organic active matrix, Organic TFT, Large-area display

A newly developed technologies of flexible active-matrix mini-LED displays are presented. The backplane is based on high-performance organic single-crystal TFTs laminated on screen-printed large-area plastic substrates. The devices are suited to the application for large-area signages.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

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

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

Keywords: Printed Electronics, Organic thin-film transistors, Metal nanoparticles

We propose a large-scale fabrication method of electronic devices based on solution-processed coating and printing. This method relies on bottom-up printing processes using soluble metal nanoparticles and organic semiconductors, resulting in thin-film electronic devices to be printed at room temperature without application of heat. We successfully fabricated high-performance organic thin-film transistors on plastic and paper substrates. In addition, the printing technique with 1-micron line width and space was also achieved. Our fabrication method is very promising for low-cost fabrication of high-resolution flexible electronics.

9:50 AM - 10:05 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

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

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

Keywords: LTPS TFTs, Hybrid Backplane, LTPO

A novel Four-Photomask complementary metal oxide semiconductor (CMOS) technology for low temperature polycrystalline silicon (poly-Si) thin film transistors (LTPS TFTs) was proposed in the first time. The combination of poly-Si layer and P plus (P+) region definitions within one lithography process was realized by a half-tone photomask. In this paper, the characteristics of TFTs within a half-tone Poly-Si Photomask of lithography processes were reported and compared with electrical characteristics of typical Six-Photomask lithography processes. The Integrated Poly-Si Photomask Technology can be applied to reduce the numbers of photomask of making an IGZO and LTPS Hybrid TFTs Array.

10:05 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Mid-sized Hall B)

[AMD4-5L] Improving Performances of Oxide Phototransistors Using a Mechano-Chemically Treated Porous Structure as The Visible Light Absorption Layer

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

Keywords: Oxide TFT, Photosensor, Visible light, Mechano-chemical treatment

In this research, we suggest indium gallium zinc oxide (IGZO) thin film transistors (TFTs) for detection of visible light using a porous oxide layer (POL) resulting from mechano-chemical treatment. When compared with conventional IGZO TFT, the IGZO TFT with the POL exhibits photoresponsivity of 341.32 A/W, photosensitivity of 1.10×10^6 , and detectivity of 4.54×10^{10} Jones under 532 nm light illumination.

Oral Presentation

[FLX2] Stretchable and Flexible Devices

Chair: Manabu Ito (Toppan Printing Co.)

Co-Chair: Mitsuru Nakata (NHK)

Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B (1F)

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

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

5:20 PM - 5:45 PM

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

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

5:45 PM - 6:10 PM

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

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

6:10 PM - 6:30 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

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

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

Keywords: flexible and stretchable epoxy films, excellent thermal stability and physical properties, printability of conductive inks with no surface treatment, high optical transparency with low retardation, recommended substrate for FHE, 3D wirings, flexible displays, wearable sensors or medical electronics

Authors developed two types of novel epoxy films with excellent printability for conductive or dielectric inks without surface treatments. High flexible type shows high durability against repeated folding. Stretchable type shows high elongation and recovery. These are recommendable for substrates of FHE, foldable displays or lighting devices, stretchable/wearable sensors, etc.

5:45 PM - 6:10 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

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

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

Keywords: Stretchable Electronics, Polymer Dielectric, TFT, Bendable, IGT0

Flexible/stretchable active-matrix electronics strongly demand the design of new concept material, which should have the good electrical properties and mechanical durability. In this paper, we will address the design of hybrid dielectric film, which consists of the polymer-based backbone and high permittivity additive. By virtue of smart cross linker selection, we are able to achieve the high performance oxide transistor with the hybrid polymer gate dielectric film. The fabricated transistors can withstand the 100 times mechanical bending stress under an extremely small curvature radius of 1mm. Simultaneously, they exhibit the high mobility of $>20 \text{ cm}^2/\text{Vs}$ and $I_{\text{ON/OFF}}$ ratio of $>10^7$, indicating that this approach can be one of the ways for the highly mechanically stable electronics.

6:10 PM - 6:30 PM (Thu. Nov 28, 2019 5:20 PM - 6:30 PM Mid-sized Hall B)

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

*Nian Liu¹, Huafei Xie², Macai Lu¹, Xueru Mei¹, Lei Wen¹, 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))

Keywords: IGZO, Flexible Display, Polyimide, Thin-Film Transistor, Micro LED

We discussed the effect of polyimide substrate on TFTs, the water from polyimide diffused into IGZO which deteriorated device characteristic. By reducing hydrogen content in GI we optimized device characteristic, and GI 1step deposition is more stable. Finally, we did the static bending and dynamic test, TFTs keep good stability.

Oral Presentation

[EP2/DES4] Advanced Electronic Paper Displays and Systems

Chair: Norihisa Kobayashi (Chiba Univ.)

Co-Chair: Haruhiko Okumura (Toshiba)

Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107 (1F)

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

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

9:00 AM - 9:20 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:15 AM

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

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

10:15 AM - 10:35 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

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

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

Keywords: reflective LCD, VA, MRS, IGZO, 1Hz drive

We have developed a reflective LCD with full color video image and low power consumption. 22-inch and 11-inch prototype have achieved excellent optical properties and flicker-less 1Hz driving by a new twisted VA-LC mode, reliable materials, an optimal electrode design with micro reflective structure (MRS), and IGZO-TFT technology.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

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

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

Keywords: reflective displays, electro-wetting display technology, digital out of home displays, sunlight readability, energy consumption

Etulipa develops reflective digital displays for out of home advertisement using electro-wetting display technology. The black and white character application for electronic changeable copy boards is tested in the field. A matrix panel has been developed for full color displays. The panel has been designed for a seamless experience.

9:50 AM - 10:15 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

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

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

Keywords: e-paper , color , specification , gamut , subtractive

E-paper has been approached as a "normal" display, and measurements are based on measurements as used for emissive displays, or at the very best reflective monochrome LCD. This may be adequate for grayscale e-paper displays, but as soon as color is added, these metrics are no longer suitable. This paper introduces a better way to evaluate color e-paper displays.

10:15 AM - 10:35 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 107)

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

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

Keywords: electrowetting display, driving system, driving waveform

In order to play video in real time of electrowetting display, a display driving system which included a DVI video codec system and FPGA timing control system was designed. The paper also proposed an improved multi-gray scales dynamic symmetrical driving waveform, which improved the oil-splitting phenomenon and suppressed the charge-trapping phenomenon while increasing the gray level.

Oral Presentation

[EP3] Electrochromic Devices

Chair: Shuichi Maeda (Tokai University)

Co-Chair: Yoshihiko Hotta (Ricoh)

Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107 (1F)

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

*Masayoshi Higuchi¹, Yukio Fijii¹, Shigeki Kuroiwa², Keishi Ohashi², Yoshiharu Hamada³, Akihiko Kubota³ (1. National Institute for Materials Science (Japan), 2. Waseda University (Japan), 3. Tama Art University (Japan))

5:20 PM - 5:35 PM

[EP3-2L] Optimization of Prussian Blue Modified Counter Electrode in Ag Deposition-based Electrochromic Device

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

5:35 PM - 5:50 PM

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

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

5:50 PM - 6:05 PM

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

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

6:05 PM - 6:20 PM

5:20 PM - 5:35 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

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

*Masayoshi Higuchi¹, Yukio Fijii¹, Shigeki Kuroiwa², Keishi Ohashi², Yoshiharu Hamada³, Akihiko Kubota³
(1. National Institute for Materials Science (Japan), 2. Waseda University (Japan), 3. Tama Art University (Japan))

Keywords: metallo-supramolecular polymer, electrochromic device, product design, nature-inspiration

Nature-inspired flexible electrochromic devices have been fabricated using electrochromic metallo-supramolecular polymer for the first time in the world. The use of Ru(II)-based polymer, which changes the color between red and green, and the multi-layer coating method have enabled to reproduce the nature of a real fallen leaf by the devices.

5:35 PM - 5:50 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

[EP3-2L] Optimization of Prussian Blue Modified Counter Electrode in Ag Deposition-based Electrochromic Device

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

Keywords: Electrochromism, Silver, Electrodeposition, Smart window, Electronic paper

Prussian blue modified electrode was introduced into Ag deposition-based electrochromic (EC) device as the counter-reaction material for charge compensation of Ag redox. We discuss the bi-stability of the optical states and desirable features of Prussian blue film for metal deposition based EC device.

5:50 PM - 6:05 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

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

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

We have already reported a novel multicolor electrochromism in a single device by introducing a porous counter electrode having high capacitance. In this paper, we investigated the effect of capacitance properties of the counter electrode into coloration properties of 10-methylphenothiazine molecule.

6:05 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:20 PM Room 107)

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

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

Keywords: Electrochromic device, Metallo-supramolecular polymer, Low voltage , Cyclic stability

Ultrahigh cycle stability more than 100,000 cycles has been achieved in an electrochromic device with an Fe(II)-based metallo-supramolecular polymer layer and a modified counter electrode layer. The reversible color change between bluish-violet and colorless occurred at low applied voltages and the transmittance change reached >60%.

Oral Presentation

[PRJ2] Optical Components

Chair: Hidekazu Hatanaka (USHIO)

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

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108 (1F)

[PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes

*Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiisa Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyoda Gosei Co., Ltd. (Japan))

9:00 AM - 9:20 AM

[PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays

Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway (Norway))

9:20 AM - 9:40 AM

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

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

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-1(Invited)] Watt-class Operation of GaN-based Blue and Green Laser Diodes

*Hideki Watanabe¹, Yusuke Nakayama¹, Yukio Hoshina¹, Masahiro Murayama¹, Yuichiro Kikuchi², Yukihiisa Kogure², Yasuhiro Kadowaki², Koichi Mizutani³, Takahiro Koyama¹, Noriyuki Fuutagawa¹, Hidekazu Kawanishi¹, Toshiya Uemura³, Katsunori Yanashima¹ (1. Sony Corporation (Japan), 2. Sony Semiconductor Manufacturing Corporation (Japan), 3. Toyoda Gosei Co., Ltd. (Japan))

Keywords: Visible laser diodes, High power, GaN, Projector

Visible laser diodes have recently attracted a great deal of attention as light sources for various display and lighting applications. In this paper, recent progress in green and blue lasers developed at Sony, which realize watt-class output power, are reported.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

[PRJ2-2] Laser Beam Modulation with a Fast Focus Tunable Lens for Speckle Reduction in Laser Projection Displays

Zequn Jian¹, *Zhaomin Tong¹, Yifei Ma¹, Mei Wang¹, Suotang Jia¹, Xuyuan Chen^{1,2} (1. Shanxi University (China), 2. University of Southeast Norway (Norway))

Keywords: speckle reduction, focus tunable lens, angular diversity, spatial diversity

We propose a laser speckle reduction method using a fast focus tunable lens (FTL). Different laser beams are generated after modulating the FTL. Thus, when the laser beams are used to illuminate a diffuser, various speckle images are obtained, and the summed speckle images yield a speckle image with reduced speckle contrast ratio.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

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

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

Keywords: DLP Projection System, Large Area Displays, Total Internal Reflection Prism

Two different types of the achromatic TIR prism set are designed to mini projector. Type1 prism set is the first prism with a small Abbe number material stacked with the second prism with a large Abbe number material. Type2 prism set is an opposite design to Type1 prism set.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Room 108)

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

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

Keywords: red laser, laser projector, speckle reduction, wall plug efficiency, tensile strain

We developed 638nm and 642nm red laser diodes with 3.5W pulse / 2.4W CW operation. The 3.5W pulsed operation and wall plug efficiency of 43% are the world's highest in 638nm to the best of our knowledge. The lineups of multiple wavelengths are ideal as red light sources for projector.

Oral Presentation

[PRJ3] Image Quality and Display Devices

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Andrés Vásquez Quintero (University of Ghent)

Co-Chair: Tetsuji Suzuki (JVC KENWOOD)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108 (1F)

[PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications

*Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))

5:20 PM - 5:40 PM

[PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology

*Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))

5:40 PM - 6:00 PM

[PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module

*Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))

6:00 PM - 6:20 PM

[PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects

*Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-1(Invited)] Fast switching, high accuracy LCoS for 3D holographic applications

*Huang-Ming Philip Chen¹, Jhou-Pu Yang¹, Yao-Chung Chang¹ (1. National Chiao Tung University (Taiwan))

Keywords: Liquid crystal on silicon, spatial light modulator, holography, virtual and augmented reality display

A 0.7-inch, 4K2K LCoS-SLM with full 2π radians phase modulation to cover depth-focus image was developed. The full phase modulation was found 0.9 and 1.5 ms under the digital driving scheme with $DV = 1.75$ V at $T=45$ °C. A 200 mm depth of 3D reconstruction holographic image was demonstrated.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-2(Invited)] High Resolution Phase-only 4K2K LCoS Spatial Light Modulator for Holographic Display Technology

*Chun-Wei Tsai¹, Tse Li¹, Chen Wang¹ (1. Jasper Display Corp. (JDC) (Taiwan))

Keywords: Liquid Crystal on Silicon (LCoS), Spatial Light Modulator (SLM), Holographic Display, 4K2K

High resolution, full phase modulation, small pixel pitch, high aperture ratio, and fast response time are the requirements to enhance the quality of holographic display by using the LCoS-SLM. In this paper, we develop a 3D floating holographic display and to increase the angle of view as 36.67 degree with high resolution phase-only 4K2K LCoS-SLM.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-3] Temperature Dependence Measurement of Color Speckle for Projected Fiber-out White Laser Beam from RGB Laser Module

*Junichi Kinoshita¹, Keizo Ochi¹, Akira Takamori¹, Kazuhisa Yamamoto¹, Kazuo Kuroda², Koji Suzuki³, Keisuke Hieda⁴ (1. Osaka University (Japan), 2. Utsunomiya University (Japan), 3. Oxide Corporation (Japan), 4. HIOKI.E.E.CORPORATION (Japan))

Keywords: laser module, color speckle, far field pattern, fiber, laser display

Temperature dependence of color speckle of the projected image of a fiber-out white laser beam from a laser module with red, green, blue laser diodes was measured. Larger temperature dependence of the red laser diode was found to greatly affect the performance of the white beam and color-speckle.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 108)

[PRJ3-4] Standardization Activities for Head-Mounted Displays from Ergonomics Aspects

*Kei Hyodo¹, Hiroyasu Ujike², Mitsunori Tada² (1. Yuasa System Co. Ltd. (Japan), 2. AIST (Japan))

Keywords: Head-mounted displays, ergonomics, Optical properties, Standardization

As novel display devices, head-mounted displays (HMD) are getting popular. These devices have unique characteristics. Because of those, there are immediate requirements of having standards to evaluate those HMDs to avoid unwanted impacts to viewers. In order to answer those, ISO TC 159/SC4/WG2 and WG12 started developing standards for HMDs.

Oral Presentation

[3DSA5/3D5] Light Field 2

Chair: Jung-Young Son (Konyang Univ.)

Co-Chair: Munekazu Date (NTT)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall (2F)

[3DSA5/3D5-1] An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom

*Sangwoon Kwak¹, Joungil Yun¹, Won-Sik Cheong¹, Jeongil Seo¹ (1. ETRI (Korea))

5:20 PM - 5:40 PM

[3DSA5/3D5-2] GPU-Accelerated Interactive Virtual View Synthesis from Light Field Images

*Hyeonjin Jung¹, Joungil Yun², Won-Sik Cheong², Youngmin Yi¹ (1. University of Seoul (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

5:40 PM - 6:00 PM

[3DSA5/3D5-3] Accommodation Response to a Super-Multiview Display Based on Time-Division Multiplexing Parallax Barrier

*Yuta Watanabe¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:00 PM - 6:20 PM

[3DSA5/3D5-4] An Autostereoscopic Display with Time-Multiplexed Directional Backlight Using a Curved Lens Array

*Garimagai Borjigin¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-1] An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom

*Sangwoon Kwak¹, Joungil Yun¹, Won-Sik Cheong¹, Jeongil Seo¹ (1. ETRI (Korea))

Keywords: View Synthesis, Light Field, Virtual Reality, 6DoF

In this paper, virtual view synthesis of sparse light field images is considered. We analyze the patch-wise 3D warping and blending methods of the conventional view synthesis, and propose an improved algorithm for supporting 6DoF. We suggest an enhancement for the super-pixel and additional blending weights, and present experimental results using multi-view contents of MPEG.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-2] GPU-Accelerated Interactive Virtual View Synthesis from Light Field Images

*Hyeonjin Jung¹, Joungil Yun², Won-Sik Cheong², Youngmin Yi¹ (1. University of Seoul (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

Keywords: Light Field, View Synthesis, GPU, CUDA

We present a GPU based acceleration of a virtual view synthesis from multiple Light Field images. For the synthesis of a 2K virtual view from 24 images of the same resolution, we achieved 21.31 FPS using four Titan V GPUs with algorithmic optimizations, which corresponds 923 times of speedup.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-3] Accommodation Response to a Super-Multiview Display Based on Time-Division Multiplexing Parallax Barrier

*Yuta Watanabe¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Time-division parallax barrier, Super-multiview, Accommodation response

We have measured the focal accommodation response of viewers to a dense light field generated by time-division sextuplexing parallax barriers. We have confirmed that focal accommodation in front of or behind the display screen is induced as expected.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Small Hall)

[3DSA5/3D5-4] An Autostereoscopic Display with Time-Multiplexed Directional Backlight Using a Curved Lens Array

*Garimagai Borjigin¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Autostereoscopy, Curved Lens array, Crosstalk level, Time-division multiplexing, Directional light

We propose an autostereoscopic display with a curved directional backlight unit. The proposed backlight unit composed of a curved lens array and dot-matrix light sources suppresses the influence of filed curvature. Thus the crosstalk level is reduced without adding an additional layer of lens.

Oral Presentation

[3D4/VHF4/3DSA4] Illusion

Chair: Sumio Yano (Shimane University)

Co-Chair: Yuzo Hisatake (Shizuoka Univ.)

Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall (2F)

[3D4/VHF4/3DSA4-1(Invited)] Innovative mobile force display: Buru-Navi

*Hiroaki Gomi¹, Sho Ito¹, Ryoma Tanase¹ (1. NTT Communication Science Labs. (Japan))

9:00 AM - 9:20 AM

[3D4/VHF4/3DSA4-2(Invited)] Displaying Deformation of Virtual Objects Using Visuo-Haptic Interaction

*Yuki Ban¹ (1. The University of Tokyo (Japan))

9:20 AM - 9:40 AM

[3D4/VHF4/3DSA4-3(Invited)] Real-World Implementations of Visual Illusions by Using Augmented Reality Techniques

*Takahiro Kawabe¹ (1. NTT Communication Science Laboratories (Japan))

9:40 AM - 10:00 AM

[3D4/VHF4/3DSA4-4] Gloss Enhancement beyond Projector Performance using the Glare Illusion

*Shinji Nagata¹, Toshiyuki Amano¹ (1. Wakayama University (Japan))

10:00 AM - 10:20 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-1(Invited)] Innovative mobile force display: Buru-Navi

*Hiroaki Gomi¹, Sho Ito¹, Ryoma Tanase¹ (1. NTT Communication Science Labs. (Japan))

Keywords: tactile navigation, directional sensation, virtual reality, multisensory integration, force feedback

Humans capture the environmental world not only by vision but also by somatosensory information. Here we introduce several types of mobile force-display gadgets 'Buru-Navi' recently developed, and showcase some application trials for pedestrian navigation and for enhancing immersive sensation along a video scene.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-2(Invited)] Displaying Deformation of Virtual Objects Using Visuo-Haptic Interaction

*Yuki Ban¹ (1. The University of Tokyo (Japan))

Keywords: Visuo-haptic Interaction, Object Deforming, Virtual Reality

We developed the visuo-haptic shape display system with which users can deform virtual objects dynamically. Our system senses how the force is applied to the grasping object, and deforms the virtual grasping object and the virtual hands according to the direction and size of the force.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-3(Invited)] Real-World Implementations of Visual Illusions by Using Augmented Reality Techniques

*Takahiro Kawabe¹ (1. NTT Communication Science Laboratories (Japan))

Keywords: Human vision, Illusion, Information presentation technique, Cast shadow, Motion perception

Visual illusions refer to perceptual experiences wherein the appearance of objects and scenes is distorted. By taking advantage of the illusion which is often interpreted as undesired elements in perception, our technique can offer visual experiences which are not produced on the basis of the previous techniques.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:20 AM Small Hall)

[3D4/VHF4/3DSA4-4] Gloss Enhancement beyond Projector Performance using the Glare Illusion

*Shinji Nagata¹, Toshiyuki Amano¹ (1. Wakayama University (Japan))

Keywords: Glare illusion, Spatial augmented reality, Gloss, Projector

The glare illusion is a well-known illusory perception in which a region appears brighter than its actual luminance when surrounded by a gradation of luminance. We propose a method of enhancing gloss beyond projector performance using this glare illusion. The effectiveness of the proposed method is confirmed by comparing it with the proposed and conventional method.

Oral Presentation

[OLED4] QD Material & Devices

Special Topics of Interest on Quantum Dot Technologies

Chair: Takeo Wakimoto (Merck Performance Materials)

Co-Chair: Toshiaki Ikuta (JNC Corp.)

Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204 (2F)

[OLED4-1(Invited)] Anion Exchange Perovskite Quantum-Dots for Highly Efficient Light Emitting Devices

*Takayuki Chiba¹, Junji Kido¹ (1. Yamagata University (Japan))

9:00 AM - 9:20 AM

[OLED4-2(Invited)] Efficient Perovskite Light-Emitting Diodes Enabled by Synergetic Device Architecture

Yanqing Li¹, Yang Shen¹, *Jianxin Tang¹ (1. Soochow University (China))

9:20 AM - 9:40 AM

[OLED4-3] "Efficient Indium Phosphate based Quantum Dot Light Emitting Diode using Sol-gel processed Electron Transfer Layer"

*Ji Eun Yeom¹, Dong Hyun Shin¹, Mude Nagarjuna Naik¹, Raju Lampande¹, Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

9:40 AM - 10:00 AM

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

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

10:00 AM - 10:20 AM

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

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

10:20 AM - 10:35 AM

9:00 AM - 9:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-1(Invited)] Anion Exchange Perovskite Quantum-Dots for Highly Efficient Light Emitting Devices

*Takayuki Chiba¹, Junji Kido¹ (1. Yamagata University (Japan))

Keywords: Perovskite, Quantum-dots, Ligand exchange, Anion-exchange, LED

Perovskites quantum dots have attracted much attention for used in display and lighting applications, owing to their narrow band emission with high photoluminescence quantum yields, color tunability, and solution processability. Here, we demonstrate ligand-exchange and anion-exchange perovskite quantum dots using ammonium salts for use in highly efficient light-emitting devices.

9:20 AM - 9:40 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-2(Invited)] Efficient Perovskite Light-Emitting Diodes Enabled by Synergetic Device Architecture

Yanqing Li¹, Yang Shen¹, *Jianxin Tang¹ (1. Soochow University (China))

Keywords: Perovskite light-emitting diodes, CsPbBr₃, light outcoupling, moth-eye nanostructures

In this work, we demonstrated a facile route was realized by combining bioinspired moth-eye nanostructures and half-ball lens to enhance light outcoupling. As a result, the maximum external quantum efficiency of green perovskite light-emitting diodes was improved to 28.2%, which represented a substantial step toward achieving practical applications of PeLEDs.

9:40 AM - 10:00 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

[OLED4-3] " Efficient Indium Phosphate based Quantum Dot Light Emitting Diode using Sol-gel processed Electron Transfer Layer"

*Ji Eun Yeom¹, Dong Hyun Shin¹, Mude Nagarjuna Naik¹, Raju Lampande¹, Jang Hyuk Kwon¹ (1. Kyung Hee University (Korea))

Keywords: QLED, Quantum dot, Inverted structure, InP-QD

Here, we report an efficient indium phosphate (InP) based inverted red Quantum Dot-Light Emitting Diodes (QLEDs) by incorporating a sol-gel processed Mg-doped ZnO layer. The red InP-QLED with our sol-gel processed Mg:ZnO layer reveals a maximum EQE of 7.7% , which is significantly higher than the ZnO and Mg:ZnO nanoparticles layers. These results suggest that the sol-gel processed Mg-doped ZnO layer is relatively efficient in terms of performances.

10:00 AM - 10:20 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

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

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

Keywords: Ambient Contrast Ratio, Quantum dot, Circular polarizer

Quantum dots are promising color conversion materials to achieve high resolution full color display with wide color gamut and low cost. In this work, we studied the ambient contrast ratio of QD-OLED devices and demonstrated an optimal structure to realize high contrast displays

10:20 AM - 10:35 AM (Thu. Nov 28, 2019 9:00 AM - 10:35 AM Room 204)

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

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

Keywords: InGaN, Light Emitting Diode (LED), Organic LED (OLED), Quantum Dots (QDs), Blue

A soluble form of InGaN was synthesized, producing a solution that exhibited blue photo-luminescence (PL) upon UV light exposure. This solution was used in the fabrication of a blue light-emitting diode (LED) that was produced using solution processable methods, a world first for an InGaN-base LED. The PL properties of the solution and the electro-luminescence (EL) and device characteristics of the LED are presented.

Oral Presentation

[OLED5] OLED Optical Design

Chair: Yasunori Kijima (Huawei Technologies Japan K. K.)

Co-Chair: kengo Kishino (idemitsu Kosan Co, Ltd.)

Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204 (2F)

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

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

5:20 PM - 5:40 PM

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

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

5:40 PM - 6:00 PM

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

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

6:00 PM - 6:20 PM

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

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

6:20 PM - 6:40 PM

5:20 PM - 5:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

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

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

Keywords: AMOLED, Cathode, Patterning, Transparent, Under Display Sensor

Patterning of the cathode layer in top-emission AMOLED displays has been a technological barrier to realize both large area top emission AMOLED displays, and high transparency AMOLED displays. Using ConducoTorr(TM) Electrode materials we demonstrate the first mass production ready cathode patterning process in a high-resolution OLED using self-assembly.

5:40 PM - 6:00 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

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

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

Keywords: ITO free, Transparent electrode, Thermal evaporation

Herein, we report a new organic/Ag/organic (OAO) multilayer flexible transparent electrode fabricated a thermal evaporation process. This OAO electrode showed superior optical and electrical characteristics of which transmittance of 81.34% at 550 nm wavelength and low sheet resistance of 9.51 Ω/sq . Its flexible reliability is also very excellent as sheet resistance variation at the radius of curvature of 5 mm with bending cycles of 2,000 is negligible. Fabricated green phosphorescent organic light emitting diodes with this OAO electrode showed high current efficiency of 75.1 cd/A.

6:00 PM - 6:20 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

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

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

Keywords: Metallic Nanostructure, Color Filter, White OLED, Color Conversion Material (CCM)

We have designed and optimized the geometric parameters of metallic nanostructure with color conversion material as a color filter for whiteOLED display to enhance the optical efficiency. Optical intensity of red and green light in whiteOLED was increased by 73.0% and 29.1%, respectively after applying metallic nanostructure with quantum-dot materials.

6:20 PM - 6:40 PM (Thu. Nov 28, 2019 5:20 PM - 6:40 PM Room 204)

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

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

Keywords: light extraction, viewing angle, TEOLED

We fabricated the nano-structure applicable for a highly efficient and color stable TEOLED by using thermal evaporation and organic vapor phase deposition, respectively. The nano-structure integrated TEOLEDs showed efficiency increase by 12% (thermal evaporation) and 32% (OVPD), respectively. The $\Delta(u' v')$ from normal direction to 30° were 0.06 and 0.03, respectively.

Oral Presentation

[INP3] Haptic Technologies (1)

Special Topics of Interest on Automotive Displays

Chair: Makoto Sato (Tokyo Institute of Technology)

Co-Chair: Nobuyuki Hashimoto (Citizen)

Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206 (2F)

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

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

9:00 AM - 9:25 AM

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

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

9:25 AM - 9:50 AM

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

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

9:50 AM - 10:15 AM

9:00 AM - 9:25 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

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

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

Keywords: Haptic Display, Wearable Device, Hapbeat, Music Listening, Virtual Reality

Hapbeat is a wearable haptic device which can easily enhance the immersion of digital contents such as VR, gaming, music, movie, etc. In this paper, I explain a basic mechanism of Hapbeat and a series of challenges to widespread it into the public.

9:25 AM - 9:50 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

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

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

Keywords: Haptics, User experience, Wearable computing, Interaction design

We have developed a haptic system, Comptics, that enables easy and rapid making, playing, and sharing of haptic experience. Comptics is composed of a haptic stimulation device, wearable user interface, and design and communication protocols (DCP) on a computer that uses unhearable signals.

9:50 AM - 10:15 AM (Thu. Nov 28, 2019 9:00 AM - 10:15 AM Room 206)

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

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

Keywords: Haptic feedback, Skin stretch device, Driving Simulator

A new concept of buttock skin stretch to induce the perception of shear forces while sitting is reported. The buttock skin stretch is suitable for a driving simulator to enhance the whole-body experiences such as the centrifugal force of the car and the inclination of the car body in driving.

Oral Presentation

[INP4] Haptic Technologies (2)

Special Topics of Interest on Automotive Displays

Chair: Masashi Konyo (Tohoku University)

Co-Chair: Vibol Yem (Tokyo Metropolitan University)

Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206 (2F)

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

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

5:20 PM - 5:45 PM

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

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

5:45 PM - 6:10 PM

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

*Ki-Uk Kyung¹ (1. KAIST (Korea))

6:10 PM - 6:35 PM

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

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

6:35 PM - 6:50 PM

5:20 PM - 5:45 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

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

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

Keywords: Haptic, Illusion, Neuro Science, Design, VR

'DigitalHaptics™' is the world first invention of illusionary haptics technology, developed originally by AIST based on Neuro Science. It realized many miracle haptics such as Pushing, Pulling, Texture, and Softness in the Air, and theoretically enables the almost all kinds of haptic feeling, as same as visual composition of RGB.

5:45 PM - 6:10 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

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

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

Keywords: Tactile device, Fingertip, Wearable device, Virtual world

Author developed a wearable tactile device mounted to the fingertips for interaction with objects in the virtual environment. The device can provide sensations of pressure, low-frequency vibration and forward-flexion illusionary force in thumb, index and middle fingers by electrical stimulation; and high-frequency vibration and skin deformation by mechanical stimulation.

6:10 PM - 6:35 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

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

*Ki-Uk Kyung¹ (1. KAIST (Korea))

Keywords: sensor, flexible, actuator, EAP, haptic

This talk will introduce recent technologies for polymer based sensors and actuators. Polymer based tactile sensors support functions of detecting multiple contact forces as well as touch positions. Flexible actuators may provide haptic cues to users.

6:35 PM - 6:50 PM (Thu. Nov 28, 2019 5:20 PM - 6:50 PM Room 206)

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

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

Keywords: tactile display, electrostatic, segmented-electrode, free-shaped tactile sensation

We developed an electrostatic-tactile touch display using a segmented-electrode array as both tactile pixels and touch sensors. This structure allows presenting real localized tactile textures in any shape. A driving scheme in which the tactile strength is independent of the grounding state of the human body was also demonstrated.