

2016 46th European Solid-State Device Research Conference (ESSDERC 2016)

**Lausanne, Switzerland
12-15 September 2016**



**IEEE Catalog Number: CFP16543-POD
ISBN: 978-1-5090-2970-9**

**Copyright © 2016 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 publication is a representation of what appears in the IEEE Digital Libraries. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP16543-POD
ISBN (Print-On-Demand):	978-1-5090-2970-9
ISBN (Online):	978-1-5090-2969-3
ISSN:	1930-8876

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

CURRAN ASSOCIATES INC.
proceedings
.com

ESSDERC 2016 Table of Contents

A1L-A ESSDERC/ESSCIRC Plenary Keynote 1: Greg Yeric

Date: Tuesday, September 13, 2016

Time: 08:45 - 09:40

Room: Auditoire A

Chair(s): Adrian Ionescu; *EPFL*

At the Core of System Scaling 1

Greg Yeric

ARM Research, United States

B1L-A ESSDERC/ESSCIRC Plenary Keynote 2: Ahmad Bahai

Date: Wednesday, September 14, 2016

Time: 08:45 - 09:40

Room: Auditoire A

Chair(s): ChristianENZ; *EPFL*

Ultra-low Energy Systems: Analog to Information 3

Ahmad Bahai

Texas Instruments, United States

C1L-A ESSDERC/ESSCIRC Plenary Keynote 3: Tobi Delbruck

Date: Thursday, September 15, 2016

Time: 08:45 - 09:40

Room: Auditoire A

Chair(s): Heike Riel; *IBM Zurich Research Laboratory*

Neuromorphic Sensing and Processing..... 7

Tobi Delbruck

Universität Zürich / Eidgenössische Technische Hochschule Zürich, Switzerland

A4L-B ESSDERC Keynote 1: Laurent Malier

Date: Tuesday, September 13, 2016
Time: 15:20 - 16:15
Room: Auditoire B
Chair(s): Heike Riel; *IBM Zurich Research Laboratory*

Low Power Advanced Digital Technologies to Enable Internet of Things 15

Laurent Malier, Andreia Cathelin, Giorgio Cesana, Laurent Le Pailleur
ST Microelectronics, France

B3L-B ESSDERC Keynote 2: Mattias Steffen

Date: Wednesday, September 14, 2016
Time: 13:15 - 14:10
Room: Auditoire B
Chair(s): Andras Kis; *EPFL*

Progress, Status, and Prospects of Superconducting Qubits for Quantum Computing 17

Matthias Steffen, Jay M. Gambetta, Jerry M. Chow
IBM TJ Watson Research Center, United States

C4L-B ESSDERC Keynote 3: John Rogers

Date: Thursday, September 15, 2016
Time: 13:15 - 14:10
Room: Auditoire B
Chair(s): Heike Riel; *IBM Zurich Research Laboratory*

Soft Electronics for the Human Body 21

John A. Rogers
Northwestern University, United States

A5L-E Enabling the Internet of Things: System and Energy Considerations

Date: Tuesday, September 13, 2016

Time: 16:20 - 17:50

Room: 5C

Chair(s): Stefan Rusu; *Taiwan Semiconductor Manufacturing Co.*
Ralf Brederlow; *Texas Instruments*

INVITED: WSN for Machine Area Network Applications..... 23

Xiaolin Lu, Il Han Kim, Ariton Xhafa, Jianwei Zhou
Texas Instruments, United States

30% Static Power Improvement on ARM Cortex®-A53 Using Static Biasing-Anticipation 29

Fady Abouzeid, Christophe Bernicot, Sylvain Clerc, Jean-Marc Daveau, Gilles Gasiot, Daniel Noblet, Dimitri Soussan, Philippe Roche
STMicroelectronics, France

Sub-Threshold Latch-Based Icyflex2 32-Bit Processor with Wide Supply Range Operation 33

Marc Pons, Thanh-Chau Le, Claude Arm, Daniel Séverac, Jean-Luc Nagel, Marc Morgan, Stéphane Emery
Centre Suisse d'Électronique et de Microtechnique SA, Switzerland

A 55nm Ultra Low Leakage Deeply Depleted Channel Technology Optimized for Energy Minimization in Subthreshold SRAM and Logic..... 37

Harsh N. Patel³, Abhishek Roy³, Farah Yahya³, Ningxi Liu³, Benton Calhoun³, Kazuyuki Kumeno², Makoto Yasuda², Akihiko Harada¹, Taiji Ema¹

¹*Mie Fujitsu Semiconductor Limited, Japan;* ¹*Mie Fujitsu Semiconductor Limited, United States;* ²*Mie Fujitsu Semiconductor Ltd, Japan;* ³*University of Virginia, United States*

B2L-E Energy Efficient Devices & Circuits for Digital & Analog/RF Functions

Date: Wednesday, September 14, 2016

Time: 10:05 - 11:35

Room: 5C

Chair(s): Eric Pop; *Stanford University*

Andrei Vladimirescu; *ISEP*

INVITED: Designing Energy Efficient and Hysteresis Free Negative Capacitance

FinFET with Negative DIBL and 3.5X ION Using Compact Modeling Approach 41

Girish Pahwa, Tapas Dutta, Amit Agarwal, Yogesh Singh Chauhan

Indian Institute of Technology, Kanpur, India

Effect of Material Parameters on Two-Dimensional Materials Based TFETs: an

Energy-Delay Perspective 47

Tarun Kumar Agarwal³, Iuliana Radu¹, Praveen Raghavan¹, Gianluca Fiori⁴, Aaron

Thean¹, Marc Heyns³, Wim Dehaene²

¹IMEC, Belgium; ²Katholieke Universiteit Leuven, Belgium; ³Katholieke Universiteit

Leuven / IMEC, Belgium; ⁴Università di Pisa, Italy

Experimental Demonstration of a Nanoelectromechanical Switch-Based Logic

Library Including Sequential and Combinational Gates 51

Christopher Ayala⁴, Antonios Bazigos¹, Daniel Grogg³, Ute Drechsler², Christoph

Hagleitner²

¹École Polytechnique Fédérale de Lausanne / ams AG, Austria; ²IBM Research GmbH,

Switzerland; ³TE Connectivity Ltd., Switzerland; ⁴Yokohama National University, Japan

Reflection Amplifier Based on Graphene 55

Pankaj Sharma¹, Laurent Bernard¹, Antonios Bazigos², Arnaud Magrez¹, László Forró¹,

Adrian Ionescu¹

¹École Polytechnique Fédérale de Lausanne, Switzerland; ²École Polytechnique

Fédérale de Lausanne / ams AG, Switzerland

B5L-D Emerging Design & Integration Techniques for Enhanced Circuit Performance

Date: Wednesday, September 14, 2016

Time: 14:15 - 15:35

Room: 5B

Chair(s): Eric Pop; *Stanford University*

Piotr Grabiec; *ITE*

Heterogeneously Integrated Program Voltage Generator for 1.0V Operation NAND Flash with Best Mix & Match of Standard CMOS Process and NAND Flash Process 59

Masahiro Tanaka, Kota Tsurumi, Tomoya Ishii, Ken Takeuchi

Chuo University, Japan

A Highly Tunable 65-nm CMOS LIF Neuron for a Large Scale Neuromorphic System 63

Syed Ahmed Aamir, Paul Müller, Andreas Hartel, Johannes Schemmel, Karlheinz Meier

Ruprecht-Karls-Universität Heidelberg, Germany

Delay Partitioning Helps Reducing Variability in 3DVLSI 67

Alexandre Ayres², Olivier Rozeau¹, Bertrand Borot², Laurent Fesquet³, Maud Vinet¹

¹CEA-Leti, France; ²STMicroelectronics, France; ³Université Grenoble-Alpes, France

20.3dB 0.39mW AM Detector with Single-Transistor Active Inductor in Bendable a-IGZO TFT 71

Tilo Meister², Koichi Ishida², Reza Shabanpour², Bahman K. Boroujeni², Corrado Carta²,

Niko Münzenrieder¹, Luisa Petti¹, Giuseppe Cantarella¹, Giovanni Antonio Salvatore¹,

Gerhard Tröster¹, Frank Ellinger²

¹Eidgenössische Technische Hochschule Zürich, Switzerland; ²Technische Universität Dresden, Germany

C5L-E Sensors and Circuits for Ubiquitous Sensing

Date: Thursday, September 15, 2016

Time: 14:35 - 16:35

Room: 5C

Chair(s): Ralf Brederlow; *Texas Instruments*

Mirjana Banjevic; *Sensirion*

INVITED: History, Present State-of-Art and Future of Incremental ADCs 75

Chia-Hung Chen, Yi Zhang, Gabor Temes

Oregon State University, United States

A Wearable ECG Monitoring Device with Flexible Embedded Denoising and Compression 79

Chenyu Wang, Han Jin, Yajie Qin, Li-Rong Zheng

Fudan University, China

A 9.8b-ENOB 5.5fJ/Step Fully-Passive Compressive Sensing SAR ADC for WSN Applications..... 83

Wenjuan Guo, Nan Sun

University of Texas at Austin, United States

Energy Performance of Nonvolatile Power-Gating SRAM Using SOTB Technology 87

Yusuke Shuto, Shuu'Ichirou Yamamoto, Satoshi Sugahara

Tokyo Institute of Technology, Japan

INVITED: Development of High Sensitivity CMOS-MEMS Inertia Sensor and its Application to Early-Stage Diagnosis of Parkinson's Disease..... 91

Kazuya Masu, Daisuke Yamane, Katuyuki Machida, Masato Sone, Yoshihiro Miyake

Tokyo Institute of Technology, Japan

A2L-C Silicon-Based Opto- and mm Wave Devices

Date: Tuesday, September 13, 2016

Time: 10:05 - 11:45

Room: 5A

Chair(s): Dana Cristea; *IMT Bucharest*
Denis Flandre; *Université catholique de Louvain*

Development of Plasmonic MEMS CMOS Infrared Sensors for Occupancy Detection..... 97

Mohamed Chowdhury, Zeeshan Ali, Sophie Boual, Richard Hopper, Florin Udrea
University of Cambridge, United Kingdom

Crosstalk Mapping in CMOS SPAD Arrays..... 101

Andrea Ficarella⁵, Lucio Pancheri⁵, Gian Franco Dalla Betta⁵, Paolo Brogi⁴, Gianmaria Collazuol², Pier Simone Marrocchesi⁴, Fabio Morsani¹, Lodovico Ratti³, Aurore Savoy-Navarro⁶

¹*Istituto Nazionale di Fisica Nucleare & Sezione di Pisa, Italy*; ²*Università di Padova, Italy*; ³*Università di Pavia, Italy*; ⁴*Università di Siena, Italy*; ⁵*Università di Trento, Italy*; ⁶*University Paris-Diderot, France*

Solution Processable PbS Quantum Dots/Silicon Multispectral Detectors 105

Dana Cristea, Paula Obreja, Rebeca Tudor, Bogdan Bită
IMT Bucharest, Romania

Small-Signal IMPATT Diode Characterization for mm-Wave Power Generation in Monolithic Scenarios 109

Wogong Zhang, Michael Oehme, Klaus Matthies, Viktor Stefani, Ashraful Raju, Erich Kasper, Jörg Schulze
Universität Stuttgart, Germany

18 Ps Rise Time in Large Active-Area InGaAs Nanowire Array Avalanche Photodetectors..... N/A

Diana Huffaker¹, Alan Farrell³, Pradeep Senanayake³, Marc Currie²

¹*Cardiff University, United Kingdom*; ²*Navy Research Laboratory, United States*;

³*University of California at Los Angeles, United States*

A2L-D CMOS Scaling

Date: Tuesday, September 13, 2016

Time: 10:05 - 11:45

Room: 5B

Chair(s): Nadine Collaert; *IMEC*
Hiroshi Iwai; *Tokyo Inst. of Technology*

INVITED: FDSOI Devices: Issues and Innovative Solutions..... 117

Sorin Cristoloveanu², Maryline Bawedin¹

¹*Grenoble Institute of Technology, France*; ²*Grenoble Institute of Technology / Université Grenoble Alpes, France*

INVITED: End of the Downsizing and World After That 121

Hiroshi Iwai

Tokyo Institute of Technology, Japan

Performance and Layout Effects of SiGe Channel in 14nm UTBB FDSOI: SiGe-First Vs. SiGe-Last Integration..... 127

Remy Berthelon³, Francois Andrieu¹, Pierre Perreau¹, Elise Baylac³, Alexandre Pofelski³, Emmanuel Josse³, Didier Dutartre³, Alain Claverie², Michel Haond³

¹*CEA-Leti, France*; ²*CEMES-CNRS, France*; ³*STMicroelectronics, France*

Towards High Performance Sub-10nm finW Bulk FinFET Technology 131

Thomas Chiarella, Stefan Kubicek, Erik Rosseel, Romain Ritzenthaler, Andryi Hikavyi, Pierre Eyben, An De Keersgieter, Lars-Åke Ragnarsson, Min-Soo Kim, Soon-Aik Chew, Tom Schram, Steven Demuynck, Miroslav Cupak, Luc Rijnders, Morin Dehan, Naoto Horiguchi, Jerome Mitard, Dan Mocuta, Anda Mocuta, Aaron Thean
IMEC, Belgium

A2L-E Electrical Characterization of Advanced Technologies

Date: Tuesday, September 13, 2016

Time: 10:05 - 11:45

Room: 5C

Chair(s): Guido Groeseneken; *IMEC*

Tibor Grasser; *TU Wien*

INVITED: Electrical Characterization of FDSOI CMOS Devices 135

G rard Ghibaudo

Grenoble Institute of Technology, France

Statistical Characterization of Drain Current Local and Global Variability in Sub 15nm Si/SiGe Trigate pMOSFETs..... 142

Romain Lavieville³, Theano Karatsori³, Christoforos Theodorou³, Sylvain Barraud², Charalabos Dimitriadis¹, G rard Ghibaudo³

¹*Aristotle University of Thessaloniki, Greece;* ²*CEA-Leti / Universit  Grenoble Alpes, France;* ³*Grenoble Institute of Technology, France*

Impact of GigaRad Ionizing Dose on 28 nm Bulk MOSFETs for Future HL-LHC 146

Alessandro Pezzotta³, Chunmin Zhang³, Farzan Jazaeri³, Claudio Bruschini³, Giulio Borghello², Federico Faccio¹, Serena Mattiazzi⁴, Andrea Baschiroto⁵, Christian Enz³

¹*CERN, Switzerland;* ²*CERN / Universit  degli Studi di Padova / Universit  degli Studi di Udine, Switzerland;* ³* cole Polytechnique F d rale de Lausanne, Switzerland;*

⁴*Universit  degli Studi di Padova, Italy;* ⁵*Universit  degli Studi Milano-Bicocca*

INVITED: Thermal-Aware CMOS: Challenges for Future Technology and Design Evolutions..... 150

Ken Uchida, Tsunaki Takahashi

Keio University, Japan

A3L-C Resistive RAM

Date: Tuesday, September 13, 2016

Time: 13:15 - 14:55

Room: 5A

Chair(s): Geoffrey Burr; *IBM*

Paolo Pavan; *Università di Modena e Reggio Emilia*

INVITED: Physical Understanding and Optimization of Resistive Switching

Characteristics in Oxide-RRAM..... 154

Jinfeng Kang¹, Peng Huang¹, Zhe Chen¹, Yudi Zhao¹, Chen Liu¹, Runze Han¹, Lifeng Liu¹, Xiaoyan Liu¹, Yangyuan Wang¹, Bin Gao²

¹*Peking University, China*; ²*Tsinghua University, China*

Energy Dissipation During Pulsed Switching of Strontium-Titanate Based

Resistive Switching Memory Devices..... 160

Karsten Fleck², Ulrich Böttger², Rainer Waser², Nabeel Aslam¹, Susanne Hoffmann-Eifert¹, Stephan Menzel¹

¹*Forschungszentrum Jülich, Germany*; ²*Rheinisch-Westfälische Technische Hochschule Aachen, Germany*

Lowering Forming Voltage and Forming-Free Behavior of Ta2O5 ReRAM Devices 164

Wonjoo Kim¹, Dirk J. Wouters², Stephan Menzel¹, Christian Rodenbücher¹, Rainer Waser², Vikas Rana¹

¹*Forschungszentrum Jülich, Germany*; ²*Rheinisch-Westfälische Technische Hochschule Aachen, Germany*

Impact of Si/Al Implantation on the Forming Voltage and Pre-Forming Conduction

Modes in HfO2 Based OxRAM Cells 168

Marios Barlas¹, Boubacar Traoré¹, Laurent Grenouillet¹, Sophie Bernasconi¹, Philippe Blaise¹, Mouhamad Alayan¹, Benoit Sklenard¹, Eric Jalaguier¹, Philippe Rodriguez¹, Frédéric Mazon¹, Emmanuel Vilain¹, Marc Guillermet¹, Simon Jeannot², Elisa Vianello¹, Luca Perniola¹

¹*CEA-Leti, France*; ²*STMicroelectronics, France*

A3L-D III-V Devices

Date: Tuesday, September 13, 2016
Time: 13:15 - 14:55
Room: 5B
Chair(s): Massimo Rudan; *University of Bologna*
Fabian Bufler; *Synopsys, Inc*

New Fast Distributed Thermal Model for Analysis of GaN Based Power Devices..... 172

Vice Sodan¹, Federica Maggioni¹, Herman Oprins¹, Steve Stoffels¹, Martine Baelmans²,
Ingrid De Wolf¹

¹IMEC, Belgium; ²Katholieke Universiteit Leuven, Belgium

Performance of Tri-Gate AlGaIn/GaN HEMTs 176

Mohamed Alsharef², Ralf Granzner², Frank Schwier², Erdin Ture¹, Ruediger Quay¹,
Oliver Ambacher¹

¹Fraunhofer-Institut für Angewandte Festkörperphysik IAF, Germany; ²Technische
Universität Ilmenau, Germany

A Full-Quantum Simulation Study of InGaAs NW MOSFETs Including Interface Traps 180

Michele Visciarelli, Antonio Gnudi, Elena Gnani, Susanna Reggiani
Università di Bologna, Italy

Performance Study of Strained III-V Materials for Ultra-Thin Body Transistor Applications..... 184

Martin Rau¹, Troels Markussen², Enrico Caruso³, David Esseni³, Elena Gnani⁴, Antonio
Gnudi⁴, Petr Khomyakov¹, Mathieu Luisier¹, Patrik Osgnach³, Pierpaolo Palestri³,
Susanna Reggiani⁴, Andreas Schenk¹, Luca Selmi³, Kurt Stokbro²

¹Eidgenössische Technische Hochschule Zürich, Switzerland; ²QuantumWise A/S,
Denmark; ³Università degli Studi di Udine, Italy; ⁴Università di Bologna, Italy

Effect of Surface Roughness and Phonon Scattering on Extremely Narrow InAs-Si Nanowire TFETs 188

Hamilton Carrillo-Nuñez, Reto Rhyner, Mathieu Luisier, Andreas Schenk
Eidgenössische Technische Hochschule Zürich, Switzerland

A3L-E High Performance Power Devices

Date: Tuesday, September 13, 2016

Time: 13:15 - 14:55

Room: 5C

Chair(s): Mikael Östling; *KTH Royal Institute of Technology*
Susanna Reggiani; *University of Bologna*

INVITED: SiC Power Devices: from Conception to Social Impact 192

B. Jayant Baliga

North Carolina State University, United States

Wide Temperature Range Integrated Amplifier in Bipolar 4H-SiC Technology 198

Raheleh Hedayati, Luigia Lanni, Ana Rusu, Carl-Mikael Zetterling

KTH Royal Institute of Technology, Sweden

600 V, Low-Leakage AlGaIn/GaN MIS-HEMT on Bulk GaN Substrates 202

Muhammad Alshahed³, Mohammed Alomari³, Christine Harendt³, Joachim Burghartz³,
Clemens Wächter¹, Thomas Bergunde¹, Stephan Lutgen²

¹*AZUR SPACE Solar Power GmbH, Germany*; ²*III-V Semiconductor Consulting, Germany*; ³*Institut für Mikroelektronik Stuttgart, Germany*

INVITED: Wide BandGap Power Devices and Applications: the U.S. Initiative 206

Anant Agarwal², Laura Marlino¹, Robert Ivester², Mark Johnson²

¹*Oak Ridge National Laboratory, United States*; ²*United States Department of Energy, United States*

A5L-C Novel Devices

Date: Tuesday, September 13, 2016
Time: 16:20 - 18:10
Room: 5A
Chair(s): Francois Andrieu; *CEA*
Erwin Hijzen; *NXP Semiconductors*

Novel FDSOI Band-Modulation Device: Z2-FET with Dual Ground Planes 210

Hassan El Dirani², Pascal Fonteneau², Yohann Solaro³, Philippe Ferrari³, Sorin Cristoloveanu¹

¹*Grenoble Institute of Technology / Université Grenoble Alpes, France;*

²*STMicroelectronics, France;* ³*Université Grenoble Alpes, France*

A CMOS-Compatible Boosted Transistor Having >2x Drive Current and Low Leakage Current..... 214

Jin-Woo Han³, Victor Moroz², Andrey Kuchero², Dinesh Maheshwari³, Valentin Abramzon³, Zvi Or-Bach³, Yoshio Nishi¹, Yuniarto Widjaja³

¹*Stanford University, United States;* ²*Synopsys, Inc., United States;* ³*Zeno Semiconductor, United States*

Impact of Intermediate BEOL Technology on Standard Cell Performances of 3D VLSI..... 218

Mélanie Brocard, Guillaume Berhault, Sébastien Thuries, Fabien Clermidy, Perrine Batude, Claire Fenouillet-Beranger, Laurent Brunet, François Andrieu, Fabien Deprat, Joris Lacord, Olivier Rozeau, Gérald Cibrario, Olivier Billoint
CEA-Leti, France

Analog Performance of Strained SOI Nanowires Down to 10K..... 222

Bruna Paz³, Marcelo Pavanello³, Mikaël Cassé¹, Sylvain Barraud², Gilles Reimbold¹, Maud Vinet¹, Olivier Faynot¹

¹*CEA-Leti, France;* ²*CEA-Leti / Université Grenoble Alpes, France;* ³*Centro Universitário FEI, Brazil*

INVITED: Opportunities brought by sequential 3D CoolCube™ integration 226

Maud Vinet¹, Perrine Batude¹, Claire Fenouillet-Beranger¹, Laurent Brunet¹, Vincent Mazzochi¹, Vincent Lu², Fabien Deprat¹, Jessy Micout¹, Bernard Previtali¹, Paul Besombes¹, Nils Rambal¹, François Andrieu¹, Olivier Billoint¹, Mélanie Brocard¹, Sébastien Thuries¹, Guil-laume Berhault¹, Cristiano Lopes Dos Santos¹, Gérald Cibrario¹, Fabien Clermidy¹, Daniel Gitlin¹, Olivier Faynot¹

¹*CEA-Leti, France.* ²*STMicroelectronics*

A5L-D 2D Electronics I

Date: Tuesday, September 13, 2016

Time: 16:20 - 17:50

Room: 5B

Chair(s): Max Lemme; *University of Siegen*
Thomas Zimmer; *University of Bordeaux*

INVITED: 2D Electronics - Opportunities and Limitations 230

Zhansong Geng, Wilhelm Kinberger, Ralf Granzner, Jörg Pezoldt, Frank Schwier
Technische Universität Ilmenau, Germany

Contact Resistance Study of "Edge-Contacted" Metal-Graphene Interfaces 236

Vikram Passi¹, Amit Gahoi¹, Jasper Ruhkopf¹, Satender Kataria¹, Francois Vaurette²,
Emiliano Pallecchi², Henri Happy², Max Lemme¹
¹*Universität Siegen, Germany*; ²*Université Lille1, France*

Physics-Based Electrical Compact Model for Monolayer Graphene Fets 240

Jorge Daniel Aguirre-Morales³, Sébastien Frégonèse³, Chhandak Mukherjee², Cristell
Maneux², Thomas Zimmer², Wei Wei¹, Henri Happy¹
¹*Université Lille1, France*; ²*University of Bordeaux, France*; ³*University of Bordeaux /
Centre National de la Recherche Scientifique, France*

CVD Graphene-FET Based Cascode Circuits: A Design Exploration and Fabrication Towards Intrinsic Gain Enhancement 244

Mario Iannazzo¹, Eduard Alarcon¹, Himadri Pandey², Vikram Passi², Max Lemme²
¹*Universitat Politècnica de Catalunya · BarcelonaTech, Spain*; ²*Universität Siegen,
Germany*

B2L-C Variability and RTN Characterization

Date: Wednesday, September 14, 2016
Time: 10:05 - 11:45
Room: 5A
Chair(s): Gunnar Malm; *KTH Royal Institute of Technology*
Eric Bury; *IMEC*

On-Chip I-V Variability and Random Telegraph Noise Characterization in 28 nm CMOS 248

Amy Whitcombe², Scott Taylor¹, Martin Denham¹, Vladimir Milovanović², Borivoje Nikolić²

¹Raytheon Vision Systems, United States; ²University of California, Berkeley, United States

Probing Defects Generation During Stress in High- κ /Metal Gate FinFETs by Random Telegraph Noise Characterization..... 252

Francesco Maria Puglisi², Felipe Costantini², Ben Kaczer¹, Luca Larcher², Paolo Pavan²

¹IMEC, Belgium; ²Università di Modena e Reggio Emilia, Italy

Noise-Induced Dynamic Variability in Nano-Scale CMOS SRAM Cells 256

Christoforos Theodorou³, Mouenes Fadlallah⁴, Xavier Garros², Charalabos Dimitriadis¹, Gérard Ghibaudo³

¹Aristotle University of Thessaloniki, Greece; ²CEA-Leti, France; ³Grenoble Institute of Technology, France; ⁴Lebanese University, Lebanon

Comprehensive Study of Random Telegraph Noise in Base and Collector of Advanced SiGe HBT: Bias, Geometry and Trap Locations 260

Chhandak Mukherjee³, Thomas Jacquet³, Thomas Zimmer³, Cristell Maneux³, Anjan Chakravorty¹, Josef Boeck², Klaus Aufinger²

¹Indian Institute of Technology, Madras, India; ²Infineon Technologies AG, Germany; ³University of Bordeaux, France

Random Telegraph Signal Phenomena in Avalanche Mode Diodes: Application to SPADs 264

Vishal Agarwal, Anne-Johan Annema, Satadal Dutta, Ray Hueting, Lis Nanver, Bram Nauta

Universiteit Twente, Netherlands

B2L-D Gas Sensors

Date: Wednesday, September 14, 2016

Time: 10:05 - 11:45

Room: 5B

Chair(s): Mirjana Banjevic; *Sensirion*

Volker Cimalla; *Fraunhofer*

INVITED: Novel Suspended Graphene Devices for Extreme Sensing 268

Hiroshi Mizuta, Jian Sun, Manoharan Muruganathan

Japan Advanced Institute of Science and Technology, Japan

INVITED: Ultra Low Power NO₂ Gas Sensors Based on Suspended CNFETs 272

Christofer Hierold, Kiran Chikkadi, Miroslav Haluska, Cosmin Roman

Eidgenössische Technische Hochschule Zürich, Switzerland

Composition-Modulated Electrodeposited PdNi-Si Hydrogen Sensors for Low Power Applications 276

Kees de Groot², Long Tao Dong², Ashwin Usgaocar², Valerie Chavagnac¹

¹*Géosciences Environnement Toulouse, France;* ²*University of Southampton, United Kingdom*

CMOS-Compatible SOI Micro-Hotplate-Based Oxygen Sensor 280

Viorel Avramescu¹, Andrea De Luca², Mihai Brezeanu¹, Zeeshan Ali², Florin Udrea², Octavian Buiu¹, Cornel Cobianu¹, Bogdan Serban¹, Julian Gardner³, Viorel Dumitru¹, Alisa Stratulat¹

¹*Honeywell Romania, Romania;* ²*University of Cambridge, United Kingdom;* ³*University of Warwick, United Kingdom*

B4L-C 2D Electronics II

Date: Wednesday, September 14, 2016

Time: 14:15 - 15:55

Room: 5A

Chair(s): Frank Schwierz; *TU Ilmenau*
Grace Xing; *Cornell University*

INVITED: High-Quality Synthetic 2D Transition Metal Dichalcogenide Semiconductors	284
Dumitru Dumcenco, Dmitry Ovchinnikov, Kolyo Marinov, Andras Kis <i>École Polytechnique Fédérale de Lausanne, Switzerland</i>	
Graphene / a-Si:H Multispectral Photodetectors.....	287
Daniel Schneider, Andreas Bablich, Max Lemme <i>Universität Siegen, Germany</i>	
Adhesion Lithography to Fabricate MoS2 Fets with Self-Assembled Monolayer-Based Gate Dielectrics	291
Takamasa Kawanago, Ryo Ikoma, Du Wanjing, Shunri Oda <i>Tokyo Institute of Technology, Japan</i>	
Floating Gate Memory Based on MoS2 Channel and iCVD Polymer Tunneling Dielectric.....	295
Myung Hun Woo, Byung Chul Jang, Junhwan Choi, Gwang Hyuk Shin, Hyejeong Seong, Sung Gap Im, Sung-Yool Choi <i>Korea Advanced Institute of Science and Technology, Korea</i>	
Toward Effective Passivation of Graphene to Humidity Sensing Effects	299
Anderson Smith ¹ , Karim Elgammal ¹ , Xuge Fan ¹ , Max Lemme ² , Anna Delin ¹ , Frank Niklaus ¹ , Mikael Östling ¹ ¹ <i>KTH Royal Institute of Technology, Sweden</i> ; ² <i>Universität Siegen, Germany</i>	

B4L-E More than Moore Devices

Date: Wednesday, September 14, 2016

Time: 14:15 - 15:55

Room: 5C

Chair(s): Denis Rideau; *STMicroelectronics*
Marco Bellini; *ABB*

Management of Parasitic Bipolars in Modular High Power LDMOS Technology 303

Moshe Agam, Jaroslav Pjenčák, Dušan Prejda, Agajan Suwhanov, Thierry Yao, Ladislav Šeliga

ON Semiconductor, Czech Rep.; ON Semiconductor, United States

Impact of Device Geometry of the Fin Electron-Hole Bilayer Tunnel FET 307

Cem Alper¹, Jose Luis Padilla³, Pierpaolo Palestri², Adrian Ionescu¹

¹*École Polytechnique Fédérale de Lausanne, Switzerland;* ²*Università degli Studi di Udine, Italy;* ³*University of Granada, Spain*

The Exploitation of Magnetization Orientation Encoded Spin-Transfer Torque for an Ultra Dense Non-Volatile Magnetic Shift Register 311

Thomas Windbacher, Alexander Makarov, Viktor Sverdlov, Siegfried Selberherr

Technische Universität Wien, Austria

Closed-Form Transition Rate in Hopping Conduction 315

Enrico Piccinini², Massimo Rudan², Rossella Brunetti¹

¹*Università degli Studi di Modena e Reggio Emilia, Italy;* ²*Università di Bologna, Italy*

Analysis of Substrate Currents Propagation in HVCMOS Technology 319

Camillo Stefanucci³, Pietro Buccella², Ehrenfried Seebacher¹, Alexander Steinmair¹, Maher Kayal², Jean Michel Sallese²

¹*ams AG, Austria;* ²*École Polytechnique Fédérale de Lausanne, Switzerland;* ³*École Polytechnique Fédérale de Lausanne / ams AG, Switzerland*

B7L-D Wide Bandgap Innovative Devices

Date: Wednesday, September 14, 2016

Time: 16:20 - 18:00

Room: 5B

Chair(s): Edwin Piner; *Texas State University*

Gheorge Brezaeanu; *Politehnica University of Bucharest*

Novel AlGaIn/GaN Omega-FinFETs with Excellent Device Performances..... 323

Ki-Sik Im³, Chul-Ho Won³, Jae Hwa Seo³, In Man Kang³, Sindhuri Vodapally³, Yong Soo Lee³, Jung-Hee Lee³, Yong-Tae Kim², Sorin Cristoloveanu¹

¹*Grenoble Institute of Technology / Université Grenoble Alpes, France;* ²*Korea Institute of Science and Technology, Korea;* ³*Kyungpook National University, Korea*

Low-Energy Consumption Nano-Opto-Electronics Based on III-Nitride-LED

Mesoscopic Structures..... 327

Detlev Grützmacher, Martin Mikulics, Hilde Hardtdegen

Forschungszentrum Jülich, Germany

INVITED: Diamond Electronics..... 330

Mutsuko Hatano², Takayuki Iwasaki², Satoshi Yamasaki², Toshiharu Makino¹

¹*National Institute of Advanced Industrial Science and Technology, Japan;* ²*Tokyo Institute of Technology, Japan*

INVITED: Replacing Si to SiC: Opportunities and Challenges..... 472

Muhammad Nawaz, Kalle Ilves

ABC Corporate Research

B9L-C Quantum Devices

Date: Wednesday, September 14, 2016

Time: 16:20 - 17:50

Room: 5A

Chair(s): Ryochi Ishihara; *TU Delft*
Andras Kis; *EPFL*

INVITED: Quantum Dot Devices: Technology Vehicles for Nanoscale Physics and Paths for Future Applications 333

Shunri Oda

Tokyo Institute of Technology, Japan

A Manufacturable Process for Single Electron Charge Detection, a Step Towards Quantum Computing..... 337

Gabriel Droulers, Serge Ecoffey, Dominique Drouin, Michel Pioro-Ladriere

Université de Sherbrooke, Canada

Ballistic Transport and High Thermopower in One-Dimensional InAs Nanowires..... 341

Siegfried Karg, Vaness Schaller, Andrew Gaul, Kirsten Moselund, Heinz Schmid, Bernd

Gotsmann, Johannes Gooth, Heike Riel

IBM Research GmbH, Switzerland

Graphene Quantum Capacitors for High-Q Tunable LC-Tanks for RF ICs..... 345

Clara Moldovan, Wolfgang Vitale, Michele Tamagnone, Juan Mosig, Adrian Ionescu

École Polytechnique Fédérale de Lausanne, Switzerland

B9L-E Steep Slope Devices

Date: Wednesday, September 14, 2016

Time: 16:20 - 17:50

Room: 5C

Chair(s): Elena Gnani; *University of Bologna*
Thomas Ernst; *CEA*

INVITED: Steep Slope Transistors: Tunnel FETs and Beyond 349

Alan Seabaugh², Cristóbal Alessandri², Mina Asghari Heidarlou², Hua-Min Li², Leitao Liu², Hao Lu², Sara Fathipour², Paolo Paletti², Pratyush Pandey², Trond Ytterdal¹

¹Norwegian University of Science and Technology, Norway; ²University of Notre Dame, United States

Field-Enhanced Design of Steep-Slope VO₂ Switches for Low Actuation Voltage 352

Wolfgang Vitale¹, Michele Tamagnone¹, Clara Moldovan¹, Nicolas Émond², Emanuele Casu¹, Luca Petit¹, Boris Le Droff², Mohamed Chaker², Juan Mosig¹, Adrian Ionescu¹

¹École Polytechnique Fédérale de Lausanne, Switzerland; ²Institut National de la Recherche Scientifique, Canada

16Kb Hybrid TFET/CMOS Reconfigurable CAM/SRAM Array Based on 9T-TFET Bitcell 356

Navneet Gupta³, Adam Makosiej¹, Andrei Vladimirescu², Amara Amara², Costin Anghel²

¹CEA-Leti, France; ²Institut Supérieur d'Electronique de Paris, France; ³Institut Supérieur d'Electronique de Paris / CEA-LETI, France

Supersteep Retrograde Doping in Ferroelectric MOSFETs for Sub-60mV/dec Subthreshold Swing..... 360

Tommaso Rollo, David Esseni
Università degli Studi di Udine, Italy

C2L-D Ferroelectric and Phase Change Memory Devices

Date: Thursday, September 15, 2016

Time: 10:05 - 11:35

Room: 5B

Chair(s): Georg Tempel; *Infineon Technologies*

Thomas Mikolajick; *NaMLab gGmbH*

INVITED: Impact of Field Cycling on HfO₂ Based Non-Volatile Memory Devices 364

Uwe Schroeder⁴, Milan Pešić⁴, Tony Schenk⁴, Halid Mulaosmanovic⁴, Stefan Slesazeck⁴, Johannes Ocker⁴, Claudia Richter⁴, Ekaterina Yurchuk⁴, Karan Khullar⁴, Johannes Müller¹, Patrick Polakowski¹, Everett D. Grimley⁵, James M. LeBeau⁵, Stefan Flachowsky², Sven Jansen², Sabine Kolodinski², Ralf van Bentum², Alfred Kersch³, Christopher Künne³, Thomas Mikolajick⁶

¹*Fraunhofer IPMS-CNT, Germany*; ²*GlobalFoundries Inc., Germany*; ³*Munich University of Applied Sciences, Germany*; ⁴*NaMLab gGmbH, Germany*; ⁵*North Carolina State University, United States*; ⁶*Technische Universität Dresden, Germany*

Comparison of Hafnia and PZT Based Ferroelectrics for Future Non-Volatile FRAM Applications..... 369

Franz Paul Gustav Fengler¹, Milan Pešić¹, Sergej Starschich², Theodor Schneller², Ulrich Böttger², Tony Schenk¹, Min Hyuk Park¹, Thomas Mikolajick³, Uwe Schroeder¹

¹*NaMLab gGmbH, Germany*; ²*Rheinisch-Westfälische Technische Hochschule Aachen, Germany*; ³*Technische Universität Dresden, Germany*

Inherent Stochasticity in Phase-Change Memory Devices 373

Manuel Le Gallo², Tomas Tuma², Federico Zipoli², Abu Sebastian², Evangelos Eleftheriou¹

¹*IBM Research GmbH, Switzerland*; ²*IBM Research-Zurich, Switzerland*

Bipolar-Switching Operated Phase Change Memory (PCM) for Improved High-Temperature Reliability..... 377

Nicola Ciochini², Mario Laudato², Andrea Leonardo Lacaita², Daniele Ielmini², Mattia Boniardi¹, Enrico Varesi¹, Paolo Fantini¹

¹*Micron Technology Inc., Italy*; ²*Politecnico di Milano, Italy*

C2L-E Bio Meets Electronics

Date: Thursday, September 15, 2016

Time: 10:05 - 11:35

Room: 5C

Chair(s): Piotr Grabiec; *ITE*
Joachim Burghartz; *IMS*

INVITED: Soft and Bio-Degradable Electronics: Technology Challenges and Future Applications..... 381

Giovanni Antonio Salvatore

Eidgenössische Technische Hochschule Zürich, Switzerland

Time Multiplexed Active Neural Probe with 678 Parallel Recording Sites 385

Bogdan Raducanu³, Refet Yazicioglu¹, Carolina Lopez¹, Marco Ballini¹, Jan Putzeys¹, Shiwei Wang¹, Alexandru Andrei¹, Marleen Welkenhuysen¹, Nick van Helleputte¹, Silke Musa¹, Robert Puers², Fabian Kloosterman⁴, Chris van Hoof³, Srinjoy Mitra¹

¹IMEC, Belgium; ²Katholieke Universiteit Leuven, Belgium; ³Katholieke Universiteit

Leuven / IMEC, Belgium; ⁴NERF - Neuroelectronics Research-IMEC, Belgium

Bipolar Junction Transistor Based Sensors for Chemical and Biological Sensing 389

Sufi Zafar², Tak Ning¹

¹IBM Research GmbH, United States; ²IBM TJ Watson Research Center, United States

Signal-to-Noise Ratio Enhancement Using the Gate Coupling Effect 393

Ihor Zadorozhnyi, Svetlana Vitusevich

Forschungszentrum Jülich, Germany

C3L-C Tunnel Field Effect Transistors

Date: Thursday, September 15, 2016

Time: 10:05 - 11:45

Room: 5A

Chair(s): Andreas Schenk; *ETHZ*

Costin Anghel; *ISEP*

INVITED: Advances in Steep-Slope Tunnel FETs 397

Katsuhiro Tomioka, Junichi Motohisa, Takashi Fukui

Hokkaido University, Japan

INVITED: Complementary III-V Heterostructure Tunnel FETs 403

Kirsten Moselund², Davide Cutaia², Heinz Schmid², Heike Riel², Saurabh Sant¹, Andreas Schenk¹

¹*Eidgenössische Technische Hochschule Zürich, Switzerland*; ²*IBM Research GmbH, Switzerland*

Si n-TFETs on Ultra Thin Body with Suppressed Ambipolarity 408

Chang Liu¹, Qinghua Han¹, Gia Vinh Luong¹, Keyvan Narimani¹, Stefan Glass¹, Andreas T. Tiedemann¹, Stefan Trellenkamp¹, Wenjie Yu², Xi Wang², Siegfried Mantl¹, Qing-Tai Zhao¹

¹*Forschungszentrum Jülich, Germany*; ²*Shanghai Institute of Microsystem and Information Technology, China*

Non-Uniform Strain in Lattice-Mismatched Heterostructure Tunnel Field-Effect Transistors 412

Devin Verreck², Anne Verhulst¹, Bart Sorée³, Nadine Collaert¹, Anda Mocuta¹, Aaron Thean¹, Guido Groeseneken²

¹*IMEC, Belgium*; ²*Katholieke Universiteit Leuven / IMEC, Belgium*; ³*Universiteit Antwerpen & imec, Belgium*

C6L-C Advanced TCAD Developments

Date: Thursday, September 15, 2016

Time: 14:35 - 15:55

Room: 5A

Chair(s): Bernd Meinerzhagen; *TU Braunschweig*
Mathieu Luisier; *ETHZ*

TCAD Low-Field Mobility Model for InGaAs UTB MOSFETs Including Quasi-Ballistic Corrections 416

Stefania Carapezzi², Enrico Caruso¹, Antonio Gnudi², Susanna Reggiani², Elena Gnani²

¹*Università degli Studi di Udine, Italy*; ²*Università di Bologna, Italy*

Empirical Ballistic Mobility Model for Drift-Diffusion Simulation 420

Axel Erlebach¹, Helen Lee², Fabian Bufler¹

¹*Synopsys Schweiz GmbH, Switzerland*; ²*Synopsys Taiwan Co, Ltd., Taiwan*

A Study of Diffusive Transport in 14nm FDSOI MOSFET: NEGF Versus QDD..... 424

Gabriel Mugny⁵, Fabio Pereira⁵, Denis Rideau⁵, François Triozon², Yann Michel Niquet¹,
Marco Pala³, Davide Garetto⁶, Christophe Delerue⁴

¹*CEA, INAC-MEM, France*; ²*CEA-Leti, France*; ³*IMEP-LAHC, MINATEC/INPG, France*;

⁴*Institut d'Electronique de Microélectronique et de Nanotechnologie, France*;

⁵*STMicroelectronics, France*; ⁶*Synopsys SARL, France*

A Drift-Diffusion-Based Analytic Description of the Energy Distribution Function for Hot-Carrier Degradation in Decanometer NMOSFETs 428

Prateek Sharma⁴, Stanislav Tyaginov⁴, Stewart E. Rauch III¹, Jacopo Franco², Ben

Kaczer², Alexander Makarov⁴, Mikhail I. Vexler³, Tibor Grasser⁴

¹*GlobalFoundries Inc., United States*; ²*IMEC, Belgium*; ³*Ioffe Institute, Russia*;

⁴*Technische Universität Wien, Austria*

C6L-D Resistive Memory for Emerging Architectures and Applications

Date: Thursday, September 15, 2016

Time: 14:35 - 15:45

Room: 5B

Chair(s): Andrea Lacaita; *Politecnico di Milano*

Elisa Vianello; *CEA-Leti*

INVITED: ReRAM Technology Evolution for Storage Class Memory Application 432

Yangyin Chen, Chris Petti

SanDisk Corp., United States

Highly-Uniform Multi-Layer ReRAM Crossbar Circuits 436

Gina Cristina Adam¹, Brian Hoskins², Mirko Prezioso², Farnood Merrikh Bayat², Bhaswar Chakrabarti², Dmitri Strukov²

¹*IMT Bucharest, Romania;* ²*University of California, Santa Barbara, United States*

Large-Scale Neural Networks Implemented with Non-Volatile Memory as the Synaptic Weight Element: Impact of Conductance Response..... 440

Severin Sidler¹, Irem Boybat¹, Robert M. Shelby², Pritish Narayanan², Junwoo Jang³, Alessandro Fumarola², Kibong Moon³, Yusuf Leblebici¹, Hyunsang Hwang³, Geoffrey W. Burr²

¹*École Polytechnique Fédérale de Lausanne, Switzerland;* ²*IBM Research GmbH, United States;* ³*Pohang University of Science and Technology, Korea*

C7L-D MEMS and Microfluidics

Date: Thursday, September 15, 2016

Time: 15:50 - 17:20

Room: 5B

Chair(s): Hoel Guerin; *EPFL*
Joachim Burghartz; *IMS*

New Approach for a Multi-Cantilever Arrays Sensor System with Advanced MOEMS Readout 444

Francesco Ivaldi¹, Tomasz Bieniek¹, Paweł Janus¹, Jerzy Zająć¹, Piotr Grabiec¹,
Wojciech Majstrzyk², Daniel Kopiec², Teodor Gotszalk²

¹*Instytut Technologii Elektronowej, Poland*; ²*Wrocław University of Technology, Poland*

Microelectromechanical Resonator Based Digital Logic Elements 448

Md Abdullah Al Hafiz, Lakshmoji Kosuru, Mohammad Younis, Hossein Fariborzi

King Abdullah University of Science and Technology, Saudi Arabia

Heterogeneous Integration of Low Power pH FinFET Sensors with Passive Capillary Microfluidics and Miniaturized Ag/AgCl Quasi-Reference Electrode 452

Erick Garcia-Cordero, Hoël Guerin, Amira Muhech, Francesco Bellando, Adrian Ionescu

École Polytechnique Fédérale de Lausanne, Switzerland

C8L-C Compact Modeling

Date: Thursday, September 15, 2016

Time: 16:00 - 17:20

Room: 5A

Chair(s): Benjamin Iniguez; *Universitat Rovira i Virgili*
Wladek Grabinski; *EPFL*

Implementation of a DC Compact Model for Double-Gate Tunnel-FET Based on 2D Calculations and Application in Circuit Simulation 456

Fabian Horst², Michael Graef², Fabian Hosenfeld², Atieh Farokhnejad², Franziska Hain²,
Gia Vinh Luong¹, Qing-Tai Zhao¹, Benjamin Iñíguez³, Alexander Kloes²

¹*Forschungszentrum Jülich, Germany;* ²*Technische Hochschule Mittelhessen, Germany;*
³*Universitat Rovira i Virgili, Spain*

A Large Signal Non Quasi Static Compact Model for Printed Organic Thin Film Transistors 460

Antonio Valletta, Matteo Rapisarda, Sabrina Calvi, Luigi Mariucci, Guglielmo Fortunato
Consiglio Nazionale delle Ricerche, Italy

Compact Model for Variability of Low Frequency Noise Due to Number Fluctuation Effect 464

Nikolaos Mavredakis, Matthias Bucher
Technical University of Crete, Greece

Advanced 3-D Device and Circuit Electrothermal Simulations of Power Integrated Circuit 468

Aleš Chvála, Juraj Marek, Patrik Příbytný, Daniel Donoval
Slovak University of Technology in Bratislava, Slovakia