2017 IEEE Electron Devices Technology and Manufacturing Conference (EDTM 2017)

Toyama, Japan
28 February - 2 March 2017

IEEE Catalog Number: CFP17J58-POD
ISBN: 978-1-5090-4661-4

Copyright © 2017 by the Institute of Electrical and Electronics Engineers, Inc
All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number: CFP17J58-POD
ISBN (Print-On-Demand): 978-1-5090-4661-4
ISBN (Online): 978-1-5090-4660-7

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

2017 IEEE Electron Devices Technology and Manufacturing Conference (EDTM)

Wednesday, March 1
Main Hall, 3F

8:30-9:00 Opening

Opening Remarks, Shuji Ikeda, EDTM 2017 General Chair, tei SOLUTIONS Inc.

9:00-11:00 Plenary Session

Chair: H. Wakabayashi, Tokyo Institute of Technology

PL-1 9:00-9:40 (Invited)
Dimensions of Innovation to Enable the Next Era of Intelligent Systems, John G. Pellerin, GLOBALFOUNDRIES Inc. 1

PL-2 9:40-10:20 (Invited)
Flexible and Printed OTFT Devices for Emerging Electronic Applications, Shizuo Tokito, Yamagata University 2

PL-3 10:20-11:00 (Invited)
Advanced Heterogeneous Integration Technology Trend for Cloud and Edge, Douglas C. H. Yu, Taiwan Semiconductor Manufacturing Company 4

11:00-12:00 Exhibition Talks

Chairs: K. Ishimaru, Toshiba Corporation
R. Arghavani, Lam Research Corporation

Ex-1 Hitachi Kokusai Electric Inc.
Ex-2 Toshiba Corporation, Storage & Electronic Devices Solutions Company
Ex-3 Atomera Inc.
Ex-4 National Institute of Advanced Industrial Science and Technology (AIST)
Ex-5 TowerJazz Panasonic Semiconductor Co., Ltd.
Ex-6 Yokogawa Solution Service Corporation

13:35-15:40 Session 3M - Emerging: Emerging Technologies

Chairs: B. Zhao, ON Semiconductor
H. Akinaga, AIST

3M-1 13:35-14:00 (Invited)
Future Computing Devices – Excitation, Physarum, Fluerics, Actin, Andrew Adamatzky, University of the West of England, Bristol .... N/A

3M-2 14:00-14:25 (Invited)
Neuromorphic Technologies for Next-Generation Cognitive Computing, Robert M. Shelby[1], Pritish Narayanan[1], Stefano Ambrogio[1], Hsinyu Tsai[1], Kohji Hosokawa[2], Scott C. Lewis[3], and Geoffrey W. Burr[1], [1]IBM Research-Almaden, [2]IBM Tokyo Research Laboratory, [3]IBM T. J. Watson Research Center 8

3M-3 14:25-14:50 (Invited)
Stateful Logic Circuit and Material Using Memristors, Nuo Xu[1,2], Xinglong Shao[1], Kyung Jean Yoon[1], Hae Jin Kim[1], Kyung Min Kim[3], and Cheol Seong Hwang[1], [1]Seoul National University, [2]National University of Defense Technology, [3]Hewlett Packard Enterprise 10

3M-4 14:50-15:15 (Invited)
New-Paradigm CMOS Ising Computing for Combinatorial Optimization Problems, Masanao Yamaoka, Hitachi, Ltd. 13

3M-5 15:15-15:40 (Invited)
Understanding the Limit and Potential in Emerging Perovskite Solar Cells, Wolfgang Tress and Michael Graetzel, Swiss Federal Institute of Technology (EPFL) 15

Wednesday, March 1
Room A (201+202), 2F

13:35-15:15 Session 3A - Process: Process Technology for Advanced Devices

Chairs: J. Yugami, Hitachi Kokusai Electric Inc.
X. Guo, Shanghai Jiao Tong University

3A-1 13:35-14:00 (Invited)
The Impact of Fin Number on Device's Performance and Reliability in Tri-Gate FinFETs, Wen-Kuan Yeh[1,2], Po-Ying Chen[3], Chia-Hung Shih[4], Wenqi Zhang[1], and Yi-Lin Yang[5], [1]National University of Kaohsiung, [2]National Applied Research Laboratories, [3]National Chin-Yi University of Technology, [4]National Pingtung University, [5]National Kaohsiung Normal University 17

3A-2 14:00-14:25
Impact of e-SiGe S/D Processes on FinFET PFET TDDB Reliability, R. Ranjan, S. Uppal, H. Yu, B. Parameshwaran, T. Nigam, A. Kerber, C. LaRow, and M. I. Natarajan, GLOBALFOUNDRIES Inc. 20

3A-3 14:25-14:50
In Content Dependence of Pre-Treatment Effects on Al_2O_3/In_xGa_{1-x} as MOS Interface Properties, C. Yokoyama, C.-Y. Chang, M. Takenaka, and S. Takagi, The University of Tokyo 23

3A-4 14:50-15:15
Deep Junction by Low Thermal Budget Process for Advanced Si Power Electronics, Inès Toqué-Trésonne, Toshiyuki Tabata, Sébastien Halty, Fulvio Mazzamuto, Karim Huet, and Yoshihiro Mori, SCREEN Semiconductor Solutions Co., Ltd 26

Wednesday, March 1
Room B (203+204), 2F

13:35-15:40 Session 3B - Modeling: Reliability Analysis

Chairs: A. Oates, TSMC
S. Koul, Indian Institute of Technology Delhi

3B-1 13:35-14:00 (Invited)
Assessing Device Reliability Margin in Scaled CMOS Technologies Using Ring Oscillator Circuits, A. Kerber, S. Cimino, F. Guarin, and T. Nigam, GLOBALFOUNDRIES Inc. 28

3B-2 14:00-14:25
The Impact of RTN-Induced Temporal Performance Fluctuation Against Static Performance Variation, Takashi Matsumoto[1], Kazutoshi Kobayashi[2], and Hidetoshi Onodera[3], [1]The University of Tokyo, [2]Kyoto Institute of Technology, [3]Kyoto University 31

3B-3 14:25-14:50
Critical Discussion on Temperature Dependence of BTI in Planar and FinFET Devices, P. Srinivasan and Tanya Nigam, GLOBALFOUNDRIES Inc. 33

3B-4 14:50-15:15
Characterization of Critical Peak Current and Model of Cu/Low-k Interconnects under Short Pulse-Width Conditions, M. H. Lin, W. S. Chou, Y. T. Yang, Y. C. Peng, and A. S. Oates, Taiwan Semiconductor Manufacturing Company 36

3B-5 15:15-15:40
New Analytical Equations for Skin and Proximity Effects in Interconnects Operated at High Frequency, Haojun Zhang, Jian-Hsing Lee, Natarajan Mahadeva Iyer, and Linjun Cao, GLOBALFOUNDRIES Inc. 39

Wednesday, March 1
Main Hall, 3F

15:55-18:25 Session 4M - Package: Subsystem Integration & Packaging

Chairs: S. Yamamichi, IBM
Y. Kurita, Toshiba Corporation

4M-1 15:55-16:20 (Invited)
System Integration in a Package for Cloud and Edge, Tadahiro Kuroda, Keio University 42

4M-2 16:20-16:45 (Invited)
III-V/Si Low Temperature Direct Bonding Technology for Photonic Device Integration on SOI, Nobuhiko Nishiyama, Yusuke Hayashi, Junichi Suzuki, and Shigehisa Arai, Tokyo Institute of Technology 44

4M-3 16:45-17:10 (Invited)
Focused Technologies in Near Future from OSAT View Point, Akio Katsumata, Akira Takashima, Kazuhiro Sawada, Hideki Sumihara, and Norio Ito, J-DEVICES Corporation 46

4M-4 17:10-17:35
BGA Packaging Process for a Device Made by Minimal Fab, Sommawan Khumpuang[1,2], Fumito Imura[1,2], and Shiro Hara[1,2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Minimal Fab 49

4M-5 17:35-18:00
Electrodeposited Cobalt for Advanced Packaging Applications, Bryan Buckalew, Justin Oberst, and Thomas Ponnuswamy, Lam Research Corporation 51

4M-6 18:00-18:25 (Invited)
Packaging Design Considerations for Mobile and Internet of Things (IOT), Piyush Gupta, Qualcomm Inc. 53

Wednesday, March 1
Room A (201+202), 2F

15:55-18:00 Session 4A - Material: Advanced FEOL Materials

Chairs: I. Muneta, Tokyo Institute of Technology
P. Li, National Chiao Tung University

4A-1 15:55-16:20 (Invited)
Biocompatible ALD Barrier Coatings for Medical Devices, Mikko Matvejeff[1], Satu Ek[1], Riina Ritasalo[1], Jesse Kalliomäki[1], Päivi Järvinen[1], Oili Ylivaara[2], and Erik Östreng[1], [1]Picosun, [2]VTT …… 56

4A-2 16:20-16:45 (Invited)
Enablement of Cost Effective CVD/ALD Processing through Precursor Design, Jean-Marc Girard, Air Liquide Advanced Materials Inc. …… 59

4A-3 16:45-17:10
Impact of Hydrogen Annealing Behavior of C_3H_5 Carbon Cluster Ion Implanted Projection Range Using Microwave Heat Treatment, Takeshi Kadono, Ryosuke Okuyama, Ayumi Masada, Ryou Hirose, Yoshihiro Koga, Hidehiko Okuda, and Kazunari Kurita, SUMCO Corporation …… 61

4A-4 17:10-17:35
New Opportunity of Ferroelectric Tunnel Junction Memory with Ultrathin HfO_2-Based Oxides, Xuan Tian and Akira Toriumi, The University of Tokyo …… 63

Wednesday, March 1
Room B (203+204), 2F

15:55-18:25 Session 4B - Device: Advanced FET Technology

Chairs: J. Ida, Kanazawa Institute of Technology
N. Horiguchi, imec

4B-1 15:55-16:20 (Invited)
Withdrawn

4B-2 16:20-16:45
Punch-Through Stop Doping Profile Control via Interstitial Trapping by Oxygen-Insertion Silicon Channel, Robert J. Mears[1], Hideki Takeuchi[1], Robert J. Stephenson[1], Marek Hytha[1], Richard Burton[1], Nyles W. Cody[1], Doran Weeks[1], Dmitri Choutov[1], Nidhi Agrawal[2*], and Suman Datta[2**] , [1]Atomera Inc., [2]Pennsylvania State University, [*]currently at Micron Technology Inc., [**]currently at Notre Dame University …… 65

4B-3 16:45-17:10 (Invited)
FinFET/Nanowire Design for 5nm/3nm Technology Nodes: Channel Cladding and Introducing a "Bottleneck" Shape to Remove Performance Bottleneck, Victor Moroz, Joanne Huang, and Munkang Choi, Synopsys, Inc. …… 67

4B-4 17:10-17:35
A Computational Study of Fundamentals and Design Considerations for Vertical Tunneling Field-Effect Transistor, Sheng Luo, Kain Lu Low, Xiaoyi Zhang, Qianyu Zhao, Hsin Lin, and Gengchiau Liang, National University of Singapore …… 70

4B-5 17:35-18:00
Analysis of Break-Even Time for Nonvolatile SRAM with SOTB Technology, Daiki Kitagata, Yusuke Shuto, Shuu'ichirou Yamamoto, and Satoshi Sugahara, Tokyo Institute of Technology …… 72

4B-6 18:00-18:25

Role of Floating Body Effect on Super Steep Subthreshold Slope PN-Body Tied SOI FET, Takahiro Yoshida, Jiro Ida, Syouta Inoue, Syougo Uchikura, Atsushi Hashimoto, Keisuke Hayashi, Taichi Iwasaki, Masanori Kamako, and Takashi Horii, Kanazawa Institute of Technology 75

18:25-19:05 Authors Interview in Main Hall, 3F
Poster Session in Foyer, 3F

*For Poster Session, please see the detailed information from page (17).

Thursday, March 2
Main Hall, 3F

8:30-10:10 Session 5M - Process: Innovative Process Tools

Chairs: K. Nojiri, Lam Research Corporation
Y. Kawasaki, SMIT

5M-1 8:30-8:55 (Invited)

EUV Lithography Insertion for High Volume Manufacturing: Status and Outlook, Alek Chen[1] and Junji Miyazaki[2], [1]ASML US Inc., [2]ASML Japan Co., Ltd. 77

5M-2 8:55-9:20

Local, Isotropic, and Damageless Doping to Oxide Semiconductors by Using Electrochemistry, Takeaki Yajima, Tomonori Nishimura, and Akira Toriumi, The University of Tokyo 80

5M-3 9:20-9:45 (Invited)

Process Development for CMOS Fabrication Using Minimal Fab, Sommawan Khumpuang[1,2], Kazuhiro Koga[1,2], Yongxun Liu[1], and Shiro Hara[1,2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Minimal Fab 82

5M-4 9:45-10:10

New Compact ECR Plasma Source for Silicon Nitride Film Formation in Minimal Fab System, Tetsuya Goto[1], Kei-ichiro Sato[2], Yuki Yabuta[3], Shigetoshi Sugawa[1], and Shiro Hara[4], [1]Tohoku University, [2]Kotec Co., Ltd., [3]Seinan Industries Co., Ltd., [4]National Institute of Advanced Industrial Science and Technology (AIST) 84

Thursday, March 2
Room A (201+202), 2F

8:30-10:10 Session 5A - Device: More-than-Moore Technologies

Chairs: R. Huang, Peking University
K. Uchida, Keio University

5A-1 8:30-8:55

A Scalable Si-Based Micro Thermoelectric Generator, Takanobu Watanabe[1], Shuhei Asada[1], Taiyu Xu[1], Shuichiro Hashimoto[1], Shunsuke Ohba[1], Yuya Himeda[1], Ryo Yamato[1], Hui Zhang[1], Motohiro Tomita[1], Takashi Matsukawa[2], Yoshinari Kamakura[3], and Hiroya Ikeda[4], [1]Waseda University, [2]National Institute of Advanced Industrial Science and Technology (AIST), [3]Osaka University, [4]Shizuoka University 86

5A-2 8:55-9:20 (Invited)
Health Monitoring of Houses and Communities by Recording Earthquake Response of Buildings, Minoru Yoshida[1], Yoichi Tanaka[1], Shoichi Ikeda[1], Soichiro Murata[2], Yoshiya Oda[3], and Masatake Ushiro[4], [1]Hakusan Corporation, [2]SAP Japan, [3]Tokyo Metropolitan University, [4]Business Break-Through University 88

5A-3 9:20-9:45 (Invited)
Smart Biosensing Technologies to Detect Single Bacteria and Viruses, Masateru Taniguchi, Osaka University 90

5A-4 9:45-10:10
Strain-Engineering in Germanium Membranes Towards Light Sources on Silicon, D. Burt[1], A. Z. Al-Attili[1], Z. Li[1], F. Liu[1], K. Oda[2], N. Higashitarumizu[3], Y. Ishikawa[3], O. M. Querin[4], F. Gardès [1], R. W. Kelsall[4], and S. Saito[1], [1]University of Southampton, [2]Hitachi, Ltd., [3]The University of Tokyo, [4]University of Leeds 92

Thursday, March 2
Room B (203+204), 2F

8:30-9:45 Session 5B - Modeling: Multi Physics Simulation

Chairs: A. Schenk, ETH Zurich
M. Natarajan, GLOBALFOUNDRIES Inc.

5B-1 8:30-8:55
Transient Characterization of Graphene NEMS Switch ESD Protection Structures, Qi Chen[1], Cheng Li[1], Jimmy Ng[2], Fei Lu[1], Chenkun Wang[1], Feilong Zhang[1], Rui Ma[3], Ya-Hong Xie[2], and Albert Wang[1], [1]University of California, Riverside, [2]University of California, Los Angeles, [3]Intel 95

5B-2 8:55-9:20 (Invited)
Reliability Modeling of RF MEMS Switches and Phase Shifters for Microwave and Millimeter Wave Applications, Shiban K. Koul and Sukomal Dey, Indian Institute of Technology .... N/A

5B-3 9:20-9:45 (Invited)
Multi-Scale and Multi-Domain Simulation of Electrical Power System, Shimeng Huang[1], Xiao Li[1], Tinghao Yeh[2], Shanghsun Mao[2], Takayuki Sekisue[3], Vel Ambalavanar[1], and Sameer Kher[1], [1]ANSYS Inc., [2]ANSYS Taiwan, [3]ANSYS Japan 100

Thursday, March 2
Main Hall, 3F

10:25-12:05 Session 6M - Material: Advanced BEOL Materials

Chairs: S. Kim, Yeungnam University
P. R. Berger, Ohio State University

6M-1 10:25-10:50 (Invited)
Nano-Structure-Controlled Very Low Resistivity Cu Wires Formed by High Purity Electrolyte and Optimized Additives, Jin Onuki[1], Kunihiro Tamahashi[1], Takashi Inami[1], Takatoshi Nagano[1], Yasushi Sasajima[1], and Shuji Ikeda[2], [1]Ibaraki University, [2]tei SOLUTIONS 103

6M-2 10:50-11:15
Withdrawn

6M-3 11:15-11:40 (Invited)
Advanced Materials and Interconnect Technologies for Next Generation Smart Devices, Rozalia Beica, Dow Electronic Materials

6M-4 11:40-12:05 (Invited)
Proximity Gettering Technology for Advanced CMOS Image Sensors Using C_3H_5 Carbon Cluster Ion Implantation Techniques, Kazunari Kurita, Takeshi Kadono, Ryosuke Okuyama, Ayumi Masada, Ryou Hirose, Yoshihiro Koga, and Hidehiko Okuda, SUMCO Corporation 105

Thursday, March 2
Room A (201+202), 2F

10:25-12:05 Session 6A - Device: FET Reliability

Chairs: G. Xiao, National University of Singapore
Y.-C. King, National Tsing Hua University

6A-1 10:25-10:50 (Invited)
New Visions for IC Yield Detractor Detection, Bill Nehrer, Kelvin Doong, and Dennis Ciplickas, PDF Solutions 107

6A-2 10:50-11:15
Comparative Study on RTN Amplitude in Planar and FinFET Devices, Zexuan Zhang[1], Zhe Zhang[1], Shaofeng Guo[1], Runsheng Wang[1], Xingsheng Wang[2], Binjie Cheng[2], Asen Asenov[2,3], and Ru Huang[1], [1]Peking University, [2]Synopsys, Inc., [3]University of Glasgow 109

6A-3 11:15-11:40 (Invited)
A BTI Analysis Tool (BAT) to Simulate p-MOSFET Ageing under Diverse Experimental Conditions, Souvik Mahapatra, Narendra Parihar, Subrat Mishra, Beryl Fernandez, and Ankush Chaudhary, Indian Institute of Technology Bombay 111

6A-4 11:40-12:05
Accurate Mapping of Oxide Traps in Highly-Stable Black Phosphorus FETs, Yu. Yu. Illarionov[1,2], G. Rzepa[1], M. Waltl[1], T. Knobloch[1], J.-S. Kim[3], D. Akinwande[3], and T. Grasser[1], [1]Technische Universtät Wien, [2]Ioffe Physical-Technical Institute, [3]The University of Texas at Austin 114

Thursday, March 2
Room B (203+204), 2F

10:25-12:05 Session 6B - Modeling: Reliability & Modeling

Chairs: S. Huang, Peking University
M. Miura-Mattausch, Hiroshima University

6B-1 10:25-10:50 (Invited)
ESD Performance Enhancement Methodologies for CMOS Power Transistors, Mahadeva Iyer Natarajan and Jian-Hsing Lee, GLOBALFOUNDRIES Inc. 116

6B-2 10:50-11:15
Aging Simulation of SiC-MOSFET in DC-AC Converter, Kenshiro Sato, Shinya Sekizaki, Dondee Navarro, Yoshifumi Zoka, Naoto Yorino, Hiroshi Zenitani, Hans Jürgen Mattausch, and Mitiko Miura-Mattausch, Hiroshima University 119

6B-3 11:15-11:40

Degradation Caused by Negative Bias Temperature Instability Depending on Body Bias on NMOS or PMOS in 65 nm Bulk and Thin-BOX FDSOI Processes, Ryo Kishida and Kazutoshi Kobayashi, Kyoto Institute of Technology ········· 122

6B-4 11:40-12:05

JFETIDG: A Compact Model for Independent Dual-Gate JFETs, Kejun Xia, Colin C. McAndrew, and Hanyu Sheng, NXP Semiconductors ········· 124

13:00-14:20 Poster Session in Foyer, 3F

*For Poster Session, please see the detailed information from page (17).

Thursday, March 2
Main Hall, 3F

14:20-16:00 Session 7M - Modeling: Device Characterization

Chairs: P. Su, National Chiao Tung University
D. Navarro, Hiroshima University

7M-1 14:20-14:45 (Invited)

How Non-Ideality Effects Deteriorate the Performance of Tunnel FETs, Andreas Schenk[1], Saurabh Sant[1], Kirsten Moselund[2], and Heike Riel[2], [1]ETH Zurich, [2]IBM Research-Zurich ········· 126

7M-2 14:45-15:10

Charge Splitting In-situ Recorder (CSIR) for Monitoring Plasma Damage in FinFET BEOL Processes, Ting-Huan Hsieh, Yi-Pei Tsai, Chrong Jung Lin, and Ya-Chin King, National Tsing Hua University ········· 128

7M-3 15:10-15:35

Geometric Variation: A Novel Approach to Examine the Surface Roughness and the Line Roughness Effects in Trigate FinFETs, E. R. Hsieh[1], Y. C. Fan[2], C. H. Liu[2], Steve S. Chung[1], R. M. Huang[3], C. T. Tsai[3], and T. R. Yew[3], [1]National Chiao Tung University, [2]National Taiwan Normal University, [3]UMC ········· 130

7M-4 15:35-16:00

A Novel Method to Characterize DRAM Process Variation by the Analyzing Stochastic Properties of Retention Time Distribution, Min Hee Cho, Namho Jeon, Moonyoung Jeong, Sungsam Lee, Satoru Yamada, and Hyeongsun Hong, Samsung Electronics Co., Ltd. ········· 132

Thursday, March 2
Room A (201+202), 2F

14:20-16:00 Session 7A - Device: Non-conventional Material-based FET Technologies

Chairs: K. Xia, NXP Semiconductors
H. Lv, Chinese Academy of Sciences

7A-1 14:20-14:45

Analysis of Subthreshold Swing and Internal Voltage Amplification for Hysteresis-Free Negative Capacitance FinFETs, Pin-Chieh Chiu and Vita Pi-Ho Hu, National Central University ········· 134

7A-2 14:45-15:10
Design Space Exploration Considering Back-Gate Biasing Effects for Negative-Capacitance Transition-Metal-Dichalcogenide (TMD) Field-Effect Transistors, Wei-Xiang You and Pin Su, National Chiao Tung University 136

7A-3 15:10-15:35
A Simple Way to Grow Large-Area Single-Layer MoS$_2$ Film by Chemical Vapor Deposition, Yan-Cong Qiao, Zhen Yang, Hai-Ming Zhao, Xue-Feng Wang, Lu-Qi Tao, Yi Yang, and Tian-Ling Ren, Tsinghua University 138

7A-4 15:35-16:00
High-Mobility and H$_2$-Anneal Tolerant InGaSiO/InGaZnO/InGaSiO Double Hetero Channel Thin Film Transistor for Si-LSI Compatible Process, Nobuyoshi Saito, Kentaro Miura, Tomomasa Ueda, Tsutomu Tezuka, and Keiji Ikeda, Toshiba Corporation 141

Thursday, March 2
Room B (203+204), 2F

14:20-16:00 Session 7B - Process: Process Innovation in MEMS and Sensors

Chairs: S. Tanaka, Tohoku University
M. Miura, Hitachi High-Technologies Corp.

7B-1 14:20-14:45 (Invited)
Growing Market of MEMS and Technology Development in Process and Tools Specialized to MEMS, Hiroshi Yanazawa and Kohji Homma, MEMS CORE Co., Ltd. 143

7B-2 14:45-15:10
Development of MEMS Vibrating Sensor with Phase-Shifted Optical Pulse Interferometry, Yusaku Ohe[1], Hitoshi Kimura[1], Norio Inou[1], Yoshiharu Hirayama[2], and Minoru Yoshida[2], [1]Tokyo Institute of Technology, [2]Hakusan Corporation 145

7B-3 15:10-15:35
Microstructuring Polydimethylsiloxane Elastomer Film with 3D Printed Mold for Low Cost and High Sensitivity Flexible Capacitive Pressure Sensor, Bengang Zhuo, Sujie Chen, and Xiaojun Guo, Shanghai Jiao Tong University 148

7B-4 15:35-16:00
Effective Performance of a Tiny-Chamber Plasma Etcher in Scallop Reduction, Sommawan Khumpuang[1,2], Hiroyuki Tanaka[1,2], and Shiro Hara[1,2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Minimal Fab 150

Thursday, March 2
Main Hall, 3F

16:15-17:55 Session 8M - Device: Memory Technology

Chairs: M. Saitoh, Toshiba Corporation
K. Tateiwa, TowerJazz Panasonic Semiconductor Co., Ltd.

8M-1 16:15-16:40
Exploiting NbO$_x$ Metal-Insulator-Transition Device as Oscillation Neuron for Neuro-Inspired Computing, Ligang Gao, Pai-Yu Chen, and Shimeng Yu, Arizona State University 152

8M-2 16:40-17:05

Ohmic Contact Formation Between $Ge_2Sb_2Te_5$ Phase Change Material and Vertically Aligned Carbon Nanotubes, Panni Wang, Suwen Li, Yihan Chen, Lining Zhang, and Mansun Chan, Hong Kong University of Science and Technology 154

8M-3 17:05-17:30

Impact of Current Distribution on RRAM Array with High and Low I_{ON}/I_{OFF} Devices, Mohammed Zackriya V.[1,2], Albert Chin[1], and Harish M. Kittur[2], [1]National Chiao Tung University, [2]VIT University 156

8M-4 17:30-17:55

3D Time-Contingent Physical Unclonable Function Array on 16nm FinFET Dielectric RRAM, Yi-Hung Chang[1], Po Shao Yeh[1], Yue-Der Chih[2], Jonathan Chang[2], Ya-Chin King[1], and Chrong Jung Lin[1], [1]National Tsing Hua University, [2]Taiwan Semiconductor Manufacturing Company 158

Thursday, March 2
Room A (201+202), 2F

16:15-17:55 Session 8A - Process: Process Innovation on Ge Surface and Interface

Chairs: Y. Akasaka, TEL
O. Nakatsuka, Nagoya University

8A-1 16:15-16:40

Surface Preparation and Wet Cleaning for Germanium Surface, Masayuki Otsuji[1], Yukifumi Yoshida[1], Hiroaki Takahashi[1], Farid Sebaai[2], Kurt Wostyn[2], Frank Holsteyns[2], Masanobu Sato[1], and Hajime Shirakawa[1], [1]Screen Semiconductor Solutions Co., Ltd, [2]imec vzw 160

8A-2 16:40-17:05

Oxidation Mechanism and Surface Passivation of Germanium by Ozone, Xiaolei Wang[1], Jinjuan Xiang[1], Chao Zhao[1,2], Tianchun Ye[1,2], and Wenwu Wang[1,2], [1]Chinese Academy of Sciences, [2]University of Chinese Academy of Sciences 162

8A-3 17:05-17:30

The Impact of Atomic Layer Depositions on High Quality Ge/GeO_2 Interfaces Fabricated by Rapid Thermal Annealing in O_2 Ambient, Laura Žurauskaitė, Per-Erik Hellström, and Mikael Östling, KTH Royal Institute of Technology 164

8A-4 17:30-17:55

Experimental Investigation on Growth Mechanism of GeO_x Layer Formed by Plasma Post Oxidation Based on Angle Resolved X-Ray Photoelectron Spectroscopy, Zhiqian Zhao[1], Xiaolei Wang[2], Jing Zhang[1], Chao Zhao[2,3], Tianchun Ye[2,3], and Wenwu Wang[2,3], [1]North China University of Technology, [2]Chinese Academy of Sciences, [3]University of Chinese Academy of Sciences 167

17:55-18:25 Authors Interview in Main Hall, 3F

Wednesday, March 1 18:25-19:05
Thursday, March 2 13:00-14:20
Foyer, 3F

Poster Session

P-1
UV-Annealing-Enhanced Stability in High-Performance Printed InO$_x$ Transistors, William J. Scheideler and Vivek Subramanian, University of California Berkeley 169

P-2
Random-Telegraph-Noise by Resonant Tunnelling at Low Temperatures, Z. Li[1], M. Sotto[1], F. Liu[1], M. K. Husain[1], I. Zeimpekis[1], H. Yoshimoto[2], K. Tani[2], Y. Sasago[2], D. Hisamoto[2], J. D. Fletcher[3], M. Kataoka[3], Y. Tsuchiya[1], and S. Saito[1], [1]University of Southampton, [2]Hitachi, Ltd., [3]National Physical Laboratory 172

P-3
Fabrication of E-Mode InGaN/AlGaN/GaN HEMT Using FIB Based Lithography, Shubhankar Majumdar[1,3], Chitrakant Sahu[2], and Dhrubes Biswas[3], [1]National Institute of Technology Raipur, [2]Malaviya National Institute of Technology Jaipur, [3]Indian Institute of Technology Kharagpur 175

P-4
Endurance Characterization of the Cu-Dope HfO$_2$ Based Selection Device with One Transistor-One Selector Structure, Qing Luo, Xiaoxin Xu, Hangbing Lv, Tiancheng Gong, Shibing Long, Qi Liu, Ling Li, and Ming Liu, Chinese Academy of Sciences 178

P-5
Investigation on Direct-Gap GeSn Alloys for High-Performance Tunneling Field-Effect Transistor Applications, Lei Liu[1], Renrong Liang[1], Guilei Wang[2], Henry H. Radamson[2], Jing Wang[1], and Jun Xu[1], [1]Tsinghua University, [2]University of Chinese Academy of Sciences 180

P-6
Online Training on RRAM Based Neuromorphic Network: Experimental Demonstration and Operation Scheme Optimization, Peng Yao[1], Huaqiang Wu[1*], Bin Gao[1], Ning Deng[1], Shimeng Yu[2], and He Qian[1], [1]Tsinghua University, [2]Arizona State University 182

P-7
Uniformity Improvements of Low Current 1T1R RRAM Arrays through Optimized Verification Strategy, Shan Wang, Xinyi Li, Huaqiang Wu, Bin Gao, Ning Deng, Dong Wu, and He Qian, Tsinghua University 184

P-8
Electroluminescence Characteristics of Rare Earth Doped Silicon Based Light Emitting Device, Fumihiro Hattori[1], Hideyuki Iwata[1], Toshihiro Matsuda[1], and Takashi Ohzone[2], [1]Toyama Prefectural University, [2]Dawn Enterprise Co., Ltd 187

P-9
High Photoresponsivity Germanium Nanodot PhotoMOSFETs for Monolithically- Integrated Si Optical Interconnects, Ming-Hao Kuo[1], Morris M. Lee[2], and Pei-Wen Li[1,2], [1]National Central University, [2]National Chiao Tung University 189

P-10
The Impact of Oxygen Insertion Technology on SRAM Yield Performance, A. Marshall[1], S. Nimmalapudi[1], W. K. Loh[2], J. Krick[3], L. Hutter[4], H. Takeuchi[5], R. Stephenson[5], R. J. Mears [5], and S. Ikeda[6], [1]The University of Texas at Dallas, [2]Consultant, [3]Logix Consulting, Inc., [4]Lou Hutter Consulting, [5]Atomera Inc., [6]tei SOLUTIONS Inc. 191

P-11
Transport Properties in Silicon Nanowire Transistors with Atomically Flat Interfaces, F. Liu[1], M. K. Husain[1], Z. Li[1], M. S. H. Sotto[1], D. Burt[1], J. D. Fletcher[2], M. Kataoka[2], Y. Tsuchiya[1], and S. Saito[1], [1]University of Southampton, [2]National Physical Laboratory 193

P-12
InAs MOS-HEMT Power Detector for 1.0 THz on Quartz Glass, Eiji Kume[1], Hiroyuki Ishii[2], Hiroyuki Hattori[2], Wen-Hsin Chang[2], Mutsuo Ogura[1], Haruichi Kanaya[3], Tanemasa Asano[3], and Tatsuro Maeda[2], [1]IRspec Corporation, [2]National Institute of Advanced Industrial Science and Technology (AIST), [3]Kyushu University 196

P-13
Analysis and Modeling of Capacitances in Halo-Implanted MOSFETs, Chetan Gupta[1], Harshit Agarwal[3], Sagnik Dey[2], Chenming Hu[3], and Yogesh S. Chauhan[1], [1]Indian Institute of Technology Kanpur, [2]Texas Instruments Inc., [3]University of California Berkeley 198

P-14
Design and Performance of Thin-Film μTEG Modules for Wearable Device Applications, Tsuyoshi Kondo, Nana Chiwaki, and Satoshi Sugahara, Tokyo Institute of Technology 201

P-15
Analysis of Spin Accumulation in a Si Channel Using CoFe/MgO/Si Spin Injectors, Taiju Akushichi, Daiki Kitagata, Yusuke Shuto, and Satoshi Sugahara, Tokyo Institute of Technology 204

P-16
SER Scaling and Trends in Planar Submicron Technology Nodes, Krishna Mohan Chavali, GLOBALFOUNDRIES Inc. 206

P-17
Fully Packaged Compliant CMOS Electronic Systems for IoT and IoE Applications, G. A. Torres Sevilla, M. D. Cordero, J. M. Nassar, A. T. Kutbee, and M. M. Hussain, King Abdulla University of Science and Technology 209

P-18
A Metal Micro-Casting Method for Through-Silicon Via (TSV) Fabrication, Jiebin Gu, Bingjie Liu, Heng Yang, and Xinxin Li, Shanghai Institute of Microsystem and Information Technology 211

P-19
Acoustic Emission Wave Sensor with Thermally Controllable Force-Enhancement Mechanism for Acoustic Emission Source Detection and Biomedical Application, Guo-Hua Feng and Wei-Ming Chen, National Chung Cheng University 213

P-20
Electroactive Polymer Actuated Gripper Enhanced with Iron Oxide Nanoparticles and Water Supply Mechanism for Millimeter-Sized Fish Roe Manipulation, Guo-Hua Feng and Shih-Chieh Yen, National Chung Cheng University 216

P-21
Low Temperature Hermetic Sealing by Aluminum Thermocompression Bonding Using Tin Intermediate Layer, Shiro Satoh, Hideyuki Fukushi, Masayoshi Esashi, and Shuji Tanaka, Tohoku University 219

P-22
Low-Carrier Density Sputtered-MoS_2 Film by H_2S Annealing for Normally-Off Accumulation-Mode FET, Jun'ichi Shimizu[1], Takumi Ohashi[1], Kentaro Matsuura[1], Iriya Muneta[1], Kuniyuki Kakushima[1], Kazuo Tsutsui[1], Nobuyuki Ikarashi[2], and Hitoshi Wakabayashi[1], [1]Tokyo Institute of Technology, [2]Nagoya University 222

P-23
Impact of Ferroelectric Domain Switching in Nonvolatile Charge-Trapping Memory, Chia-Chi Fan[1], Yu-Chien Chiu[1], Chien Liu[1], Guan-Lin Liou[2], Wen-Wei Lai[1], Yi-Ru Chen[1], Chun-Hu Cheng[2], and Chun-Yen Chang[1,3], [1]National Chiao Tung University, [2]National Taiwan Normal University, [3]Academia Sinica 224

P-24
An In-Line MOSFET Process with Photomask Fabrication Process in a Minimal Fab, Norio Umeyama[1,2], Sommawan Khumpuang[1,2], and Shiro Hara[1,2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Minimal Fab 226

P-25
Development of a Half-Inch Wafer for Minimal Fab Process, Norio Umeyama[1,2], Atsushi Yamazaki[3], Takaaki Sakai[3], Sommawan Khumpuang[1,2], and Shiro Hara[1,2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Minimal Fab, [3]Fujikoshi Machinery 228

P-26
Helium Ion Microscopy (HIM) for Imaging Fine Line Features Patterned Organic Film with Less Damage, Shinichi Ogawa[1], Tomoya Ohashi[2], Shigeki Oyama[2], and Yuki Usui[2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Nissan Chemical Industries, Ltd. 230

P-27
Supercritical Fluid Deposition of Conformal Oxide Films: 3-Dimentionally-Stacked $RuO_2/TiO_2/RuO_2$ Structures for MIM Capacitors, Yu Zhao, Yusuke Shimoyama, Takeshi Momose, and Yukihiro Shimogaki, The University of Tokyo 232

P-28
Crystallinity Improvement Using Migration-Enhancement Methods for Sputtered-MoS_2 Films, Shin Hirano, Jun'ichi Shimizu, Kentaro Matsuura, Takumi Ohashi, Iriya Muneta, Kuniyuki Kakushima, Kazuo Tsutsui, and Hitoshi Wakabayashi, Tokyo Institute of Technology 234

P-29
Low Power Transparent Resistive Switching Device with Memristive Behavior, Amitesh Kumar, Mangal Das, Rohit Singh, Pankaj Sharma, Abhinav Kranti, and Shaibal Mukherjee, Indian Institute of Technology Indore .... N/A

P-30
Photoresist Development for Wafer-Level Packaging Process, Makiko Irie, Toshiaki Tachi, and Atushi Sawano, Tokyo Ohka Kogyo Co., Ltd. 238

P-31
Second-Harmonic Susceptibility Enhancement in Gallium Nitride Nanopillars, Kangwei Wang, Haoliang Qian, Zhaowei Liu, and Paul K. L. Yu, University of California, San Diego 240

P-32
Defect Formation in SiO_2 Formed by Thermal Oxidation of SiC, Kenta Chokawa, Masaaki Araidai, and Kenji Shiraishi, Nagoya University 242

P-33
Current Enhanced Solid Phase Precipitation (CE-SPP) for Direct Deposition of Multilayer Graphene on SiO_2 from a Cu Capped Co-C Layer, Hiroyasu Ichikawa and Kazuyoshi Ueno, [1]Shibaura Institute of Technology 244

P-34
Enhanced Photoresponse of InGaZnO TFT to Ultraviolet Illumination by Using a High-*k* Dielectric, Libin Liu, Renrong Liang, Jing Wang, and Jun Xu, Tsinghua University 247

P-35
Development of *in-situ* Sb-Doped $Ge_{1-x}Sn_x$ Epitaxial Layers for Source/Drain Stressor of Strained Ge Transistors, Jihee Jeon, Akihiro Suzuki, Kouta Takahashi, Osamu Nakatsuka, and Shigeaki Zaima, Nagoya University 249

P-36
Novel in-situ Passivation of $MoCl_5$ Doped Multilayer Graphene with MoO_x for Low-Resistance Interconnects, K. Kawamoto, Y. Saito, M. Kenmoku, and K. Ueno, Shibaura Institute of Technology 252

P-37
Thickness-Independent Behavior of Coercive Field in HfO_2-Based Ferroelectrics, Shinji Migita[1], Hiroyuki Ota[1], Hiroyuki Yamada[1], Akihito Sawa[1], and Akira Toriumi[2], [1]National Institute of Advanced Industrial Science and Technology (AIST), [2]The University of Tokyo 255

P-38
Crystallinity Study of Si Single Crystal Stripe on Bended Glass Substrate Fabricated by Micro-Chevron Laser Beam Scanning Method, Wenchang Yeh and Seigo Moriyama, Shimane University 257

P-39
Physics Based System Simulation for Robot Electro-Mechanical Control Design, T. K. Maiti[1], L. Chen[1], M. Miura-Mattausch[1], S. K. Koul[2], and H. J. Mattausch[1], [1]Hiroshima University, [2]Indian Institute of Technology Delhi 259

P-40
Accurate Modeling of MOSFET Aging Based on Trap-Density Increase for Predicting Circuit-Performance Aging, Lei Chen, Hidenori Miyamoto, Tapas Kumar Maiti, Dondee Navarro, Takahiro Iizuka, Hans Jürgen Mattausch, and Mitiko Miura-Mattausch, Hiroshima University ..... N/A

P-41
Modeling and Analysis of Depletion-Mode NMOS Transistor as Transmitter/Receiver RF Switch, Runtao Ning, Tianjiao Liu, and Z. John Shen, Illinois Institute of Technology ..... N/A

P-42
An Analytical Charge-Sheet Drain Current Model for Monolayer Transition Metal Dichalcogenide Negative Capacitance Field-Effect Transistors, Renrong Liang, Chunsheng Jiang, Jing Wang, Jun Xu, and Tian-Ling Ren, Tsinghua University ..... N/A

P-43
A Simple Test Method for Electromigration Reliability of Solder/Cu Pillar Bumps Using Flat Cables, Naoki Azuma[1], Misaki Owada[1], Takumi Abe[1], Tsutomu Nakada[2], Makoto Kubota[2], and Kazuyoshi Ueno[1,3], [1]Shibaura Institute of Technology, [2]EBARA Corporation, [3]Research Center for Green Innovation ..... N/A