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TECHNICAL BRIEFS

MARVELS IN MEMS EVOLVEMENT AND DEVELOPMENT—SILICON AS A MICROMECHANICAL MATERIAL HAS BEEN DRIVING MORE-THAN-MOORE

BY JOACHIM N. BURGHARTZ

In the past issues of the EDS Newsletter, since July 2018, we were pointing to marvels in microelectronic engineering that were associated with original contributions coming as a surprise, or having an unexpectedly high impact. All of them were related to driving Moore's Law, making silicon devices smaller and squeezing more electronics on a silicon chip, and all of them were primarily technical. But how about MEMS? Microelectromechanical devices had little to do with mainstream microelectronics in the 1950s through 1970s. At Bell Labs, Uhlir looked into etching of bulk silicon and made the first steps into bulk micromachining [1]. Robbins and Schwartz from Hughes Semiconductors published in 1960 on chemical etching of silicon [2]. Richard Feynman's famous talk 'There's plenty of room at the bottom' [3] may have inspired the development of the first MEMS devices, such as Wilfinger's Resonistor [4] and Nathanson's Resonant Gate Transistor [5]. Nathanson's work can be considered the first step into surface micromachining, in which the planar wafer processes were exploited for shallow three-dimensional micromechanical structures on top of the bulk silicon wafer. Further advancements in bulk micromachining by Waggener [6] and others, led in the 1970's to the development of pressure sensors [7], inkjet nozzles [8] and other MEMS devices.

However, these achievements came from isolated efforts; there was no MEMS technical community and no focused industrial effort

(continued on page 3)

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NEWSLETTER DEADLINES

ISSUE	DUE DATE
April	January 1st
July	April 1st
October	July 1st
January	October 1st

The EDS Newsletter archive can be found on the Society web site at <http://eds.ieee.org/eds-newsletters.html>. The archive contains issues from July 1994 to the present.

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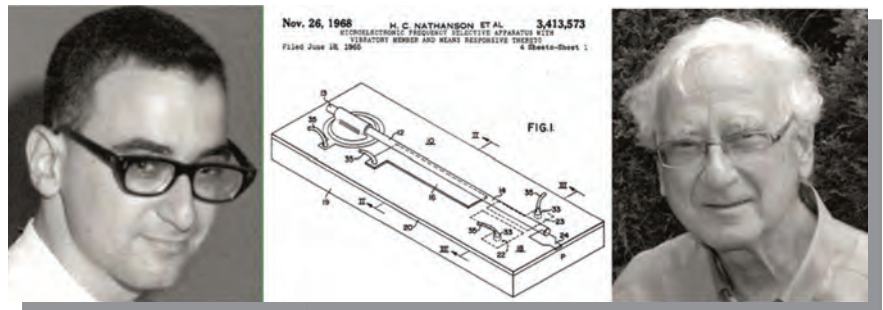
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MARVELS IN MEMS EVOLVEMENT AND DEVELOPMENT—SILICON AS A MICROMECHANICAL MATERIAL HAS BEEN DRIVING MORE-THAN-MOORE

(continued from page 1)

that could be compared to the well coordinated miniaturization of micro-electronics following Moore's Law. And the term MEMS was not even created. This clearly changed with Kurt Petersen's article 'Silicon as a Mechanical Material' [9] which appeared in the Proceedings of the IEEE in 1982. It was the time when Moore's Law was endangered as Hg-based lithography steppers seemed not extendable beyond i-line. There was a clear desire for leveraging silicon technology through new businesses, the first steps into More-than-Moore. Petersen's Proceedings paper can be considered a true marvel in micro-electronic engineering since it led to pulling together isolated efforts into a research community, by driving industrial applications, by encouraging start-ups and by putting MEMS on the semiconductor roadmap. In recognition of these efforts and successes, Kurt Petersen was honored by receiving the 2019 IEEE Medal of Honor, the highest-level award issued by the IEEE. Petersen's career



Harvey Nathanson at young age (left) and more recently (right), next to his early MEMS device (middle) [9]

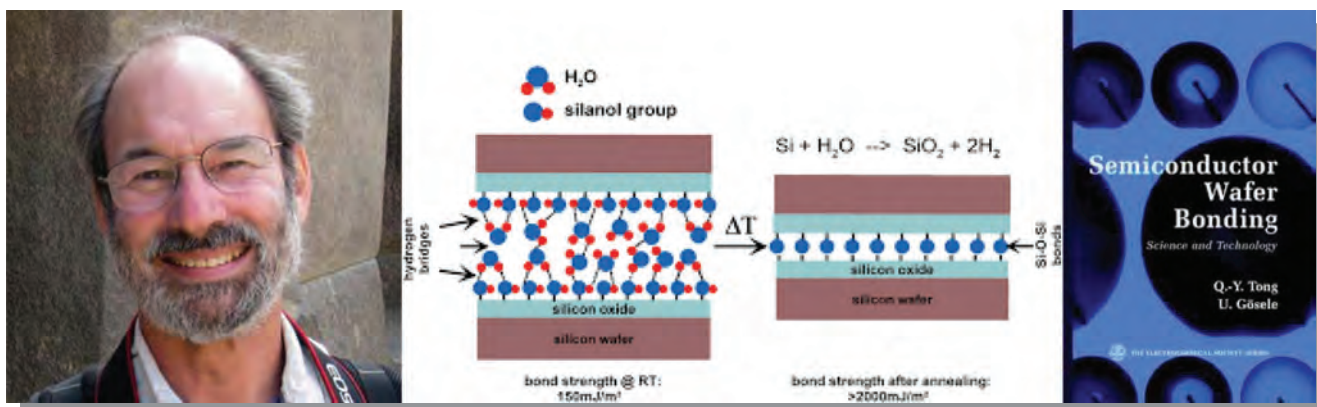
on MEMS is well described in a recent article in IEEE Spectrum [11]:

Kurt Petersen, after graduating from MIT, had joined IBM's Almaden Research Center in 1975 to work in an optics group, but he found himself bored. With an open eye for new opportunities he once came across a huge black stain on the floor which he tracked down as an ink spill caused by another group working on inkjet nozzles. He launched himself down a new career path, building MEMS technologies. Kurt read papers on silicon micromachining and got in touch

with the researchers. He remembers: "Ernest Bassous at IBM, Ken Bean at TI, Larry Hornbeck at TI, Harvey Nathanson at Westinghouse, Prof. Jim Angel at Stanford, Prof. Ken Wise at Michigan, Prof. Richard Muller at Berkeley, Prof. Wen Ko, Prof. Steve Senturia at MIT, Prof. Masayoshi Esashi at Tohoku University—these were some of my early heroes in the MEMS arena." He identified lots of micromechanical structures and devices that were likely useful to IBM, but his employer was not interested. On the contrary, many people doing



Kurt Petersen (left), recipient of the 2019 IEEE Medal of Honor, and the cover of Petersen's 1982 paper in the Proceedings of the IEEE [10], [11]



Jerry Lasky (left; courtesy of J. Lasky rep Radaris), scheme of silicon fusion bonding (SFB) (middle, [14]), and cover of Ulrich Gösele's book on SFB [15]

crazy things on silicon were finding him. Petersen turned into a technology evangelist for MEMS. At the time the proceedings paper was published, only 30 to 40 researchers around the world were working in that field. By 1990, that number had ramped up to about 600. Kurt Petersen himself contributed to growth of the field by founding six start-up companies; Transensory Devices was his first, SiTime was his most successful one. He told me: "The best story is SiTime. SiTime builds MEMS oscillators which are gradually replacing the quartz crystal. These devices are now better than the quartz crystal oscillator in every way, frequency stability, temperature performance, size, cost, reliability. SiTime has shipped cumulatively over 1B units." Kurt Petersen himself, as somebody driving an entire field, can be considered a personified marvel of microelec-

tronic engineering, or better, of silicon technology. When confronting Franz Laermer, the co-inventor of the BOSCH RIE process to be addressed later in this article, he said: "A careful definition of "successful" is required in this place: Is it about money? About technical impact? When it comes to money, SiTime is certainly not the most successful one of Kurt Petersen. Maybe the fanciest one, most innovative, with the largest impact. Kurt also co-founded NovaSensor (together with Janusz Bryzek and Joseph Mellon). This company was later bought by LUCAS for a tremendous amount of money, as far as I know at a higher price than that of SiTime later on. The most successful start-up company from the monetary value which Kurt ever founded was Cepheid. Cepheid was traded at ~\$4B at the NASDAQ stock-exchange under the ticker-symbol CPHD, and was finally taken

over by another company in a similar price-regime around \$5-6B."

When looking at what he had been influencing, Kurt Petersen said: "Silicon Fusion Bonding (SFB) and Deep Reactive Ion Etching (DRIE) have had the most impact on modern MEMS. SFB was invented at IBM [12] and Toshiba [13] around 1982 for SOI circuits. At NovaSensor, we used this technology to build MEMS devices for the first time. In fact, we invented the term Silicon Fusion Bonding. I still remember a group of us sitting around brain-storming names for this new process. At the time, Toshiba was calling it Direct Wafer Bonding. But, SFB became the preferred terminology. DRIE was invented by Franz Laermer at Bosch in about 1992."

When thinking about silicon wafer bonding, we may all be thinking of a coincidental discovery. It may have happened to many of us that



Franz Lärmer and Andrea Urban (Schilp) (left; IEEE Jun-ichi Nishizawa Medal Recipients web site), a typical etch profile resulting from the BOSCH DRIE process (middle; open content Wikimedia Commons), and a deep trench used for a high-density DRAM formerly manufactured by Infineon AG (right; courtesy Infineon AG)



Richard Muller and Roger Howe (two left) pioneered polysilicon surface micromachining. Larry Hornbeck (photo on the right) pioneered micro mirrors and TI's digital light processing device (right)

by accident two polished silicon wafers ended up in the same slot of a wafer carrier. Without any doubt, those two wafers would easily bond together and could not be separated afterwards. However, Jerry Lasky, now happily retired and kayaking and hiking in Vermont but formerly with IBM and the key inventor of SFB, told me: "The discovery of wafer bonding was not as accidental as you are imagining. I think it is a case of "chance favors the prepared mind." I was trying to do wafer bonding, being familiar with "Mallory Bonding" of wafers to glass where a voltage is placed across the system; it is heated to 350 °C and bonding occurs. However, that relies on Na⁺ in the glass to be a conductor. I was guessing that at high enough temperatures Na⁺ would not be needed. I was trying to bond an oxidized wafer to a second wafer in a test run in a furnace at 1000 °C. The wafers were in contact, but the electrodes not energized. Despite this, the wafers came out bonded! I repeated several times with the same result. This was a "research" furnace which is certainly not the cleanest system. I assumed a contaminate was playing a role. I finally got access to clean equipment and was able to show that, if I had a glass rod between two wafers but removed it prior to insertion to the furnace, they came out bonded. However, if I inserted them into the furnace held apart and removed the glass rod after they were heated to 600 °C or above, they did not bond. This was consis-

tent with OH ions absorbed on the surface contributing to the bonding. The bonding part of the process was quite well developed and very repeatable by 1984. This is described in our 1985 IEDM paper [12]."

Deep Reactive Ion Etching was invented and developed by Bosch engineers Franz Laermer and Andrea Urban (Schilp) [16] primarily for application to MEMS but also had a tremendous impact on DRAM technology in allowing for very high aspect ratio trench capacitor formation and on Through-Silicon-Vias (TSV) for three-dimensional (3D) circuit integration. Franz Laermer remembers: "The development was a R&D project at Bosch Corporate Research. Andrea Urban's and my work was strongly supported and encouraged by our department head, Dr. Gerhard Benz at that time. He once said to me: 'Your task is like struggling for the quadrature of the circle – nearly impossible to succeed. But if you make it a success, the impact would compensate for any efforts'. In fact, the efforts were minor, financially speaking: 2 people over some years, and a very limited materials budget, because we built our own provisory constructions at low cost and did not request expensive purchases." Different from Waggenger's anisotropic wet etching following the crystalline structure of silicon, the DRIE or BOSCH process allowed for vertical etch profiles in any orientation, independent from the crystalline structure. The plasma process is based on consecutive short steps of polymer deposition for side-

wall protection, and etch steps with energetic ion impact to remove the polymer from the planar regions.

In addition to Petersen's mentioning of SFB and DRIE as marvels in MEMS, I would like to bring up polysilicon surface micromachining introduced by Howe and Muller in 1983 [17]. Polysilicon and silicon dioxide are generally used as active and sacrificial layers to build up complex micromechanical structures on top of the wafer surface. This technological concept had an unexpected impact on the emergence of MEMS. Three-dimensional microstructures became feasible through first building them up and finally releasing them by removing the sacrificial material. Prominent examples are the Digital Light Processing (DLP) device invented by Larry Hornbeck at Texas Instruments [18], [19], the Analog Devices and Bosch inertial sensor product lines, electrostatically actuated micro gear devices [20], micromechanical resonators [21], and implantable medical neuro probes [22].

In conclusion, MEMS as a whole can be considered a marvel of micro-electronic engineering, or more generally of silicon technology, because it features the foundation of what we call now 'More-than-Moore.' For this it took the early efforts and indications of what else could be done with silicon technology beyond integrating electronic functions at ever increasing density and performance, such as Nathanson's first MEMS device in the 1960's. It needed Petersen's vision

and entrepreneurship to give birth to the MEMS community in the 1970's, and it took the numerous efforts thereafter from the 1980's to indentify and develop MEMS technologies and applications that led to an unexpectedly high economic value. There is more to come.

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EXECUTIVE DIRECTOR'S MESSAGE TO IEEE MEMBERS

Fellow IEEE members:

I am writing today to update you about a recent increase in fraudulent email scams targeting IEEE members.

These fraudulent email messages have use spoofed addresses to pose as someone known to the recipient. Fraudulent messages often contain personal details about IEEE members drawn from non-IEEE online sources and from social media sites accessible by search engines. These emails attempt to commit financial fraud by exploiting the professionalism and camaraderie among IEEE members. These fraudulent messages often include a request for urgent assistance, and will ask the recipient to transfer funds or goods to a third party.

I encourage all IEEE members to remain alert to the risk of fraudulent emails and to maintain continued vigilance online.

Please feel free to contact the IEEE IT security team at security@ieee.org if you have any questions, concerns, or need help with this topic.

With best regards,
Stephen Welby
 IEEE Executive Director

REVIEW OF THE 2019 IEDM

BY RIHITO KURODA AND DINA TRIYOSO

“Innovative Devices for an Era of Connected Intelligence” was the theme of the 2019 IEEE International Electron Devices Meeting (December 7–11, 2019), and was chosen to reflect the conference’s focus this year on the processors, memories, 3D architectures, power devices, quantum computing concepts and other technologies needed to drive diverse new applications of electronics technology forward. The 65th annual IEDM featured a technical program of 238 papers given by many of the world’s top scientists and engineers in the field. It was preceded by a series of 90-minute tutorials on Saturday, Dec. 7th, and by day-long short courses on Sunday, Dec. 8th.

The 90-minute Saturday tutorial sessions on emerging technologies have become a hugely popular part of IEDM. They are presented by experts in the fields, the goal being to bridge the gap between textbook-level knowledge and leading-edge current research. The topics for 2019 were:

- Oxide Semiconductors and Application, Hideo Hosono, Tokyo Institute of Technology
- In-Memory Computing for AI, Abu Sebastian, IBM
- Magnetic Field Sensors, Keith Green, TI
- Cryogenic MOSFET Modeling, Christian Enz, EPFL
- Ferroelectric Memories & Beyond, Johannes Mueller, GLOBALFOUNDRIES and Thomas Mikolajick, NaMLab/TuDresden
- 3D Sequential Integration, Perrine Batude, Leti

The short courses offered the opportunity to learn about important areas and developments, and to network with global experts. This year they focused on:

- Technology Scaling in the EUV Era and Beyond, organized by Wook-Hyun Kwon, Samsung
- Technologies for Memory-Centric Computing, organized by Ali Keshavarzi, Stanford Univ.

In addition, there were 3 Plenary Presentations on Monday, Dec. 9th:

- Process and Packaging Innovations for Moore’s Law Continuation and Beyond, Robert Chau, Senior Fellow, Intel
- Continued Scaling in Semiconductor Manufacturing Enabled by Advances in Lithography, Martin van den Brink, President and CTO, ASML
- Future of Non-Volatile Memory: From Storage to Computing, Kazunari Ishimaru, Senior Fellow, Kioxia

There was a career-focused luncheon on Tuesday, Dec. 10th this year featuring industry and scientific leaders talking about their personal experiences in the context of career growth. It was moderated by Jungwoo Joh of Texas Instruments. The speakers were Ramune Nagisetty, Senior Principal Engineer, Intel and Linda Somerville, Vice President, Micron Technology. There was also an evening panel where experts gave their views on important industry topics in a fun, engaging format. Audience participation was encouraged to foster an open and vigorous exchange of ideas. The title of this year’s evening panel was “Rest in Peace Moore’s Law, Long Live AI,” organized by Vijay Narayanan, IBM Fellow and Manager, Materials Research. Finally, there were two poster sessions, one on MRAM technology organized by the IEEE Magnetics Society, the other a student research showcase hosted by the Semiconductor Research Corporation and IEEE EDS.

The conference’s technical program was organized into multiple parallel sessions featuring papers from the following technical subcommittees: A) Advanced Logic Technology, B) Emerging Device and Compute Technology, C) Memory Technology, D) Microwave, Millimeter-Wave and Analog Technology, E) Modeling and Simulation, F) Optoelectronics, Displays and Imag-

ers, G) Power Devices and Systems, H) Reliability of Systems and Devices, and I) Sensors, MEMS and Bioelectronics. Each session had many high impact papers which cannot all be summarized in this review.

In addition, there were four Focus Sessions with papers on the following topics:

- Emerging AI Hardware Technologies—Increased semiconductor capabilities open up the possibility to further increase computers’ abilities to recognize signals and patterns, to make decisions based on that input, and then to act on those decisions on their own. Among other topics, this Focus Session discussed various in-memory processing approaches for faster, more energy-efficient AI processing, analog computing techniques, the use of different device types for network “neurons,” and a photonics-based approach for faster neural networks. The session included the following speakers and topics: “Design Considerations for Efficient Deep Neural Networks on Processing-in-Memory Accelerators,” Vivian Sze, MIT, “Towards 1000TOPS/W DNN Inference with Analog in-Memory Computing – A Circuit Blueprint, Device Options and Requirements,” Stefan Cosemans, IMEC, “The Marriage of Training and Inference for Scaled Deep Learning Analog Hardware,” Tayfun Gokmen, IBM, and “Can In-Memory/Analog Accelerators be a Silver Bullet for Energy-Efficient Inference?,” Jun Deguchi, Kioxia.
- Human Machine Interface – Electronic systems in different forms, such as wearables (e.g., fitness trackers), humanoid robots and AR/VR goggles, are making inroads in many areas for applications such as communications, health, entertainment, industrial productivity,

and others. This Focus Session surveyed and explored key issues related to the interface of these bio-electronic systems with humans. It addressed challenges related to computer vision and image sensing capabilities, as well as the development of haptic sensors, and also bioelectronic interfaces with humans for the purpose of medical diagnostics and healthcare. The session included the following speakers and topics: "The Neuropixels Probe: A CMOS-Based Integrated Microsystems Platform for Neuroscience and Brain Computer Interfaces," Barun Dutta, IMEC, "Microfabricated Bioelectronic Systems for Prevention, Diagnostics and Treatment of Neurological Disorders," Stephanie P. Lacour, EPFL, "Haptics-Led Innovation for Coming Society," Kouhei Ohnishi, Keio Univ., "Challenges in the Development of Wearable Human Machine Interface Systems," Brendan O'Flynn, Tyndall National Institute, "Intelligent Vision Systems – Bringing Human-Machine Interface to AR/VR," Chiao Liu, Facebook, "Low-Latency Interactive Sensing for Machine Vision," Paul K. J. Park, Samsung, and "High-Speed Image Processing Devices and Its Applications," Masatoshi Ishikawa, The University of Tokyo.

- Quantum Computing Infrastructure – Quantum computing has emerged as a possible candidate to address specific computational challenges not reachable by today's classical machines, because it exploits the laws of quantum physics and may make much more powerful and/or specialized computers possible. Future scaling of quantum computing beyond a few tens of qubits will also entail challenges for the classical electronics and systems surrounding the qubits themselves. This Focus Session explored system-level challenges of quantum computing, such as relevant semiconductor-related fabrication

and interconnect issues, and control electronics, and will brainstorm R&D directions for new materials, devices, circuits, manufacturing approaches and benchmarks for the scalable integration of a large number of qubits with CMOS technology, operating at cryogenic temperatures. The session included the following speakers and topics: "Manufacturing Low Dissipation Superconducting Quantum Processors," Matthew Reagor, Rigetti Computing, "Scalable Quantum Computing Infrastructure Based on Superconducting Electronics," Oleg A. Mukhanov, SeeQC, "Silicon Hard-Stop Spacers for 3D Integration of Superconducting Qubits," William D. Oliver, MIT, "A Sparse Spin Qubit Array with Integrated Control Electronics," Lieven M. K. Vandersypen, QuTech, TU Delft, "High-Volume Electrical Characterization of Semiconductor Qubits," Ravi Pillarisety, Intel, "Qubit Read-Out in Semiconductor Quantum Processors: Challenges and Perspectives," Tristan Meunier, CNRS, "Challenges in Scaling-Up the Control Interface of a Quantum Computer," David J. Reilly, Microsoft Quantum Sydney, The Univ. of Sydney, "III-V-on-CMOS Devices and Circuits: Opportunities in Quantum Infrastructure," Cezar B. Zota, IBM

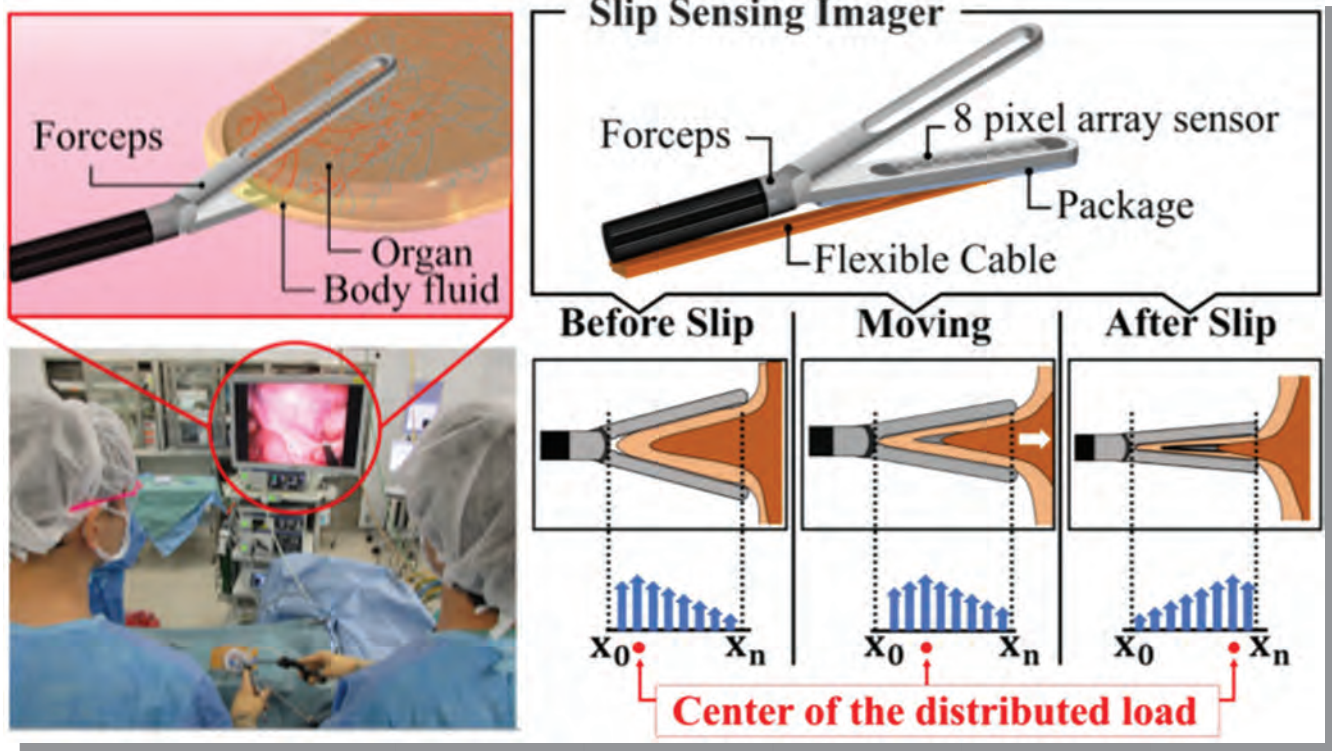
- Reliability and Security in Circuits & Systems – Reliability is a major design concern for computing systems, given the many inter-relationships between devices and circuits, plus the increasing need to detect/resist malware at the circuit level. This Focus Session explored topics ranging from high-level discussions of major reliability issues to specific approaches to address key challenges. The session included the following speakers and topics: "Challenges in Radio Frequency and Mixed-Signal Circuit Reliability," Vijay Reddy, TI,

"Telemetry for System Reliability," Robert Kwasnick, Intel, "Enabling Prognostics of Robust Design with Interpretable Machine Learning," Jay Sarkar, Western Digital, "Security and Reliability - Friend or Foe?," Ingrid Verbauwhede, KU Leuven, "Designing Secure Cryptographic Circuits," Naofumi Homma, Tohoku Univ., "Leveraging Circuit Reliability Effects for Designing Robust and Secure Physical Unclonable Functions," Chris H. Kim, Univ. Minnesota, and "Custom CMOS and Post-CMOS Crossbar Circuits for Resource-Constrained Hardware Security Primitives," Kaiyuan Yang, Rice University.

Here are summaries of several noteworthy papers:

"Highly Sensitive Slip Sensing Imager for Forceps Grippers Used Under Low Friction Condition," by K Ando et al. of Kagawa Univ./Takamatsu Red Cross Hospital

Our internal organs are slippery because they are covered with blood and other body fluids, so grasping and pulling them with forceps can be challenging. Although contact-force sensors have been placed on the tips of forceps used in laparoscopic and robotic surgeries, there currently is no way to know if they are slipping, other than visually via a monitor, which has limited usefulness. A Kagawa University team described a highly sensitive slip-sensing imager (sub-mm resolution) and novel algorithm that can, in effect, give forceps a sense of touch. The idea is to use the device to visualize the spatial distribution of the grasping force across the organ's surface. The center of that distributed load is calculated, and as the forceps are moved the algorithm relates any corresponding movements of the load center to slippage. Built on an SOI wafer, the device's force-sensor pixels consist of a 20 μm -thick piezoelectric silicon diaphragm (400 μm diameter) with a center contact, and with a force detection circuit integrated on the diaphragm. The diaphragm acts as a



The images on the left show a forceps gripping a slippery organ surface during laparoscopic surgery, and on the right is a depiction of the algorithm of slip detection, based on calculation of the center of the distributed load on the sensing device. ("Highly Sensitive Slip Sensing Imager for Forceps Grippers Used Under Low Friction Condition," K. Ando et al., Kagawa Univ./Takamatsu Red Cross Hospital)

strain gauge as it flexes due to varying grasping force. The images on the left show a forceps gripping a slippery organ surface during laparoscopic surgery, and on the right is a depiction of the algorithm of slip detection, based on calculation of the center of the distributed load on the sensing device.

"Millimeter-Scale Thin-Film Batteries for Integrated High Energy-Density Storage" by S. Oukassi et al. at CEA-Leti

There has been great progress in miniaturizing electronics but the miniaturization of power sources has not kept pace. Although integrated electrochemical capacitors offer high power density, high frequency response and novel form factors, their low energy densities are of limited value for MEMS and autonomous device applications that require long periods between charging. CEA-Leti researchers discussed a thin-film battery with the highest areal energy density yet reported ($890 \mu\text{Ah}/\text{cm}^2$) and high power density ($450 \mu\text{Ah}/\text{cm}^2$). Built on silicon

wafers using UV photolithography and etching for the successive deposition and patterning of each layer, the thin-film battery integrates a $20 \mu\text{m}$ -thick LiCoO_2 cathode in a Li-free anode configuration. It showed good cycling behavior over 100 cycles, and the fact it was built using a wafer-level process opens up the possibility to tightly integrate this battery technology with future electronic devices.

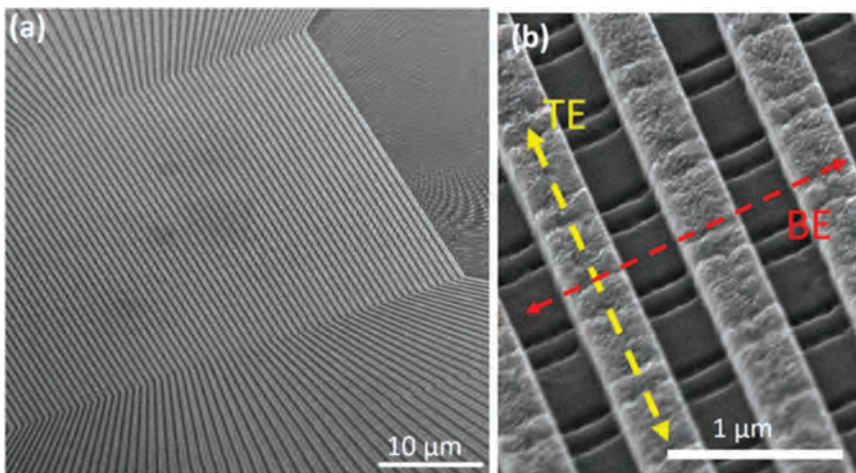
"Multiphysics Simulation & Design of Silicon Quantum Dot Qubit Devices," by F.A. Mohiyaddin et al., IMEC/KU Leuven/ETH Zurich

Design software such as TCAD is used to produce highly accurate models of semiconductor devices and their operation, but no analogous tools exist to model qubits, the basis of quantum computing, because the field is so new and complex. If these design tools did exist, the development of quantum computers could take place much more quickly. A team led by IMEC has taken a step to create such a software

framework, and described how they used multiphysics simulation methods to develop a comprehensive design methodology for qubits built in silicon. They modeled device electrostatics, stress, micromagnetics, band structure and spin dynamics. Based on the results of these studies, they say that single-electron qubits in quantum dots can be induced and optimized in silicon MOSFETs with thin ($<20 \text{ nm}$) gate oxides. The researchers discussed critical aspects of their methodology, the parameters they modeled, and next steps.

"Monolithic 180 nm CMOS-Controlled GHz Ultrasonic Impedance Sensing and Imaging," by M. Abdelmejeed et al., Cornell Univ./A-STAR)

Researchers led by Cornell discussed the monolithic integration of a piezoelectric AlN resonator into a CMOS-controlled, GHz ultrasonic impedance sensor/imager. The device measures changes in surface properties such as surface oxidation, materials, liquid viscosity and others, and



allow for an extremely large number (~1025) of challenge-response pairs (a common cryptographic protocol), as well as 4x better density vs. other ReRAM architectures plus a ~100x improvement in power efficiency and more robust security metrics.

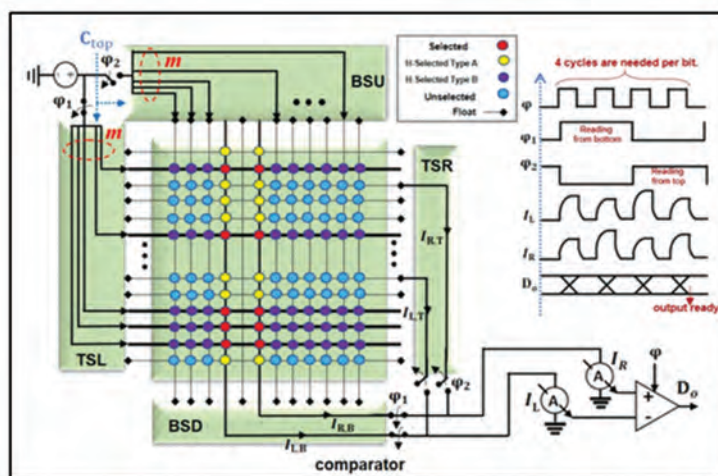
“High-Definition Visible-SWIR InGaAs Image Sensor Using Cu-Cu Bonding of III-V to Silicon Wafer,” by S. Manda et al. at Sony

Demand for imaging in the short-wavelength infrared range (SWIR, or 1,000–2,000 nm wavelengths) has been increasing for industrial, science, medical, agricultural and security purposes. InGaAs has been used to build SWIR sensors because it can absorb light in this range that silicon cannot. With conventional back-illuminated InGaAs sensors, each pixel of a photodiode array is connected to a readout circuit on a silicon wafer by means of a microbump. But it is difficult to scale these bumps, and so creating fine pitch pixel arrays for greater image definition is difficult. A Sony team described an architecture in which each pixel in an InGaAs/InP photodiode array is connected to the readout circuit not with microbumps, but by means of copper-to-copper bonding, resulting in a much tighter pitch. They used the technique to build a prototype 1280 × 1024-pixel array with a 5 μm pitch. Also, thinning of the InP layer and process optimization yielded a sensor that demonstrated high sensitivity and low dark current, respectively. The researchers say this work paves the way for high-definition SWIR imaging.

Edited by Carmen M. Lilley

Rihito Kuroda is IEDM 2019 Publicity Chair and Associate Professor at Tohoku University

Dina Triyoso is IEDM 2019 Publicity Vice Chair and Technologist at TEL Technology Center America



Above are SEM images showing (a) the 4096 ReRAM crossbar array, and (b) a zoom-in on a portion of the crossbar. Below the images is a timing diagram and schematic of the proposed architecture, including a 64 × 64 crossbar, selectors (top, bottom, right and left) and a comparator. (“Ultra-Low Power Physically Unclonable Function with Nonlinear Fixed-Resistance Crossbar Circuits,” M.R. Mahmoodi et al., UC Santa Barbara)

is meant for use in wearable, IoT and smartphone systems to detect fingerprints with high resolution, determine tissue states, and for other applications. This is the first time monolithic fabrication has been successfully demonstrated, and it led to small, power-efficient GHz sensing arrays with improved performance vs. the standard two-chip heterogeneous integration approach, thanks to less parasitic coupling and a higher signal-to-noise ratio.

“Ultra-Low Power Physically Unclonable Function with Nonlinear Fixed-Resistance Crossbar Circuits,” by M.R. Mahmoodi et al., UC-Santa Barbara.

The spread of networked mobile devices and smart gadgets in the IoT landscape has created an urgent need to protect them with lightweight and low-power cryptographic solutions. A physically unclonable function (PUF) is a hardware intrinsic security primitive, or basic programming element. UC Santa Barbara researchers discussed an ultra-low-power PUF that operates on the varying electrical resistances and current leakages that arise from intrinsic process variations in ReRAM crossbar arrays. The team built 4K-ReRAM passive crossbar circuit arrays fabricated with a CMOS-compatible process suitable for back-end-of-the-line (BEOL) integration. The arrays

UPCOMING TECHNICAL MEETINGS

2020 IEEE INTERNATIONAL CONFERENCE ON MICROELECTRONIC TEST STRUCTURES (ICMTS)

It is our great pleasure to invite you to the 33rd IEEE International Conference on Microelectronic Test Structures (ICMTS), which will be held April 6–9, 2020 in Edinburgh, UK. The event provides an ideal opportunity to present and discuss your ideas and results about test structures, measurements and characterisation. Sponsored by the IEEE Electron Devices Society, ICMTS is a truly international conference, which rotates its meeting venues in a three year cycle between Europe, the United States and Asia. The next meeting will be held in the shadow of Arthur's Seat, an ancient volcano in the Royal Holyrood Park at the centre of Scotland's capital city.

ICMTS is the leading measurement and characterisation conference for all micro- and nanofabrication processes including integrated circuits, photonics, and micro- and nanosystem technologies. The conference brings together designers and users of test structures to discuss recent developments and future directions, as well as exchanging viewpoints and identifying challenges.

2020 ICMTS will begin proceedings on the first day with a Tutorial and Short Course session, covering topics ranging from basic test structure design to more specialised topics such as test for packaging, photonics characterisation and the relevance of AI. These tutorials sessions are aimed towards research students and early career engineers in the semiconductor industry, and provide a valuable introduction to the development of microelectronic test and measurement, before going on to consider the current areas of interest and concern within the domain.



Edinburgh Castle (courtesy University of Edinburgh)

The subsequent technical program has been designed by the Technical Program Committee to reveal the current advances and challenges present in the field of microelectronic and microsystem test, measurement and characterisation. During the conference there will also be an associated equipment exhibition giving attendees the opportunity to view the latest characterisation equipment and technologies. Convivial breaks will allow networking with many of the best measurement, equipment design, and manufacturing experts as well as like-minded engineers with decades of experience in solving measurement issues.

Further networking opportunities and local entertainment will be available to all attendees during the Welcome reception on the first evening of the conference, and the Exhibition reception on the second evening. The final evening is reserved for the con-

ference banquet, which will be held in the Surgeons' Hall, the Category A listed headquarters of the Royal College of Surgeons of Edinburgh.

One oral presentation will be awarded the coveted ICMTS Best Paper Award by the Technical Program Committee. All accepted papers, if presented, will be submitted for possible inclusion on IEEE Xplore®. On behalf of the local and technical committees, we hope very much to see you at 2020 ICMTS in Edinburgh. "Lang may yer lum reek" as we say in Scotland. Slàinte Mhath!

Further details and registration can be found at: www.icmts.net

*Stewart Smith
General Chair of ICMTS 2020
University of Edinburgh*

*Jonathan Terry
Treasurer and Local Chair of ICMTS 2020
University of Edinburgh*

2020 INTERNATIONAL RELIABILITY PHYSICS SYMPOSIUM (IRPS)

The International Reliability Physics Symposium (IRPS) is the world's premier forum for leading-edge research addressing developments in the Reliability Physics of devices, materials, circuits, and products used in the electronics industry. IRPS is the conference where **emerging reliability physics challenges and practical solutions** to achieve realistic **end-of-life projections** are first discussed.

This year, the IRPS will be held **March 29th–April 2nd at the Hilton DFW Lakes Executive Conference Center, Dallas, Texas**. The IRPS begins with two full days of tutorials and a year-in-review on Sunday, March 29th and Monday, March 30th followed by three days (Tuesday–Thursday, March 31st–April 2nd) of plenary and parallel technical sessions presenting original, state-of-the-art work. **Late paper submission due January 24, 2020.**

The IRPS draws presentations and attendees from industry, academia and governmental agencies worldwide. No other meeting presents as much leading work in so many different areas of reliability of electronic devices, encompassing silicon device, non-silicon device, process technology, nanotechnology, optoelectronics, photovoltaic, MEMS technology, circuits and systems reliability including packaging. This year, the IRPS is **soliciting increased participation** in the following areas: **Wide bandgap semiconductors device reliability, 2.5/3D packaging; ESD in advanced nodes, Emerging memory reliability, Circuit and System reliability and aging, Beyond CMOS—reliability issues in neuromorphic computing, and Reliability and testing challenges in automotive electronics;**

For the first time in over a decade, IRPS is returning to Dallas, Texas, a major international hub. In Dallas

you can **EXPLORE** the cosmopolitan downtown, museums, and shopping. You can also **DISCOVER** nearby Fort Worth and its historic Fort Worth Stockyards. While in Texas make sure to **DELIGHT** in the numerous Tex-Mex and BBQ restaurants.

Opportunities at the symposium include:

- **Two-Day Tutorial Program** (Sunday–Monday, March 29th–March 30th). The IRPS tutorial program is a comprehensive two-day event designed to help both the new engineer and experienced researcher. The program contains both beginner and expert tracks and is broken down into topic areas that allow the attendee to participate in tutorials relevant to their work with minimal conflicts between subject areas.
- **Year-in-Review Session** (Monday, March 30th). These seminars provide a summary of the most significant developments in the reliability community over the past year. This serves as a convenient, single-source of information for attendees to keep current with the recent reliability literature. Industry experts serve as the “tour guide” and save you time by collecting and summarizing this information to bring you up to date in a particular area as efficiently as possible.
- **Evening Poster Reception**. The poster session provides an additional opportunity for authors to present their original research. The setting is informal and allows for easy discussion between authors and other attendees.
- **Evening Session Workshops**. These workshops enhance the symposium by providing the attendees an opportunity to meet

in informal groups to discuss key reliability physics topics with the guidance of experienced moderators. Some of the workshop topics are directly coupled to the technical program to provide a venue for more discussion on the topic.

- **Vendor Exhibits**. Held in parallel with the technical sessions, the equipment demonstrations provide a forum for manufacturers of state-of-the-art laboratory equipment to present their products. Attendees are encouraged to visit the manufacturers' booths for information and demonstrations.
- **IRPS Paper Awards**. IRPS bestows awards for Best Paper, Outstanding Paper, Best Poster and Best Student Paper. The Best Paper author is typically invited to present the paper at ESREF in October.
- **IEW Co-Location**. This year the IRPS will be co-located with the International ESD Workshop. Now in its 14th year, the IEW provides a relaxed, invigorating atmosphere to present new work and engage in discussions about the latest issues confronting the ESD and EOS communities.

For registration and other information, visit the IRPS-2020 home page at www.irps.org.

The IRPS committee members look forward to seeing you in Dallas!

Gaudenzio Meneghesso
2020 IRPS General Chair
University of Padova

Barry P. Linder
2020 IRPS Publicity Chair
IBM

2020 IEEE INTERNATIONAL MEMORY WORKSHOP (IMW)

The 12th International Memory Workshop (IMW) will be held at Hotel Taschenbergpalais Kempinski Dresden, Dresden, Germany, from May 17–20, 2020. The history of the IMW dates back to the NVSMW (Nonvolatile Semiconductor Memory Workshop) which began in 1976, and later merged with the ICMTD (International Conference on Memory Technology and Design) to become the IMW. The IMW is sponsored by the IEEE Electron Devices Society and meets annually in May. The workshop covers all types of memory technology, is focused on advancing innovation in memory technology, and is organized in a way that provides excellent professional development and networking opportunities for attendees.

The IMW is the premier international forum for both new and seasoned technologists having diverse technical backgrounds to share and learn about the latest developments in memory technology with the global community. The scope of workshop content ranges from new memory concepts in early research to the technology drivers currently in volume production as well as emerging technologies in development. Topics include new device concepts, technology advancements, scaling and integration, circuit design and reliability, as well as emerging applications. Consistent with the increased impor-



tance of memory system architecture and integration, the workshop also includes increasing coverage of the systems in which memories are deployed and the co-evolution of memory technology along with memory systems and applications.

The IMW is the preeminent forum covering the latest developments, innovations, and evolving trends in the memory industry. Typical workshop attendance exceeds 250 attendees and the technical program begins with a full day short course given by distinguished experts that provides an excellent professional development opportunity for both new and experienced technologists. The single-track technical program spans three days and also includes an evening poster session for informal technical discussion with authors as well as a panel discussion where experts discuss and debate a current hot topic. The workshop included invited talks from industry and research leaders. Tutorial

and highlight in the recent workshops included 3D NAND, DRAM, Embedded memories, Emerging memories (PCM, RRAM, MRAM, FeRAM) and innovations for storage class memories, data centric architectures, tremendous growth of connected objects, and neuromorphic memory, quantum computing and in-memory computing. The technical program is organized to maximize networking opportunities and facilitate open information exchange among workshop contributors, committee members, and attendees. The program schedule includes ample time dedicated to social events including provided refreshment breaks, a workshop luncheon, and an evening banquet.

On behalf of the organizing committee, I cordially invite you to participate in the 2020 IMW to continue to participate in the advancement of innovation in the rapidly evolving memory industry. For additional information, including the call for papers, key dates, abstract submission instructions, registration information, and technical program details, please visit the IMW website for the latest updates: <http://www.ewh.ieee.org/soc/eds/imw/>. I look forward to seeing you in Dresden this May.

Akira Goda
2020 IMW Publicity Chair
Micron

THE 40TH ANNUAL 2020 SYMPOSIA ON VLSI TECHNOLOGY & CIRCUITS ANNOUNCES CALL FOR PAPERS ON THE THEME: "THE NEXT 40 YEARS OF VLSI FOR UBIQUITOUS INTELLIGENCE"

Celebrating its 40th year of delivering unique perspectives on the convergence of technology and circuits in the microelectronics industry, the 2020 Symposia on VLSI Technology & Circuits have announced a call for papers around the theme: "The Next 40 Years of VLSI for Ubiquitous Intelligence." Held jointly on a fully-overlapping schedule, the two Symposia integrate advanced technology developments, innovative circuit design, and the applications they enable, such as machine learning, IoT, artificial intelligence, wearable/implantable biomedical applications, big data, cloud/edge computing, virtual reality (VR)/augmented reality (AR), robotics, and autonomous vehicles.

The deadline for paper submissions to both Symposia is February 10, 2020. Complete details for paper submission can be found online at: <https://vlsisymposium.org/blog/call-for-papers-for-the-2020-symposia/>

The weeklong Symposia have a reputation as the microelectronics industry's premiere international conference integrating technology, circuits, and systems with a range and scope unlike any other conference. The Symposia program features technical presentations, a demonstration session, evening panel discussions, joint focus sessions, short courses, and an all-day "Friday Forum" provides a focused discussion on a specific topic relevant to the Symposia theme. A single registration enables participants to attend both Symposia.

Special events at the Symposia include an evening reception and joint banquet celebrating the past 40 years of technology and circuit progress, as well as a look ahead to the next 40 years of innovations. Also, the IEEE Electron Devices Society and the



The 40th Symposia on VLSI Technology & Circuits will be held at the Hilton Hawaiian Village. Pictured, the Rainbow Tower by the private lagoon

Solid State Circuits Society will hold mentoring events for Women in Engineering and Young Professionals.

Best Student Paper Awards for each Symposia are chosen based on the quality of the papers and presentations. The recipients will receive a monetary award, travel cost support, and a certificate at the opening session of the 2021 Symposium. For a paper to be reviewed for this award, the author must be enrolled

as a full-time student at the time of submission, must be the lead author and presenter of the paper, and must indicate on the web submission form that the paper is a student paper.

Further Information, Registration and Official Call for Papers. Visit: <http://www.vlsisymposium.org>.

*Chris Burke, President
BtB Marketing Communications
Chris.burke@btbmarketing.com*

SOCIETY NEWS

MESSAGE FROM INCOMING EDS PRESIDENT

Dear EDS members:



Meyya Meyyappan
EDS President

I am delighted to start my term as the President of EDS. Our Society is one of the oldest within IEEE and has a storied past with a celebrated history. It is indeed my honor and privilege to serve as EDS President.

First, I would like to thank Fernando Guarin for his outstanding stewardship of EDS the past two years as President, introducing new initiatives in education, humanitarian activities, social media presence and many others. It is my intention to continue all of them and expand even further. I have already received approval from our Board of Governors (BoG) for a summer school program starting this year. Our intention is to financially support a couple of summer schools in different parts of the world each year on topical areas of interest to EDS. Our education portfolio includes Distinguished Lecturer (DL) program, Mini-colloquium (MQ), webinars, BS, MS and PhD student fellowships, educational outreach to high school students and participation at the IEEE level educational activities. If you have additional suggestions regarding how EDS can enhance its educational offerings, please drop me a line.

Given the level of our educational engagement, we need a focused contact person within the Society and thus, I have created a new Vice President position, *VP for Education*, with the approval of our BoG. We received approval for another position as well, *VP for Strategic Direction and Planning*. As I alluded to in a column two

years ago, our profession is changing rapidly: end of Moore's law, Heterogeneous Integration, emerging of *IoT*, new computing paradigms and rebooting computing, and others. This VP and his/her committee will focus on future directions for the EDS, work with IEEE's Future Direction Initiatives and figure out where and how EDS can contribute and participate in the new IEEE initiatives, and finally prepare our Society for the new era in the coming decades.

Talking about the future, we have been making strides in creating a new journal called *IEEE Journal on Flexible and Printed Devices* (JFPD). Flexible and hybrid electronics and devices are critical for *IoT* and we anticipate many of our members from academia and industry will make a vast amount of contributions as they have done in all past electronic revolutions. This journal will serve as a forum to publish early research results as well as further advanced developments, and will also complement the new EDS Conference on Flexible Electronics. The journal proposal just passed the Phase I stage approval by IEEE and hopes to get through the Phase II gate at the February 2020 TAB meeting. If all goes well, you can anticipate the first issue by Q3 of 2020.

Besides working with the EXCOM, BoG and the EDS staff in executing the goals of the Society, a major role of the EDS President is engaging IEEE on various matters. After all, we are one of the 46 Societies and Councils that constitute the IEEE and thus, governed by the IEEE policies and procedures. Every aspect of running the Society is governed by IEEE and needs approval. Here are some plain

and simple facts: the Society's income is derived from the surplus gained from our conferences, our share of the fees accrued from downloads of papers from our journals and proceedings, interest/investment income from our reserve funds (managed by IEEE) and finally, a small fraction from Society membership dues. We return only about ~ 25% of the income or under to membership services with a vast majority (over 50–60%) going to IEEE overhead and administrative costs. This is not unique only to EDS but to all other Societies as well. We need to work with IEEE to reverse this. Indeed, Fernando, working with like-minded counterparts from other Societies, has successfully managed to get a small reduction in overhead last year. We will continue our efforts to achieve further reductions and I am optimistic, as we have two very knowledgeable people onboard: our newly elected Treasurer Bin Zhao and our new President-elect Ravi Todi. Both have significant past experience with IEEE Financial Committee, policies and procedures.

Finally, Societies like ours cannot survive without dedicated volunteers. We survive and thrive because of the enthusiasm of our volunteers and the time they devote to organizing and running conferences, serving our publications as editors and reviewers, serving on all the EDS committees and many more. Please think about volunteering to serve and help our Society. Please visit our website <https://eds.ieee.org/> to learn about various volunteering opportunities.

Meyya Meyyappan
EDS President
NASA Ames Research Center

REPORT ON THE DECEMBER 2019 EDS BOARD OF GOVERNORS MEETING



Jacobus W. Swart
EDS Secretary

The BOG meeting was held on December 8th, at the Hilton Union Square San Francisco, USA, before the IEDM 2019 conference and following the EDS Executive Committee and

technical committee meetings the day before. There were enough members present to form the needed quorum defined by the Constitution and Bylaws. EDS President, Fernando Guarin, began the meeting with welcome words and an overview talk. After the President's report, many presentations were given, with motions discussed and approved.

The president Fernando Guarin began his speech with the moto "...building EDS on the foundation of the past to meet the challenges of the future." He highlighted the following major areas of EDS operations:

- EDS journals continue to be of high quality with high Impact Factor (3.75 for EDL) and short cycle time. EDL has the shortest cycle time of all IEEE Journals (4.1 weeks in 2019).
- Editor-in-Chiefs were re- and/or appointed for the different journals: Jesus del Alamo for EDL, Giovanni Ghione for T-ED, Enrico Sangiorgi for J-EDS, Edmundo Gutierrez for TDMR and Daniel Tomaszewski for the EDS Newsletter.
- EDS financially sponsors 16 conferences. Three new and successful conferences were highlighted: IEEE Flexible Electronic Technology Conference (IFECT), Electronic Manufacturing and Device Conference (EDTM) and Latin America Electron Device Conference (LAEDC).
- After closing some inactive EDS chapters and approving new ones, we have a total of 203 chapters remaining rather stable.

- Seven webinars were organized in 2019, as a valuable activity within the Education Program of EDS.
- EDS on social media platforms (Facebook, LinkedIn, Twitter and IEEE Collabratec) continue to increase engagement and interest for our society. We have added new ad campaigns and will continue to monitor their results. In addition, the creation of an EDS video to promote the society was approved.
- Other outreach and social/educational activities are ongoing, financed by the EDS Mission Fund and in collaboration with the IEEE SIGHT Program, such as the EDS-ETC program and Mexico IEEE EDS Center of Excellence in Puebla. This initiative also received a matching fund from CONACyT in Mexico.
- The EDS Mission Fund will end the year with an amount of over 150 thousand dollars, to support EDS mission-driven humanitarian, educational, and research initiatives.
- The number of members of EDS decreased by 1.17% compared to previous year, although the number of student members increased by 16.38%. EDS has a lower decrease compared to other sister societies, but efforts have to continue to keep and attract new members.
- The finances of the society are stable and considered in a healthy stage, with an estimated surplus of \$120 thousand. Main revenues come from conferences and publications.

More specific activities were reported by the President-Elect, Program VP's, Editor-in-Chiefs and Committee members:

- President-Elect, Meyya Meyyappan, presented a motion for changing some items in the EDS Constitution & Bylaws. After discussion, the following motions were approved:
- Split the Vice President of Technical Committees and Meetings into two

VP positions (Technical Committee VP and Meetings VP). Both will be a part of the EDS Executive Committee (ExCom).

- Add a new position as the Vice President of Strategic Planning. This position will be a part of the EDS Executive Committee (ExCom).
- Change the position, Chair of Educational Activities to Vice President of Educational Activities. This position will be a part of the EDS Executive Committee (ExCom).
- Add a new position as the Humanitarian Activities Chair. This position will not be a part of the EDS Executive Committee (ExCom).
- Delete a portion of Bylaw 11. Society Business. To hold a meeting when there is no quorum present is not in compliance with Robert's Rules and against IEEE policy.

VP Regions/Chapters, M.K. Radhakrishnan, gave a detailed report on EDS chapters health in the various regions. Several petitions for new chapters were received and 11 of these were approved. The Chapter of the Year Award was successful in Region 9 and Region 10, with 3 or more nominations; but Region 8 received only one nomination and Regions 1-7 received no nominations. For this reason, a motion was presented and approved to change the regional Chapter of the Year Award to global awards:

- Chapter of the Year Award for EDS & Joint Society Chapters
- Chapter of the Year Award for EDS/Joint Society Student Branch Chapters.

A total of 16 mini-colloquia were held in 2019, in addition to 138 Distinguished Lectures. A motion was proposed and approved to establish an EDS Eminent Lecturer category.

In the VP of Membership presentation, evolution of number of members per region and category were presented and discussed, including mechanisms to promote membership. Many new

ideas were presented, and two main motions were approved:

- “Awarded Student Membership” Program which consists of: N “Gold Awarded Student Membership” per year; M “Silver Awarded Student Membership” per year; were $N + M = < 100$. The implementation will start from January 1, 2020. The awarded student will have a free membership for one year.
- Special Membership Growth Program, which is funded at \$5,000/year (\$1000/chapter) – the implementation will start from January 1, 2020. This program will fund chapters with new activities to enhance member recruitment.

VP of Technical Committees and Meetings, Ravi Todi, reported on work by the technical committees and the current EDS conference portfolio. After discussing the list of conferences, a motion was presented to approve the repeat conference list for the year 2021:

- 2021 EDS Financial sponsored repeat conferences as presented
- 2021 EDS Technical sponsored repeat conferences as presented

- EDS adoption of the Rebooting Computing Conference and the IRDS Roadmap Activities

EDS Treasurer, Subu Iyer, presented the finance figures and evolution of EDS, showing the healthy status of the society. The proposed budget was approved after a motion.

VP of Publications and Products, Tsu-Jae King Liu, presented publication figures and indicators on EDS solely sponsored journals as well as joint publications with sister societies. The main indicators for EDL, TED and J-EDS for 2019 were as follows respectively: Number of submissions: 2700, 2370 and 420; acceptance rate (%): 17.8, 35.0 and 42.6; time from submission to e-publication (weeks): 4.1, 12.9 and 11.1. The EDS co-sponsored journals are J-PV, T-DMR, T-SM, J-LT and J-MEMS. These journals present acceptance rate in the range of 30% to 45%. TED is the champion of EDS with the highest number of IEEE *Xplore* downloads, ranked number 8 within IEEE journals. Ideas to improve the indicators of the journals were discussed.

Other important topics on the agenda were Education Activities, Awards,

Strategic Planning and the report by the chair of the EDS Fellows Committee.

At the conclusion of the BoG meeting, elections were held for a new President-Elect, Secretary, Treasurer and 7 BoG members. With this, the secretary says goodbye, thanking all that helped him to fulfill his duties during his two-year term, and send good wishes to the new secretary after January 2020. He is also thankful to the Newsletter Editor-in-Chief, Carmen Lilley, for her dedication and effort to edit it with a high-quality level.

After the BoG meeting, everyone attended the annual EDS Awards Dinner, with the highlight of the evening being the announcement of the newly elected officers and BoG members. Many people were recognized for their volunteer service to the society, and awards were presented. Among them were two winners of the EDS Chapter of the Year Award, as well as recipients of the EDS Early Career Award, and the Masters and PhD Student Fellowships.

Jacobus W. Swart
EDS Secretary

MESSAGE FROM THE EDITOR-IN-CHIEF

Dear Reader,



Carmen M. Lilley
Editor-in-Chief
EDS Newsletter

Welcome to the January 2020 issue of the EDS newsletter. I want to send warm greetings to all of the newsletter readers and best wishes in the New Year! You will find

many items of interest, including the popular review of the 2019 IEEE International Electron Devices Meeting that took place December 7–11, 2019 in San Francisco, California. As my term of Editor-in-Chief nears its end, I also want to send many thanks to newsletter article authors, regional editors, and Joyce Lombardini for all of your contributions during my tenure as EiC. It has been a pleasure to work

with you over these three years and the newsletter would not exist without your contributions. I will introduce our new EiC in the April Newsletter as we transition to new leadership for the coming years.

Sincerely,
Carmen M. Lilley

CONGRATULATIONS TO LEON CHUA 2019 IEEE EDS CELEBRATED MEMBER



To honor and recognize esteemed IEEE Electron Devices Society alumni, EDS created the Celebrated Member Program. Those of us in EDS can take pride in the accomplishments of these Celebrated Members and draw from the inspiration to advance our field and to achieve more,



Leon Chua, 2019 IEEE EDS Celebrated Member

because it is not only their work but ours as well, that can help transform the world around us.

Recently, Professor Chua was presented with the EDS Celebrated Member crystal during the Plenary of the 2019 IEEE International Electron Devices Meeting (IEDM), held in the Grand Ballroom of the Hilton San Francisco Union Square, San Francisco, California.

For a complete bio for Prof. Chua, please visit the EDS Celebrated Member gallery, at <https://eds.ieee.org/members/celebrated-members>.

AWARDS AND CALL FOR NOMINATIONS

2019 EDS CHAPTER OF THE YEAR AWARD WINNERS

The EDS Chapter of the Year Award is presented annually to recognize chapters for the quality and quantity of the activities and programs implemented during the prior July-June period.

In 2013, the Society expanded its Chapter of the Year Award to include one chapter in each IEEE Region (1 thru 7, 8, 9 and 10).

The 2019 EDS Chapter of the Year Award winners:

- **ED/AP/MTT/COM/EMC Tomsk Chapter** (Region 8) — award presentation to be decided
- **ED Universidad Estadual de Campinas Student Branch Chapter** (Region 9) — **Lucas Spejo** accepted the award on behalf of the chapter, presented at the EDS Board of Governors Awards Dinner in San Francisco, California.
- **ED Peking University Student Branch Chapter** (Region 10) — **Qianqian Huang** accepted the award on behalf of the chapter, presented at the EDS Board of Governors Awards Dinner in San Francisco, California.

*M. K. Radhakrishnan
EDS Vice-President of Regions/Chapters
Email: radhakrishnan@ieee.org*



(right to left) Region 10 – ED Peking University Student Branch Chapter Qianqian Huang, and Region 9 – ED Universidad Estadual de Campinas Student Branch Chapter Lucas Spejo

EDS MEMBERS NAMED RECIPIENTS OF 2020 IEEE TECHNICAL FIELD AWARDS

Six EDS Members were among the recipients of the 2020 IEEE Technical Field Awards:

IEEE Cledo Brunetti Award



James H. Stathis



Ernest Yue Wu

"For contributions to the understanding of gate dielectric reliability and its application to transistor scaling."

IEEE Electronics Packaging Technology Award



Mitsumasa Koyanagi



Peter Ramm

"For pioneering contributions leading to the commercialization of 3D wafer and die level stacking packaging."

IEEE Andrew S. Grove Award



Evelyn Hu

"For pioneering contributions to micro-electronics fabrication technologies for nanoscale and photonic devices."

IEEE Daniel E. Noble Award for Emerging Technologies



Miro Micovic

"For leadership in millimeter-wave Gallium Nitride (GaN) transistor and technology development."

IEEE Frederik Philips Award



Kazuo Yano

"For leadership in the development and materialization of human-centric IoT technology in the electronics industry."

*Samar Saha
EDS Awards Chair
Prosperious Devices
Milpitas, CA, USA*

CONGRATULATIONS TO THE 26 NEWLY ELECTED IEEE ELECTRON DEVICES SOCIETY FELLOWS

EFFECTIVE JANUARY 1, 2019



Cor L. Claeys
2019 EDS Fellows Chair

Matthias Bauer

for contributions to growth technologies for alloys for transistors

Navakanta Bhat

for contributions to electrochemical biosensors in nanoelectronic devices

Meng-Fan Chang

for contributions to static and non-volatile memories for embedded systems

Kin Ping Cheung

for contributions to plasma process-induced damage in integrated circuits

Chris Hyung-il Kim

for contributions to on-chip circuit reliability evaluation and characterization

Daniele Ielmini

for contributions to nonvolatile semiconductor memories

Hiroshi Ito

for contributions to high-speed photodiodes for millimeter and terahertz wave generation

Mona Jarrahi

for contributions to terahertz technology and microwave photonics

Christoph Jungemann

for contributions to hierarchical simulation of semiconductor devices

Ali Khakifirooz

for contributions to fully depleted silicon-on-insulator complementary-metal-oxide-semiconductor technology

Chih-Huang Lai

for contributions to magnetic information storage and spintronic devices

Roger Lake

for contributions to quantum mechanical electronic device modeling

Hai Li

for contributions to neuromorphic computing systems

Miroslav Micovic

for contributions to gallium nitride electronics

Theodore Moise

for contributions to ferroelectric memory development and engineering

Katsufumi Nakamura

for contributions to integrated circuits for digital imaging

Stewart Rauch

for contributions to microelectronics reliability

Samar Saha

for contributions to compact modeling of silicon field-effect transistors

Sayeef Salahuddin

for contributions to low power electronic and spintronic devices

Andries Scholten

for contributions to noise and radio frequency modeling of semiconductor devices

Venkat Selvamanickam

for contributions to development, and manufacturing of superconductor tapes

Munehiro Tada

for contributions to copper interconnects for very-large-scale integration

Harkhoe Tan

for contributions to compound semiconductor optoelectronic materials and devices

Deepak Uttamchandani

for contributions to photonics-based sensing

Dragica Vasileska

for contributions to computational electronics and simulation of nanoscale devices

Weisheng Zhao

for contributions to spintronic integrated circuit design

Cor L. Claeys
2019 EDS Fellows Chair
KU Leuven, Belgium

ANNOUNCEMENT OF THE 2019 EDS PhD STUDENT FELLOWSHIP WINNERS



*Tian-Ling Ren
EDS Student
Fellowship
Committee Chair*

The Electron Devices Society PhD Student Fellowship Program was designed to promote, recognize, and support PhD level study and research within the Electron Devices Society's field of interest.

EDS proudly announces three EDS PhD Student Fellowship winners for 2019: **Haitong Li**—Stanford University (USA); **Chih-Yang Lin**—National Sun Yat-Sen University (Taiwan); **Sami Bolat**—ETH Zurich, Swiss Federal Institute of Technology in Zurich (Switzerland). Brief biographies of the recipients appear below. Detailed articles about each PhD Student Fellowship winner and their work will appear in forthcoming issues of the EDS Newsletter.



B.S. in microelectronics from Peking

Haitong Li Haitong Li is currently a PhD candidate in Electrical Engineering at Stanford University, supervised by Prof. H.-S. Philip Wong. He received

University, China, in 2015, and M.S. in electrical engineering from Stanford University in 2017. His research focuses on brain-inspired computing with emerging non-volatile memories, with more than 30 publications and 700 citations to date. Haitong received 2016 IEEE EDS Masters Student Fellowship, Best Paper Award at 2016 SRC TechCon, and Best Paper nomination at 2016 Symposium of VLSI Technology.



of Professor Ting-Chang Chang. He works on next generation electronic devices with constructing conduction models by device physics. His research interests include non-volatile resistive-switching memory (RRAM), selector devices, and neuromorphic computing. In addition, he also cooperates with companies on SiGe channels, power electronics, thin film transistors, advanced MOSFETs, and ferroelectric memory. From 2015, Chih-Yang Lin has first-authored 6 research

Chih-Yang Lin is currently pursuing his PhD degree in the department of physics from National Sun Yat-sen University under the direction

articles in major peer-reviewed scientific journals, and co-authored 20 research papers (including five 2nd and 3rd author). On top of that, he has filed 17 patents including 5 U.S. patents, covering various electron devices.



Sami Bolat performs his doctoral thesis in the Laboratory for Thin Films and Photovoltaics at Empa—Swiss Federal Laboratories for Materials

Science and Technology, and is enrolled as a PhD student at the ETH Zürich. His research aims at demonstrating fully printed transistors with oxide materials on flexible substrates. He has authored and co-authored 16 papers, one book chapter and delivered oral talks at three international conferences. He will continue his doctoral research until July 2021, by which, he is expected to receive a PhD degree from the ETH Zurich.

*Tian-Ling Ren
EDS Student Fellowship
Committee Chair
Tsinghua University
Institute of Microelectronics*



Explore the different communities IEEE offers that foster networking for founders, investors and service providers within the entrepreneurial community. Join one of these groups to find like-minded technology professionals interested in promoting innovation, creativity and entrepreneurship across our disciplines. For more information, visit <https://entrepreneurship.ieee.org/ieee-startup-resources/communities/>

ANNOUNCEMENT OF THE 2019 EDS MASTERS STUDENT FELLOWSHIP WINNERS

The Electron Devices Society Masters Student Fellowship Program was designed to promote, recognize, and support Masters level study and research within the Electron Devices Society's field of interest.

EDS proudly announces the winners of the 2019 EDS Masters Student Fellowship.



Nilesh Panday is pursuing Integrated M. Tech.-Ph. D. program, under the supervision of Prof. Yogesh S. Chauhan, in the Department of Electrical Engineering, Indian Institute of Technology (IIT) Kanpur, India. Recently, he was

awarded the 2019 IEEE EDS Masters Fellowship. He is one of two students in the world and first-ever recipient from India, to get this fellowship. Earlier in 2018, he received the prestigious Prime Minister Research Fellowship (PMRF) for Doctoral research in India. He completed his B. Tech. in Electronics Engineering from National Institute of Technology (NIT) Kurukshetra in 2017.



Julian Arenas Julian was born in Bucaramanga, Santander, Colombia in 1997. He received his B.S.E.E degree from Universidad Industrial

de Santander, Bucaramanga, Colom-

bia, in 2018 with Cum Laude distinction. He is pursuing the E.E graduate studies at Universidad Industrial de Santander, focusing in quadrature clock generation and injection locking; specifically on feed-forward oscillators and phase-locked loops. Currently, Julian is an analog design intern student at IMEC. He is developing CML circuits and data converters for space applications. His research interests include low power clock references, high-speed clock generation, and current mode logic circuits for high-speed applications.

*Tian-Ling Ren
EDS Student Fellowship
Committee Chair
Tsinghua University
Institute of Microelectronics*



IEEE Young Professionals is an international community of enthusiastic, dynamic, and innovative members and volunteers. IEEE is committed to helping young professionals evaluate their career goals, polish their professional image, and create the building blocks of a lifelong and diverse professional network.

Affiliation with IEEE Young Professionals is open to Graduate Students and higher-grade members with early career interests at no additional cost. IEEE Young Professionals provides career advantage resources and helps members leverage the power of the global network through its expanding Affinity Groups and volunteer opportunities. For more information, visit <http://www.ieee.org/yp>

YOUNG PROFESSIONALS

IEEE WEST EUROPE STUDENT-YOUNG PROFESSIONAL CONGRESS (WESYP)

By ALAN BLUMENSTEIN AND MIKE SCHWARZ

The IEEE WESYP 2019 (<https://wesyp.org/>) was held in Glasgow, United Kingdom, September 19–21, and was hosted by the Glasgow Caledonian University (GCU), sponsored by the Scottish Informatics & Computer Science Alliance (SICSA) and several IEEE entities like Region 8, IEEE United Kingdom and Ireland Section, the IEEE Young Professionals UK & Ireland, among others.

The WESYP brought the opportunity for young professionals, IEEE student members and volunteers from Western Europe to get together, share stories and create a network to support each other in different projects related to IEEE or to a professional background. During the congress there were several presentations in technical areas as well as informative presentations to present the tools that IEEE offers. The tools demonstrate the volunteers to develop technical and professional activities. Even the program IEEE SIGHT, was presented. An IEEE initiative that offers support for oriented projects in help of local problems for the community, e.g. the access to clean water. The congress also hosted a poster competition and a

delicious gala dinner with typical Scottish music and dance.

The technical presentation were oriented mainly to the philosophy behind GCU, that is the achievement of the common good through a sustainable future with less equality among the people. The presentation offered different vision of technologies of the future that could help with the climate crisis or in the decision for technologies used today, like the popular discussion of changing the

power distribution system from AC to DC. The list of speakers can be found here: <https://wesyp.org/speakers/index.html>.

Beside the presentations, the participants of the congress visited the Power Networks Demonstration Center of the University of Strathclyde, where technologies in the power area are tested to certify the correct behavior of it.

~Mike Schwarz, Editor



Final day of WESYP 2019



Participants at Glasgow Caledonian University (GCU)

IEEE YOUNG PROFESSIONALS GERMANY EXCOM AND ROBERT BOSCH GROUP ORGANIZE ROBERT BOSCH SEMICONDUCTOR HEADQUARTERS COMPANY VISIT

By MIKE SCHWARZ

The IEEE Young Professionals Germany ExCom organized in cooperation with the Robert Bosch GmbH, a company visit at the semiconductor headquarters of Bosch in Reutlingen, Germany.

As one of the leading semiconductor companies in Europe and the world's largest supplier of micro-mechanical sensors in automotive and consumer applications, the semiconductor headquarters delivers more than 4 million sensors per day. Achieving a high quality and

cost effectiveness in automotive and consumer applications, an efficient and effective campus is required/demanded to fulfill these criteria.

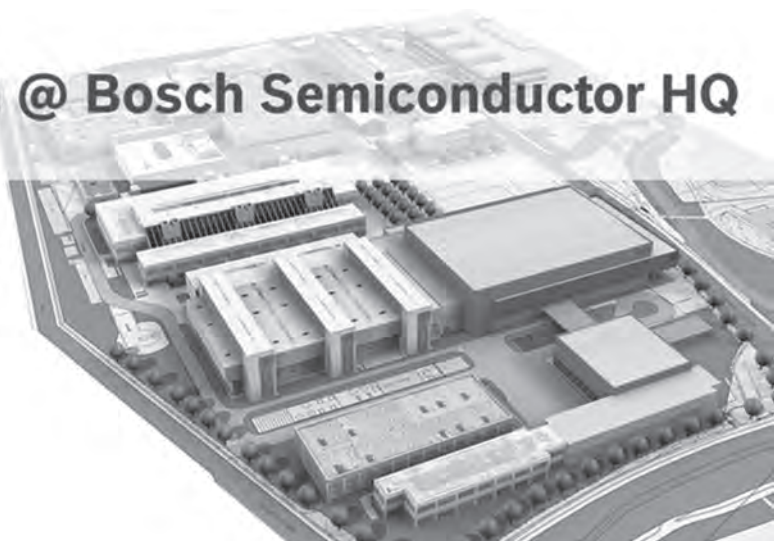
The visit takes place on April 20, 2020 and offers a MEMS fab tour, marketplace, and workshops in specific semiconductor topics of integrated circuits (IC) and micro electro mechanical systems (MEMS). A few insights into the development and production process is given with focus on the transition from development to high volume series produc-

tion. It is a one-day event, starting at 9:15 until 17:00.

The maximum number of attendees is limited to 30 IEEE Young Professionals with semiconductor background focusing on integrated circuits (IC) and/or micro electro mechanical systems (MEMS). Attendees all over the world need to register at vTools Events (<https://events.vtools.ieee.org/m/203944>).

Further information and the url to register are present at <https://www.ieee.de/affinity-groups/young-professionals/news-events/>

IEEE YP Germany AG @ Bosch Semiconductor HQ



JOINT WORKSHOP BETWEEN SPRING MOS-AK WORKSHOP AND SYMPOSIUM ON SCHOTTKY BARRIER MOS DEVICES ORGANIZED BY IEEE EDS GERMANY CHAPTER, IEEE YP GERMANY AG & TH MITTELHESSEN

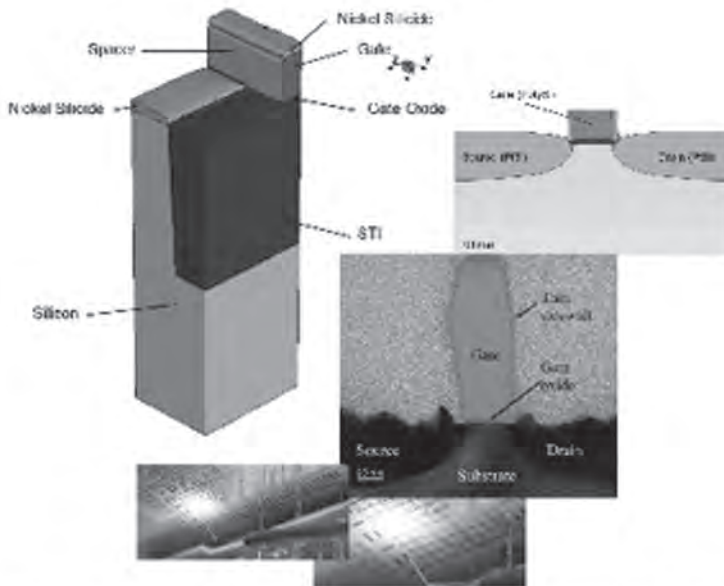
By MIKE SCHWARZ, ALEXANDER KLOES, WLADEK GRABINSKI

A joint conference/workshop between Spring MOS-AK Workshop and the Symposium on Schottky Barrier MOS

(SB-MOS) devices is planned for March 17th to 18th at the Technische Hochschule Mittelhessen—University

of Applied Sciences, Germany. This is the first joint adventure between MOS-AK (42nd MOS-AK International

Joint Spring MOS-AK Workshop & Symposium on Schottky Barrier MOS Devices 2020



Images taken from J. M. Larson, J. P. Snyder, "Overview and status of metal S/D Schottky barrier MOSFET technology", IEEE Transaction Electron Devices 53(5), 1048-1058, 2006 & M. Schwarz, L. E. Calvet, J. P. Snyder, T. Krauss, U. Scheideck and A. Klös, "Analysis and Investigation of Schottky Barrier MOSFET Current Injection with Process and Device Simulation", UMCS, 2018.



Organized by:

Prof. Alexander Klös, NanoP, Germany
 Dr. Mike Schwarz, Robert Bosch GmbH, NanoP, Germany
 Dr. Wladek Grabinski, MOS-AK Association, Switzerland
 Dr. Laurie Calvet, C2N, Palaiseau, France

**Gießen, Germany, 17th - 18th
 March 2020**

CM Meeting) and SSBMOS (4th Meeting). Additionally, within the time frame an IEEE EDS Mini-Colloquia/Distinguished Lecture is planned.

This year it is sponsored by THM, the IEEE EDS Germany chapter, IEEE Young Professionals Germany Affinity Group, and organized by Dr. Laurie Calvet (C2N, Palaiseau, France), Dr. Mike Schwarz (Robert Bosch GmbH, NanoP THM, Germany), Dr. Wladek Grabinski (MOS-AK Association (EU), Switzerland), Prof. Alexander Klös (NanoP THM, Germany), and the staff at the Center for Nanotechnology and Photonics at TH Mittelhessen.

The joint adventure starts on March 17th at 9:00 a.m. with a full day MOS-AK. On March 18th the SSBMOS and DL will be held. The following speakers have confirmed their invitations: Prof. Benjamin Iniguez (DEEEA, Universitat Rovira i Virgili), Dr. Laurie E. Calvet (C2N, CNRS-Université Paris-Sud), Dr. Mike Schwarz (Robert Bosch GmbH, NanoP THM, Germany), Prof. Max Lemme (RWTH Aachen, Germany), Prof. Walter Weber (TU Vienna, Austria).

Attendees are welcome to attend both events. Further information is available:

SSBMOS

<https://ssbmoss.blogspot.com>
<https://meetings.vtools.ieee.org/m/205569>

and

MOS-AK

<http://www.mos-ak.org>
<https://meetings.vtools.ieee.org/m/205571>



2020 PhD Student Fellowship

Description: One year fellowships will be awarded to promote, recognize, and support PhD level study and research within the Electron Devices Society's field of interest. The field of interest for EDS is all aspects of engineering, physics, theory, experiment and simulation of electron and ion devices involving insulators, metals, organic materials, plasmas, semiconductors, quantum-effect materials, vacuum, and emerging materials. Specific applications of these devices include bioelectronics, biomedical, computation, communications, displays, electro and micro mechanics, imaging, micro actuators, optical, photovoltaics, power, sensors and signal processing.

Fellowships are expected to be awarded to eligible students in each of the following geographical regions for 2020: Americas, Europe/Middle East/Africa, and Asia & Pacific. Only one candidate can win per educational institution.

Prize: US\$5,000 to the student and if necessary funds are also available to assist in covering travel and accommodation costs for each recipient to attend the EDS Governance meeting in December 2018 for presentation of the award plaque. The EDS Newsletter will feature articles about the EDS PhD Fellows and their work over the course of the next year.

Eligibility: A candidate must be an IEEE EDS student member at the time of nomination; be pursuing a doctorate degree within the EDS field of interest on a full-time basis; and continue his/her studies at the current institution with the same faculty advisor for twelve months after receipt of award. The nominator must be an IEEE EDS member and preferable be serving as the candidate's faculty advisor. Previous award winners are ineligible.

Basis for Judging: Demonstration of his/her significant ability to perform independent research in the fields of electron devices and a proven history of academic excellence.

**May 15, 2020
Submission Deadline**

Nomination Package

- Nomination letter from an EDS member
- Two letters of recommendation from individuals familiar with the student's research and educational credentials. Letters of recommendation cannot be from the nominator.
- One-page biographical sketch of the student (including student's mailing address and email address)
- Two-page (maximum) statement by the student describing his or her education and research interests, accomplishments and graduation date
- One copy of the student's under-graduate and graduate transcripts/grades. Please provide an explanation of the grading system if different from the A-F format.

Timetable

- Completed nomination packages are due at the EDS Executive Office no later than **May 15, 2020**
- Recipients will be notified by July 15
- Monetary awards will be given by August 15
- Formal award presentation will take place at the EDS Governance Meeting in December

Please submit application packages via e-mail or mail:

Email: s.lehotzky@ieee.org

Mail:

IEEE EDS Executive Office
PhD Student Fellowship Program
445 Hoes Lane
Piscataway, NJ 08854 USA

For more information contact:

Stacy Lehotzky / Email: s.lehotzky@ieee.org

Visit the EDS website:

<http://eds.ieee.org/eds-phd-student-fellowship.html>



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2020 Masters Student Fellowship

Description: One-year fellowships will be awarded to promote, recognize, and support graduate Masters level study and research within the Electron Devices Society's field of interest. The field of interest for EDS: all aspects of engineering, physics, theory, experiment and simulation of electron and ion devices involving insulators, metals, organic materials, plasmas, semiconductors, quantum-effect materials, vacuum, and emerging materials. Specific applications of these devices include bioelectronics, biomedical, computation, communications, displays, electro and micro mechanics, imaging, micro actuators, optical, photovoltaics, power, sensors and signal processing.

Fellowships are expected to be awarded to eligible students in each of the following geographical regions for 2020: Americas, Europe/Mid-East/Africa, and Asia & Pacific. Only one candidate can win per educational institution.

Prize: US\$2,000 and a plaque to the student, to be presented by the Dean or Department head of the student's enrolled graduate program.

Eligibility: Candidate must be an IEEE EDS student member at the time of nomination; be accepted into a graduate program or within the first year of study in a graduate program in an EDS field of interest on a full-time basis; and continue his/her studies at a graduate education institution. The nominator must be an IEEE EDS member and preferably be serving as the candidate's mentor or faculty advisor. Previous award winners are ineligible.

Basis for Judging: Demonstration of his/her significant ability to perform research in the fields of electron devices a proven history of academic excellence in engineering and/or physics involvement in undergraduate research and/or a supervised project.

Nomination Package

- Nomination letter from an EDS member who served as candidate's mentor or faculty advisor.
- One letter of recommendation from an individual familiar with the student's research and educational credentials. Letters of recommendation cannot be from the nominator.
- One-page biographical sketch of the student (including mailing address and e-mail address)
- Two-page (maximum) statement by the student describing his or her education and research interests, accomplishments and graduation date. This can include undergraduate, graduate and summer internship research work.
- One copy of the student's transcripts/grades. Please provide an explanation of the grading system if different from the A-F format.

Timetable

- Completed nomination packages are due at the EDS Executive Office no later than **May 15 2020**
- Recipients will be notified by July 15
- Monetary awards will be presented by the Dean or Department Chair of the recipient's graduate program at the beginning of the next academic term.

Please submit application packages via e-mail or mail:

Email: s.lehotzky@ieee.org

Mail:

IEEE EDS Executive Office
PhD Student Fellowship Program
445 Hoes Lane
Piscataway, NJ 08854 USA

For more information contact:

Stacy Lehotzky

Email: s.lehotzky@ieee.org

Visit the EDS website:

<http://eds.ieee.org/eds-masters-student-fellowship.html>

**May 15, 2020
Submission Deadline**

ED/SSC Hong Kong Joint Chapter—IEEE STEM SUMMER PROGRAM

By YANG CHAI

The ED/SSC Hong Kong Chapter worked with the Department of Electrical and Electronic Engineering at the University of Hong Kong (HKU) to organize a one-week STEM summer program, which included two days of electronic circuit construction activities. Multiple academic staff, namely Dr. Ngai Wong, Dr. C.K. Lee and Dr. Joe Yuen helped organize and deliver the day camp with solid support from Dr. Sang Lam and Prof. Mansun Chan.

About 30 select teenagers from local elite schools joined the day camp in which two full days were set aside for them to build a few interesting electronic circuits, under guidance and supervision in an electronics teaching laboratory. They were taught to read electronic circuit diagrams and then to assemble correct discrete electronic components together on the breadboard with correct wire connections. Through hands-on construction of the electronic circuits, they gained a solid idea of what the basic electronic components are, and their functions in the circuits. The students also had better appreciation of how simple electronic components can be used for building useful circuits for such as information display, audio signal synthesis, and motion sensing. They learned some basic electronic engineering concepts



High school teenagers were taught about the circuits to be constructed, with the theory explanations kept to a minimum



A bright day camp participant built a two-digit counter with neat wiring after accomplishing the construction of a single-digit one



Teenagers completed the one-week STEM summer program happily, receiving certificates from the hosting Department of Electrical and Electronic Engineering at HKU

through experimenting with their hands. Most of them were gratified with the sense of achievement in successfully building the circuits that showed the correct audio and visual effects. A few bright school children even challenged themselves by building circuits such as a two-digit counter based on the accomplished single-digit counter.

Apart from the education of the school children, the event also helped develop the abilities of the six student helpers who guided the children in the electronic circuit construction. They also gained better engineering problem-solving skills as they helped in trouble-shooting the circuits for the children. In short, both the undergraduate students and high school teenagers have gained something more than knowledge in the one-week summer program.

ED UCAS Student Chapter—2019 IEEE Electronic Exploration Camp
—by Kangwei Zhang

To inspire schoolchildren to study and work in areas related to electron devices and circuits, the IEEE EDS UCAS Student Chapter organized the third IEEE Electronic Exploration Camp in IMECAS, Beijing, China. The event took place July 15–17, 2019, at the Institute of Microelectronics of



Students constructing their circuits during the Electronic Exploration Camp

Chinese Academy of Sciences (IMECAS), with the support of the Key Laboratory of Microelectronic Devices & Integrated Technology, CAS.

Fifty school children came to IMECAS to explore and enjoy the fun of electronic circuit construction. Through the experience of trying to build a few interesting electronic circuits, they learned some basic electronic engineering concepts, such as voltage and current, signals, electrical measurements, clock generation, and the use of mathematics in engineering, etc. During the lab tour, they were also exposed to cross-disciplinary technologies such as control systems,

with the kind arrangement efforts of the Integrated Circuit Advanced Process R&D Center.

The camp successfully stimulated the interest of the participants on electronic technology and cultivated their ability in problem solving. The parents of these students were satisfied with all the arrangements of the schedule, the design of the courses, and gave a good evaluation of this camp.

ED Guangzhou Chapter—2019 IEEE Electronic Exploration Camp
—by Shaolin Zhou

As a continuation of a series of successful STEM (science, technology, engineering and mathematics) educational activities to inspire kids to study and work in electronic engineering or related areas, the ED Guangzhou Chapter and the School of Microelectronics of South China University of Technology (SCUT) co-organized a 3-day Electronic Exploration Camp on July 24–26, 2019, at the campus of SCUT with a group of volunteers of SCUT graduates and undergraduates.

This is the second time such an event was held in Guangzhou. Several dozens of school children came together to explore the fascinating electronic technologies through electronic circuit construction sessions and lab tours. Through learning and



2019 IEEE Electronic Exploration Camp Participants at IMECAS



2019 IEEE Electronic Exploration Camp Participants at SCUT



Students constructing their circuits during the Electronic Exploration Camp at SCUT

trying to build a few interesting electronic circuits, in particular a running light indicator, an electronic piano and an infrared detector, participating students were introduced to major areas of ECE, namely digital integrated circuits, photonics, signal and multimedia processing. They also learned some key electronic engineering con-

cepts such as voltage and current, signals, electrical measurements, clock generation and the use of mathematics in engineering etc. that are taught in electronic engineering programs at universities. While touring around the teaching laboratories, they were also exposed to other research or technology pillars of state key lab of

reliability of electronic devices where the IEEE ED Guangzhou Chapter is located. The students were fascinated by various experimental demonstrations in the research labs such as such as E-beam lithography, SEM and the SOC process.

~Ming Liu, Editor

CHAPTER NEWS

REPORT ON THE 2019 FRONTIERS IN NEW AND EMERGING TECHNOLOGIES (FINETECH) SYMPOSIUM

BY DEVIKA SIL

The IEEE ED Mid-Hudson and Schenectady Chapters along with IBM Research, SUNY Poly and Tokyo Electron Limited, hosted the 2019 Frontiers in New and Emerging Technologies (FINETECH) Symposium on new and emerging technologies in electron devices and systems. FINETECH 2019 was held at the SUNY Poly campus in Albany on August 22nd, featuring 3 EDS Distinguished Lectures along with an invited talk in the Plenary Session. Professor Jamal Deen, EDS Distinguished Lecturer from McMaster University, opened the symposium with a lecture on “Smart Sensors & Smart Homes for Ubiquitous-Healthcare—AI is a Key Enabler,” and Dr. Kaustav Banerjee, EDS Distinguished Lecturer from University of California, Santa Barbara, spoke on “Overcoming Fundamental Bottlenecks in Nanoelectronics with 2D Materials.” Dr. John Kymissis from Columbia University was the third EDS Distinguished Lecturer to present at FINETECH 2019, with a talk on “Thin Film Electronics for Miniature Systems in Sensing and Display.”

Dr. Rania Khalaf, Director of AI Platforms at IBM Research gave a lecture on “Making AI Faster, Safer and Easier.” All four talks were very well received by the audience, followed by interactive Q & A sessions. The mini-colloquium concluded with remarks by the organizing chair, Dr. Mukta Farooq (Chair, ED Mid-Hudson Chapter). There were 199 registered attendees. A networking lunch was provided to all attendees and speakers. This event was extremely well received, with attendees from both industry and academia.



Top Row, Left to Right: Prof. Kaustav Banerjee, Prof. Jamal Deen, Prof. John Kymissis, Dr. Mukta Farooq Bottom Row, Left to Right: Dr. Dishit Parekh, Dr. Devika Sil



Dr. Mukesh Khare (IBM Research), giving the opening remarks at FINETECH 2019

~Rinus Lee, Editor

EDS-ETC EVENT—"ELECTRONICS MAGIC" AT THE EVERLY HOTEL, PUTRAJAYA

The ED Malaysia Chapter organized an educational program named "Electronics Magic" for Form 4 students from Sekolah Menengah Alam Shah Kuala Lumpur. Electronics Magic event was part of the program planned in conjunction with the Regional Symposium of Micro and Nanoelectronics Conference (IEEE RSM2019). A total of 30 students participated in the event. In this program, the children were exposed to the knowledge of science and electronics. By utilizing the easy to use Elenco Snap Circuits® kits, students were able to learn about electronics and experience the exciting and creative world of electrical engineering. We believe it is important to touch their hearts through education, which makes them realize how important they are to our community and nation. The students' feedback was positive in that they could understand the basic theory by constructing simple electronic circuits.

RSM2019 Technical Meeting and "Buka Puasa" Event

The 12th IEEE Regional Symposium on Micro and Nanoelectronics (RSM2019) technical meeting was held on May 15, 2019 at Tenera Hotel, Bandar Baru Bangi, Selangor, by the ED Malaysia Chapter. After that a "Buka Puasa" (breaking of fast) event was held as part of a program planned for the Social and Communication Portfolio. The event was held to evaluate technical papers submit-



Participants from Sekolah Alam Shah Kuala Lumpur and facilitators from ED Malaysia Chapter



IEEE EDS Malaysia members group photo session after the RSM 2019 technical meeting

ted to the RSM2019, welcome current and new IEEE EDS members, celebrate the month of Ramadan and spirit of unity at the ED Malaysia Chapter. All EDS members enjoyed the buffet with a variety of food and

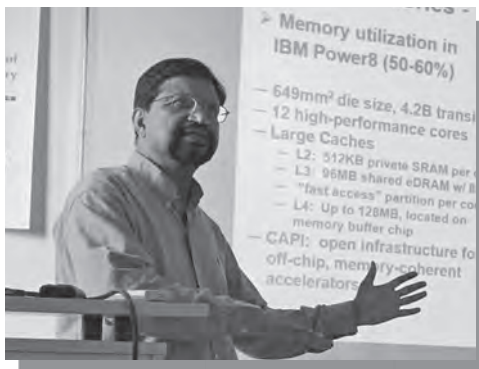
beverage, as well as special cuisine prepared for the Buka Puasa event. Members also had the chance to exchange ideas for chapter activities.

~ P Susthitha Menon, Editor

IEEE EDS DISTINGUISHED LECTURE AT ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

BY SHIH-CHIH LIU

On July 26, 2019, Dr. Rajiv Joshi, a highly distinguished researcher at the IBM T. J. Watson Research Center, New York, visited the École Polytechnique Fédérale de Lausanne (EPFL). As an EDS Distinguished Lecturer he delivered an outstanding talk to EPFL researchers from EPFL Schools of Engineering (STI) and Computer and Communication Sciences (IC). Dr. Joshi's talk *"From deep scaling to deep intelligence,"* provided an excellent overview of the evolution of semiconductor technology focusing on the important role of memories, especially in the context of emerging Artificial Intelligence (AI) applications. The tutorial covered many aspects from key concepts and state-of-the-



Dr. Joshi during his talk "From deep scaling to deep intelligence"

art technologies and circuit techniques, which was highly appreciated especially by the PhD students, all the way to emerging technologies and

future trends that set the research agenda for the following years. In particular, the mix of research coupled with the industrial perspective of a major player (IBM) in the field of microelectronics, provided interesting and highly valuable insights to the mostly academic audience. Dr. Joshi's talk was well attended by roughly 20 graduate researchers and professors from at least four different labs. After his presentation, Dr. Joshi spent time in meeting with researchers and several professors at EPFL to exchange ideas and discuss future research directions.

~Mike Schwarz, Editor

IEEE EDS DISTINGUISHED LECTURE AT IMEC LEUVEN

BY EDDY SIMEON AND MIKE SCHWARZ

On September 12th, Prof. Vijay Arora, EDS Distinguished Lecturer, gave a seminar entitled, *"From Ohm to Arora,"* explaining in detail the limits of Ohm's law at high electric field.

The seminar took place at IMEC and was attended by 45 persons (15 PhDs). This was followed by a lively discussion.



Prof. Vijay Arora during his talk "From Ohm to Arora"

IEEE EDS MINI-COLLOQUIUM ON FLEXIBLE ELECTRONICS (MQ) HELD AT UNIVERSITAT ROVIRA I VIRGILI

BY BENJAMIN INIGUEZ, LLUIS MARSAL AND MIKE SCHWARZ

A Mini-Colloquium on Flexible Electronics was held at the Universitat Rovira i Virgili (URV) on July 11th in Tarragona, Spain. The MQ was hosted and organized by the DEEEA department of the URV under the supervision of Prof. Benjamin Iniguez and Prof. Lluís Marsal.

Invited EDS Distinguished Lecturers of the MQ were Prof. Joachim Burghartz, Dr. Arokia Nathan, Prof. Magali Estrada, Prof. Lluís Marsal.

After a refreshment of approximately 30 minutes, the MQ started at 10:50 a.m., with an introduction by Prof. Benjamin Iniguez.

Afterwards, Prof. Joachim Burghartz from IMS Chips (Stuttgart, Germany) held an inspiring lecture on the topic of *"Ultra-Thin Si Chips—A New Paradigm in Silicon Technology."* He discussed issues in ultra-thin chip fabrication, device modeling and circuit design, as well as assembly and interconnects for thin chips embedded in foil substrates. Numerous distinct differences to conventional silicon technology justify the statement that ultra-thin chips features a new paradigm in silicon technology.

Next, Dr. Arokia Nathan from Cambridge Touch Technologies (Cambridge, UK) shared his experience on the *"Transparent and Flexible Nano-Electronics for Organic Displays and Ultralow Power Sensor Interfaces."* The lecture investigated the transistor operation in the different regimes, and reviewed device properties when operated in the deep sub-threshold regime or in near-OFF state, addressing the pivotal requirement of low supply voltage and



EDS Distinguished Lecturers: Joachim Burghartz, Arokia Nathan, Benjamin Iniguez, Lluís Marsal and Magali Estrada

ultralow power leading to potentially battery-less operation.

After lunch, the lecture *"Fabrication Issues of Amorphous Oxide Semiconductor Thin Film Devices"* by Prof. Magali Estrada from CINVESTAV (Mexico) followed. Her lecture gave insights on the fabrication process of high mobility, low operating voltage and low temperature processed AOSTFTs, where the semiconductor layer is Hf-In-Zn-O and the insulator HfO₂ (HIZO/HfO₂ TFTs), using spin-coated polymethyl-methacrylate (PMMA) as passivation and etch-stop layer (ESL). Furthermore, results of characterization of the fabricated devices were analyzed. Special attention was focused on the significant

increase in mobility that can be obtained, reaching values even above 300 cm²/Vs.

The last lecture was held by Prof. Lluís Marsal on the topic of *"Current progress and future perspectives in polymer solar cells."* In his lecture, Prof. Marsal outlined the perspectives and recent advances made in polymer solar cells, design and synthesis of new polymers and in particular the active layer morphology, interfacial layers and stability. Additionally, the basic device operation and various parameters limiting their efficiency and their possible solutions were discussed.

~Mike Schwarz, Editor

JOINT ACTIVITIES OF UKRAINE SECTION CHAPTERS AND ED IRE NASU STUDENT BRANCH CHAPTER

IEEE 39TH INTERNATIONAL SCIENTIFIC CONFERENCE ON ELECTRONICS AND NANOTECHNOLOGY

BY KATERYNA ARKHYPOVA AND KATERYNA IVANKO

The IEEE 39th International Scientific Conference on Electronics and Nanotechnology (ELNANO-2019) was held on April 16–18, 2019, at the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute.” It was co-sponsored by the IEEE Ukraine Section and three Section Chapters: Ukraine Section (Kyiv) ED/MTT/EP/SSC Joint Chapter, Ukraine Section (East) AP/NPS/AES/ED/MTT/GRS Joint Chapter, and Ukraine Section SP/AES Joint Chapter. Starting from 2013, the International Conference on Electronics and Nanotechnology (ELNANO) was supported by the Institute of Electrical and Electronic Engineers (IEEE). Conference Proceedings of ELNANO 2013-2019 are included in the IEEE *Xplore* Digital Library.

The IEEE ELNANO-2019 program consisted of a plenary session, three section sessions: “Micro- and nano-electronics,” “Biomedical Electronics and Signal Processing” and “Electronic systems,” six poster sessions and two half-day workshops held by Lampa Lab (Department of Design



Plenary talks by Juri Jatskevich from Electrical and Computer Engineering at the University of British Columbia, Vancouver, Canada (left) and Bertrand Vilquin from Ecole Centrale de Lyon, Institute of Nanotechnology of Lyon, France (right)

of Electronic Digital Equipment). ELNANO-2019 was aimed at priority directions of the electronics and nanotechnology development, at the establishment of cooperation between scientists and industry, at the development of the new technologies, at the exchange of experience with scientific institutions and research centers of different countries, as well as at the involvement of young people in research work. There were 231 papers submitted for presentation at IEEE ELNANO-2019. All submitted papers

were subject to three independent anonymous referee reviews. As the result, 179 papers were accepted for publication. The full list of the researchers taking part in ELNANO-2019 contained 726 authors and 118 reviewers from 26 countries. The Conference Proceedings met the requirements provided for the conferences under the auspices of IEEE and for the articles included in the IEEE *Xplore* Digital Library that are indexed by the international scientific-metric databases: Scopus and Web of Science.



Participants of IEEE ELNANO-2019



Participants of the IEEE EDS SRC Region 8 Meeting in Tarragona

Participation in 2019 EDS Region 8 Chapter Chairs Meeting in Tarragona, Spain

—by *Kateryna Arkhypova, Kateryna Ivanko, and Ievgen Kovalov*

The EDS Region 8 Chapter Chairs Meeting took place in Tarragona, Spain, on May, 25, 2019, in the framework of the EDS Board of Governance meeting. This year, three Ukrainian chapter representatives participated in the meeting with presentations of recent chapter activities. It was really useful to meet EDS representatives and BoG members in person, share news and volunteer experience, as well as to contribute to a promo video we recorded with the EDS YP Chair. We want to express our deep appreciation to the EDS team for the invitation and assistance in travel support.

2019 IEEE 2nd Ukraine Conference on Electrical and Computer Engineering

—by *Kateryna Arkhypova, Daryna Pesina, Mykhaylo Andriychuk, and Kateryna Ivanko*

Being founded by the IEEE Ukraine Section in 2017, the IEEE UKRCON-2019 was held for the second time in Lviv, one of the most beautiful cities of Western Ukraine. Its general theme was devoted to Advancing Society through Applied Physics, Electrical

and Computer Engineering (ECE), reflecting profound impact of ECE research on our daily lives. The conference program consisted of plenary and poster sessions. The plenary sessions consisted of oral presentations within seven tracks of scientific and engineering research including Microwave Techniques, Antennas & Radar Systems, Nanotechnologies, Photonics, Electron Devices & Magnetics, Bioengineering & Biorobotics, Industrial and Power Electronics & Energy Systems, System Analysis, Reliability,

Computer Science & Communications, etc. The event was co-sponsored by the IEEE Ukraine Section and almost all IEEE Ukraine Section Chapters with IEEE Region 8 partnership. Among others, the IEEE Ukraine Section (East) AP/MTT/ED/AES/GRS/NPS Societies Chapter, the IEEE Ukraine Section (Kyiv) ED/MTT/CPMT/SSC/COM Societies Chapter and IEEE Ukraine Section (West) MTT/ED/AP/CPMT/SSC Societies Chapter were technical sponsors and financial supporters.

Over 250 professionals from various organizations and countries gave their time and resources to attend, and to contribute to UKRCON-2019. Among them, keynote speakers: Prof. Jörg Rainer Noennig (TU Dresden & HafenCity University Hamburg, Germany); Prof. Mike Hinchey (University of Limerick, Republic of Ireland); Prof. Andrejs Romanovs (Riga Technical University, Latvia); Prof. Dmitri Vinnikov (Tallinn Technical University, Estonia); Prof. Gerard Granet (Institut Pascal, CNRS, SIGMA Clermont, Université Clermont Auvergne, France); Dr. Alessandro Navarrini, (National Institute for Astrophysics, Astronomical Observatory of Cagliari, Italy), and



IEEE UKRCON-2019 participants at the Opening Ceremony, Lviv, Ukraine



Plenary talks by Prof. Jörg Rainer Noennig, TU Dresden & HafenCity University Hamburg, Germany (left) and Prof. Mike Hinchey, University of Limerick, Republic of Ireland (right)

Dr. Andrei Blinov (Tallinn Technical University, Estonia).

The conference has truly become a high quality scientific platform for discussion and cooperation. We thank the organizers for both the scientific part and great social program of the event.

IEEE Ukraine Section (West) MTT/ED/AP/EP/SSC Societies Chapter

—by Mykhaylo Andriychuk

The XXIVth International Seminar/Workshop on Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED-2019) was organized by the IEEE Ukraine Section (West) MTT/ED/AP/EP/SSC Societies Chapter and MTT/ED/AP Georgia Chapter. This year, DIPED was held at the Pidstryhach Institute for Applied Problems of Mechanics and Mathematics (IAPMM), NASU, Lviv, Ukraine, on September 12–14, and it was dedicated to the 100th anniversary of Prof. Boris Z. Katsenelenbaum, master, organizer, and contributor to the DIPED Seminar/Workshop. The IEEE Ukraine Section, IAPMM, and Tbilisi State University were the co-organizers of DIPED-2018. The IEEE Electron Devices, Microwave Theory & Techniques, and Antennas & Propagation Societies provided the Technical Co-Sponsorship for the event.

The DIPED-2019 technical program consisted of 39 papers. Scientists from Georgia, Germany, Israel, Turkey, USA, and Ukraine submitted their papers, which were arranged in the following sections:

- Diffraction and Scattering,
- Propagation in Complex Media,
- EM Modeling and Measurement,
- Antenna Design,
- Inhomogeneous Structures,
- Analytical and Numerical Techniques,
- Electromagnetic and Acoustic Applications.



*Prof. Boris Z. Katsenelenbaum at work,
Nahariya, Israel, 2009*

The Plenary Session began with a talk by Prof. Nikolai Voitovich, DIPED-2019 Program Committee Co-chairman, who presented the memorial to the outstanding scientist in the area of electromagnetic wave theory, Prof. Boris Katsenelenbaum, who passed away more than four years ago in the 96th year of his life. His research works gained recognition both in former Soviet Union countries and world-wide. It was mentioned that the role of Prof. Katsenelenbaum in the establishment of the DIPED Seminar/Workshop was crucial. His enthusiasm and continuous preparing scientific papers for DIPED to much extent determined the scientific direction of the conference.

Prof. Katsenelenbaum published 12 monographs and about 120 papers on the theory of electromagnetic field. The last published papers and reports at the International conferences (Canada, Georgia, Russia, Spain, and Ukraine) were concerned with the problems of the scatterer shape reconstruction and the power transmission by a wave beams. In 1989, Prof. Katsenelenbaum obtained the State Prize of Ukraine in the area of Science and Technology. He was a member of the IEEE and the Popov Society. Since November 1998 he was living in Nahariya, Israel.

Traditionally, the DIPED Program Committee recognizes the best papers of young speakers. The following participants were awarded by the DIPED-2019 Best Young Speaker Award:

- Mr. Olexiy Breslavets for “Frequency Spectrum and Electromagnetic fields distribution in Cavity Microwave Resonator with Metal Pins Inside;”
- Mr. Ilya Persanov for “Subsurface Object Recognition in a Soil Using UWB Irradiation by Butterfly Antenna;”
- Mr. Vadym Plakhtii for “Impulse Electromagnetic Wave Propagation in Kerr Medium;”
- Mr. Olexandr Prishchenko for “Influence of Noise Reduction on Object Location;” Classification by Artificial Neural Networks for UWB Subsurface Radiolocation;”
- Mr. Illia Vodorez for “Control System Automation of the Sputtering Device WUP-5M for the Study of Wave Propagation in Complex Media.”

The recipients of the Award were recognized with a certificate from the Program Committee and a financial grant from the Organizing Committee.

Following the DIPED tradition, the conference participants spent a lot of time for free lobby discussions. After the Seminar/Workshop technical program was completed, a traditional dinner was held. The Best Young Scientist Awards were presented there. The future improvement of the Seminar/Workshop format was discussed and participant suggestions were taken into consideration. It was announced that the next XXVth DIPED-2020 Seminar/Workshop, would be held at the Tbilisi State University, Tbilisi, Georgia, in the middle of September, 2020. The previous attendees and new participants are cordially invited.

~Daniel Tomaszewski, Editor

IEEE EDS Mini-Colloquium on Nanoelectronics

BY AMIT VERMA

The ED Kanpur Chapter, Uttar Pradesh Section, organized a one-day mini-colloquium (MQ) on nanoelectronics on September 14, 2019, at IIT Kanpur. Six lecturers presented during the MQ: Prof. Saurabh Lodha (IIT Bombay), Prof. Swaroop Ganguly (IIT Bombay), Prof. Yogesh Chauhan (IIT Kanpur), Prof. Anil Kottantharayil (IIT Bombay), Prof. Abhisek Dixit (IIT Delhi), and Prof. Benjamin Iniguez (Universitat Rovira i Virgili, Spain). Various topics in nanoelectronics were presented, such as: Optoelectronics devices using 2D layered materials and their heterostructures, Atomistic modeling of electronics devices, Negative-Capac-

itance transistors, Graphene based devices, Multi-gate FET characterization and modelling, and Universal compact modelling for thin film transistors. This MQ was attended by over 45 students and faculty members, which included 30 IEEE members.

IEEE EDS Mini-Colloquium on Emerging Nanoscale Devices: Compact Modeling and Reliability

—by Sourabh Jindal

The ED Indian Institute of Technology—Roorkee Student Branch Chapter organized a MQ on “Emerging

Nanoscale Devices: Compact Modeling and Reliability,” on May 4, 2019. The event was successfully held at the Department of Electronics & Communication Engineering, of IIT Roorkee. About 55 participants, including faculty, research scholars and graduate students from IIT Roorkee, attended.

Prof. Kuei-Shu Chang-Liao, Department of Engineering and System Science, National Tsing Hua University, delivered his lecture which focused on high performance Ge pMOSFETs by engineering interfacial layer.

Prof. Mansun Chan, Electrical and Electronic Engineering Department,



Attendees of the EDS Mini-Colloquium on Nanoelectronics at IIT Kanpur



Attendees of the EDS Mini-Colloquium at IIT Roorkee



Professor Mridula Gupta, ED Delhi Chapter Chair, along with Dr. Brajesh Kaushik, Prof. Amita Dev (Vice Chancellor, IGDTUW), and Dr. Mayank Srivastava at the Inaugural function of the mini-colloquium

Hong Kong University of Science and Technology, discussed *new* applications that require device with time dependent dynamic device behaviors, such as neuromorphic computing or artificial neural-network circuits, which require a new interaction between the compact model and circuit simulator.

Prof. Yogesh Chauhan, IIT Kanpur, talked about the concept of negative capacitance proposed to achieve a sub-60mV/decade SS.

Prof. Cher Ming Tan, Electronic Department of Chang Gung University and Honorary Chair Professor at Ming

Chi University of Technology, Taiwan, addressed the reliability of the narrow interconnects, that has changed as compared to their wider counterpart.

IEEE EDS Mini-Colloquium on "Trends and Challenges in Microelectronics and VLSI Design" —by *Sneha Kabra*

The student branch of IEEE Indira Gandhi Delhi Technical University for Women (IGDTUW), along with the the ED Delhi Chapter and IEEE Delhi Section, jointly hosted a Mini-Collo-

quium on "Trends and Challenges in Microelectronics and VLSI Design," on September 6, 2019. The goal of the colloquium was to expose interested students to the challenges and the scope of work in the field, and give them insights beyond their existing academic knowledge. The event recorded around 300+ registrations from all colleges across Delhi NCR and a footfall of 150+ at the event. The demographics were diverse, with both post-graduates and graduates from wide-ranging courses being the active audience of the day.

Dr. Brajesh Kumar Kaushik, Department of ECE, Indian Institute of Technology, Roorkee, delivered a lecture on "Spintronics-Perspectives and Challenges," and Dr. Mayank Shivastava, Associate Professor, Department of Electronic Systems Engineering, IISc, Bangalore gave talk on "The Future of World Electronics and Possible Roles India Can Play." The third lecture was delivered by Dr. Manoj Saxena, Associate Professor, Deen Dayal Upadhyaya College, University of Delhi, on "Fundamental Insights into Channel and Gate Engineered Double Gate Junction-Less Transistor for Low-Voltage Low-Power Analog and Digital Circuits."

~ Manoj Saxena, Editor

IEEE EDS DISTINGUISHED LECTURE—ED BEIJING CHAPTER

BY KANGWEI ZHANG

The ED Beijing Chapter held two Distinguished Lectures (DLs) in Beijing, China, during the third quarter of 2019.

The first event was given on July 26th by Dr. Anirban Bandyopadhyay, Director of RF Strategic Applications & Business Development, GlobalFoundries, Inc., USA. His talk titled "Silicon Technologies for 5G Enhanced Mobile Broadband Radio interface on

mmWave," focused on eMBB aspect of 5G—particularly the mmWave based eMBB. He highlighted different hardware architecture options and key figures of merit for the radio interface of mmWave 5G eMBB. Also explained were various chip partitioning options and how different silicon technologies, like partially and fully depleted SOI, Silicon-Germanium BiCMOS, can address the requirements and

challenges for different mmWave 5G radio architectures, for both User Equipments (UE) and Infrastructure (small cell and backhaul). About 20 attendees and several professors attended this talk.

The second DL was given by Prof. Yang Chai of Hong Kong Polytechnic University, on August 20, 2019. His lecture, titled "Optoelectronic resistive random access memory for



ED Beijing Chapter Distinguished Lecture on July 26th, with Dr. Anirban Bandyopadhyay (first row, 7th from right)



ED Tainan Chapter DL on October 8th—(1st row, 4th from left) Dr. Y. L. Lee, Prof. Wen-Kuan Yeh (Chair of ED Tainan Chapter), Prof. Jr-Hau He (DL Speaker), Dr. Y.T. Tang, and some of the attendees

neuromorphic vision sensors,” showed simple two-terminal optoelectronic resistive random access memory (ORRAM) synaptic devices, for an efficient neuromorphic visual system that exhibited non-volatile optical resistive switching and light-tunable synaptic behaviours. The ORRAM arrays enable image sensing and memory functions as well as neuromorphic visual pre-processing with an improved processing efficiency and image recognition rate in the subsequent processing

tasks. The proof-of-concept device provides the potential to simplify the circuitry of a neuromorphic visual system and contribute to the development of applications in edge computing and the internet of things.

IEEE EDS Distinguished Lecture—ED Tainan Chapter —by Wen-Kuan Yeh

The ED Tainan Chapter held one Distinguished Lecture at Taiwan Semi-

conductor Research Institute (TSRI), Hsin-Chu, Taiwan, on October 8, 2019. The invited DL, Jr-Hau He (Professor, Department of Materials Science and Engineering, City University of Hong Kong) gave his lecture, “Solar Fuels,” which focused on new energy harvesting technology and devices for related applications. About 40 attendees and several professors of local universities attended this event.

~Ming Liu, Editor

REGIONAL NEWS

USA, CANADA & LATIN AMERICA (REGIONS 1-7 & 9)

2020 IEEE Radio Frequency Integrated Circuits Symposium (RFIC)

—by Waleed Khalil

The 2020 IEEE Radio Frequency Integrated Circuits Symposium (RFIC 2020) will be held in Los Angeles, California, USA, June 21–23, 2020.

NEW for RFIC 2020: The RFIC symposium is expanding its scope to include System Applications and Interactive Demonstrations. This includes systems and applications in 5G, radar, imaging, terahertz, biomedical, and optoelectronic areas. In addition to the Emerging Circuit Technology area introduced in RFIC 2019, this year the symposium has introduced a completely new System Applications area and sub-committee that targets advanced system presentations in a range of topics related to communication, radar, imaging, sensing, and biomedical. To further highlight the systems aspects and enrich our attendees' experience, selected papers from this area will also be presented in a new Interactive Demonstration session. Please refer to the Call for Papers and RFIC website for more details.

The symposium starts on Sunday, June 21, 2020 with workshops and short courses, followed by two exciting plenary talks. Immediately following the plenary session, we will be holding an RFIC 'interactive' Sunday reception that will highlight our industry showcase and student papers finalists for an engaging social and technical evening event.

Monday, June 22nd and Tuesday, June 23rd will be comprised of oral paper presentations, an interactive demonstration, and entertaining panel sessions.

We invite authors to submit their technical papers via the RFIC 2020 website; author guidelines and Call for Papers can be found on the website. Complete information on how and when to submit a paper will be posted on the RFIC 2020 website. The conference will solicit papers describing original work in RFIC circuits, systems engineering, design methodology, RF modeling and CAD simulation, RFIC technologies, device technologies, fabrication, testing, reliability, packaging, and modules to support RF applications in areas such as Wireless Cellular and Connectivity, Low Power Transceivers, Receiver Sub-Systems and Circuits, Mixed-Signal RF and Data Converters, Reconfigurable and Tunable Front-Ends, Transmitter Sub-Systems and Power Amplifiers, Oscillators, Frequency Synthesis, Millimeter- and Sub-Millimeter Wave Systems, and High-Speed Data Transceivers.

Same as last year, a double-blind review process will be adopted to ensure anonymity for both authors and reviewers. Detailed instructions on how to submit a paper compliant with double-blind rules will be posted on the RFIC 2020 website.

Electronic Submission Deadlines:

Technical Paper Summaries in PDF format: January 10, 2020

Final Manuscripts for the Digest and Attendee Download: March 23, 2020

All submissions must be made at rfic-ieee.org in pdf form. Hard Copies are not accepted.

DOWNLOAD the RFIC 2020 Call for Papers

EUROPE, MIDDLE EAST & AFRICA (REGION 8)

IEEE ESSDERC and ESSCIRC Gather Over 500 Participants from 42 Countries

—by Paweł Grybos

The joint **49th European Solid-State Device Research Conference** and **45th European Solid-State Circuits Conference** (<https://esscirc-essderc2019.org/>) was held on September 23–26, 2019, in Cracow, Poland. These well-established conferences, sponsored by the IEEE Electron Devices Society and the IEEE Solid-State Circuits Society, for the first time were organized in Poland. This event gathered over 500 participants from 42 countries. Approximately half of the participants originated from academia centers and half of them represented research institutes and industry developing novel materials, devices, circuits and technologies for electronic applications.

The conference program encompassed 164 talks in regular sessions and 40 lectures during tutorials. Each morning and afternoon session began with keynote presentations given by speakers from renowned universities, such as EFPL in Lausanne, Harvard University, Stanford University, Osaka University, Seoul National University, TU Eindhoven, as well as companies and research institutes including Intel, STMicroelectronics, AIXTRON SE, Tyndall National Institute.

The conferences provided the opportunity for the transfer of scientific knowledge and created an occasion to promote Polish science among industrial partners developing the most advanced electronic technologies



Conference participants in Auditorium Maximum of the Jagiellonian University in Cracow
(source –AGH Foundation)



Opening ceremony in the main building of the AGH University of Science and Technology in Cracow (source –AGH Foundation)



Underground banquet in the Wieliczka salt mine (source –AGH Foundation)

worldwide. The conferences were accompanied by other events such as the IEEE Young Professionals meeting, organized by the Polish Section of the IEEE YP, providing a forum for discussion and exchange of knowledge and opinions between experienced scientists and graduate or doctoral students in the area of microelectronics.

The President of the Republic of Poland, Andrzej Duda, addressed the conference participants by letter which was read out during the opening ceremony held at the AGH University of Science and Technology (read the official translation of his letter following this article). The joint IEEE ESSSDERC and ESSCIRC conferences enjoyed the honorary patronage of:

- the Ministry of Entrepreneurship and Technology,
- the Ministry of Science and Higher Education,
- the Ministry of Digitization,
- the Mayor of Warsaw,
- the Mayor of Cracow,
- the Rector of the AGH University of Science and Technology in Cracow,
- the Rector of the Warsaw University of Technology,
- the Rector of the Jagiellonian University in Cracow.

It should be underlined that the organization of such a prestigious event in Poland was possible only owing to the close cooperation of the following institutions:

- the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering of the AGH University of Science and Technology in Cracow,
- the Faculty of Electronics and Information Technology of the Warsaw University of Technology,
- the Faculty of Physics, Astronomy and Applied Computer Science of the Jagiellonian University in Cracow,
- Centre for Advanced Materials and Technologies CEZAMAT in Warsaw.

Formal Translation of the Letter

President of the Republic of Poland
Warsaw, September 24, 2019

Participants and Organisers
of 49th European Solid-State Device
Research Conference
of 45th European Solid-State Cir-
cuits Conference
Krakow, Auditorium Maximum of
the Jagiellonian University

Ladies and Gentlemen!

May I extend my warm greetings to the participants of the 49th European Solid-State Device Research Conference (ESSDERC) and the 45th European Solid-State Circuits Conference (ESSCIRC). I am glad that two such important and prestigious events take place in our country, in Krakow, gathering such an eminent group of experts from Poland, Europe and whole world.

There is no need whatsoever to persuade anyone about the importance of semiconductor technologies in today's world. Every year, or in fact, every moment, they play an increasingly important role in our daily lives. The progress of modern microelectronics holds a lot of promise: before our very eyes a real revolution unfolds in telecommunications, mobility, data analysis, medicine and many other areas that have direct bearing on each and every one of us. 5G technology, electromobility, artificial intelligence and the development of nanotechnologies open up new perspectives and unleash novel unheard of potential. At the same time, phenomena such as global warming and tensions in the international arena make us think about sustainability and security. I firmly believe that new technologies, as soon as they are put to good use, can make our world safer and more friendly.

It is with all the greater joy and satisfaction that I welcome the fact that in these days it is Krakow that is becoming an international centre for discussion and exchange of knowledge on modern semiconductor tech-

nologies. This former capital of Poland, a city full of historical monuments, at the same time making a very important contribution to Poland's development, certainly is a perfect venue for a scientific discussion about issues that largely shape the face of our civilisation, and will probably have an even greater impact on the future of humanity. I would like to express my appreciation and gratitude to the organisers of both conferences: the universities that have contributed greatly to the development of Polish science: the Jagiellonian University, the oldest Polish university with its grand achievements whose I have the honour to be a graduate, the university where I did my scientific work, and to whom I will always feel attached; the Stanislaw Staszic AGH University of Science and Technology in Kraków, which celebrates its centenary this year; the Warsaw University of Technology, the largest technical university in Poland with a tradition dating back to the early 19th century, and the Centre for Advanced Materials and Technology CEZAMAT. I am convinced that the meeting of the most eminent specialists in the field of microelectronics will result in new research and development projects. I would very much like to see the biggest share of them implemented in practise and implemented in Poland, by Polish scientists and by Polish companies. Poland sets great store by forging possibly closest and deepest links between science and industry in our country, we set great store by Polish innovation which should contribute to the success of domestic companies and their expansion into global markets. We want to be an innovation- friendly country, a place where research is conducted and new technologies are developed.

Once again I would like to thank the organizers of this important meeting, I wish you all fruitful deliberations, and to our foreign guests a pleasant stay in Poland.

*Sincerely,
Andrzej Duda*

2019 International Conference on Microelectronics (MIEL)

—by Ninoslav Stojadinović and
Danijel Danković

The 31th International Conference on Microelectronics (MIEL 2019) was held September 16–18, 2019, at the Faculty of Electronic Engineering, University of Niš, Niš, Serbia. The conference was organized by the IEEE Serbia and Montenegro Section—ED/SSC Chapter in cooperation with the Serbian Academy of Sciences and Arts—Branch in Niš and the Faculty of Electronic Engineering (University of Niš), under the co-sponsorship of the IEEE EDS, and under the auspices of Serbian Ministry of Education, Science, and Technological Development and Serbian Society for ETRAN.

The Mini-Colloquium on Nano- and Flexible-Electronics

(<https://eds.ieee.org/education/distinguished-lecturer-mini-colloquia-program>) held September 16th attracted a lot of interest of both domestic and foreign participants. It was an excellent introduction to the main technical program of MIEL Conference, which consisted of Tutorial on Power Devices and Modules, Plenary Session, and four regular Sessions (2 oral and 2 poster): Device Physics, Technology and Characterization, and Circuit and System Design and Testing. The attendees, 42 domestic and 40 foreign, came from 20 different countries. A total of 4 keynote invited papers and 74 regular contributions (25 in oral sessions and 49 posters) were presented. The conference proceedings (359 pages) were published through the IEEE Conference Publication Program, and is available on *IEEE Xplore*.

The keynote invited speakers were: G. Wachutka (Technical University of Munich, Germany), S. Dimitrijević (Griffith University, Nathan, Australia), Z. Prijic (University of Niš, Serbia), Z. Stamenković (IHP, Frankfurt (Oder), Germany).



Conference Chairman, Academician Ninoslav Stojadinović addressing the audience at MIEL 2019 Opening Session

Based on evaluation of the quality of the papers and presentations, three Best Paper Awards were presented to D. Osipov (University of Bremen, Germany) for an oral paper "SAR ADC Architecture with Fully Passive Noise Shaping," to Yu. I. Bogdanov (MEPhI, Moscow, Russia) for a poster paper "Non-parametric Statistical Analysis of Radiation hardness Threshold Variation in CMOS IC Wafer Lots Series with the Aim of Process Monitoring," and to L. Jürimägi (Tallinn University of Technology, Estonia) for a student paper "Algorithm for Restructuring of Structurally Synthesized BDDs." In addition, *FACTA UNIVERSITATIS, Series Electronics and Energetics* journal awarded the paper "A Parallel Adaptive LMS FIR Filter Realized in CMOS Technology" by R. Długosz (UTP University of Science and Technology, Bydgoszcz, Poland).

The ED/SSC University of Nis Student Branch Chapter has been selected as the 2018 recipient of the IEEE Electron Devices Society Region 8 Chapter of the Year Award. This award is intended to recognize the quality and quantity of the activities and programs implemented by the Region 8 chapters during the the period of July 1, 2017–June 30, 2018. The student branch chapter chose the MIEL 2019 Conference to receive their award. During the Opening Session, Arokia Nathan handed the plaque to



Arokia Nathan presenting the Region 8 EDS Chapter of the Year Award to Danijel Dankovic, University of Nis Student Branch Chapter Chair



At Conference closing and Best Paper Award ceremony: Y. M. Moskovskaya (Russia), Ninoslav Stojadinović, L. Jürimägi (Estonia) and R. Długosz (Poland)

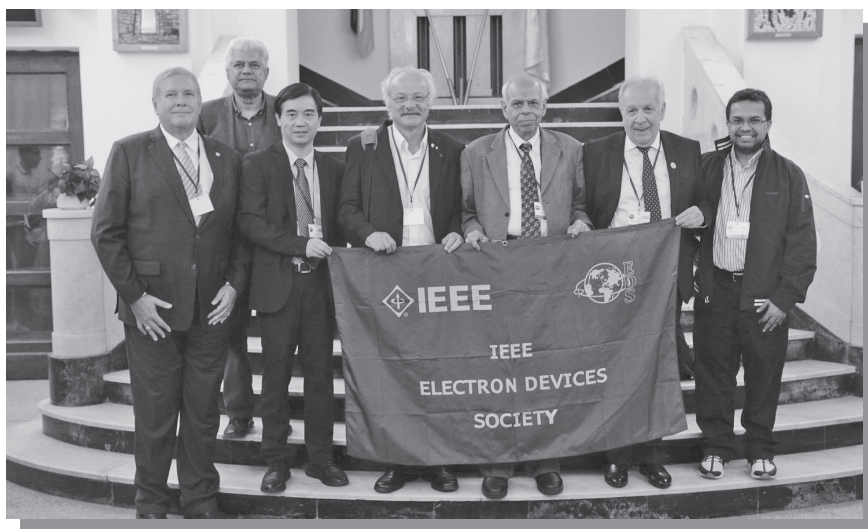
Danijel Dankovic, University of Nis Student Branch Chapter Chair.

As is among the best traditions of MIEL, the social program of this year's conference issue was particularly rich, with a conference banquet and gala-dinner as highlights. Besides the high quality of presentations, MIEL conferences are generally flavored by a friendly atmosphere and great hospitality of the local people. This special charm adds to very positive impressions the participants bring from the conference, and is one of the reasons why one rarely attends MIEL just once: one who comes will almost

certainly come again. So, we are very much looking forward to welcoming old and new friends at MIEL 2021.

Report on the IEEE EDS Mini-Colloquium on Nano- and Flexible-Electronics, Niš, Serbia
—by Ninoslav Stojadinović and Danijel Danković

An IEEE EDS sponsored Mini-Colloquium on Nano- and Flexible-Electronics (MQ) was held on Monday, September 16, 2019, at the University of Niš, Niš, Serbia. This MQ was organized in conjunction with the 31th



MQ lecturers and Ninoslav Stojadinović



Hot topics at the MQ were very attractive for students

International Conference on Microelectronics—MIEL 2019, giving great opportunity to foreign participants to be updated with novelties in modern scientific field. Detailed information on the EDS MQ can be found: (<https://eds.ieee.org/education/distinguished-lecturer-mini-colloquia-program>). The objective of the MQ was to present the topics on Nano- and Flexible-Electronics.

The event began with a welcome and opening address by Ninoslav Stojadinović, ED/SSC Chapter Chair in IEEE Serbia and Montenegro Section. The opening address was followed by six presentations given by the leading

experts in the field, including the IEEE EDS Distinguished Lecturers, as follows: “Quantum Engineering of Low-Dimensional Nanoensembles” (Vijay Arora, *Wilkes University, Pennsylvania, USA*), “New Routes and Paradigms in Device Engineering for Nanoelectronics and Nanosystems” (Simon Deleonibus, *CEA/LETI, France*), “On the ESD Protection and Non-Fatal ESD Strike on Nano CMOS Devices” (Hei Wong, *City University of Hong Kong, Hong Kong*), “Flexible CMOS Electronics for Environmental Applications Muhammad” (Mustafa Hussein, *KAUST, Saudi Arabia*), “Ultra Low Sensor Interfaces for the IoT Flexible Electronics” (Arokia

Nathan, *Cambridge Touch Technologies, UK*), and “CMOS-Compatible Gas Sensors” (Siegfried Selberherr, *Technical University of Vienna, Austria*). The event included a coffee break, lunch and welcome cocktail.

The MQ was very well received by the audience of about 75 people, in terms of organization, technical quality of the contributions and opportunities for discussion. All presentations were interactive with active participation by the attendees. The attendance was mainly MIEL 2019 Conference participants and local students and professors.

~ **Marcin Janicki, Editor**

5th CAD-TFT 2019 Workshop in Tarragona

—by Benjamin Iniguez, Lluís Marsal and Mike Schwarz

The Mini-Colloquium (MQ) on Flexible Electronics was held a day after the 5th CAD-TFT 2019 Workshop, which also took place in Tarragona on July 9–10 2019. The CAD TFT Workshop is an annual event organized alternatively in China and in Europe. The 2019 edition included 22 talks, addressing CAD modeling for TFT fabrication processes, TFT device and sensors design, modeling of TFT performances and parameter extraction.

The first session dealt with process technology and was chaired by Subjune Jung and Radu Sporea. The first talk was held on “Defect Self-Compensation for High-Mobility Bilayer InGaZnO/In₂O₃ Thin-Film Transistor” by Guoli Li (School of Physics and Electronics, Hunan University, Changsha, Hunan Province, China). Next topic was on “Room Temperature Solution Synthesized p-Type Copper(I) Iodide Semiconductors for Transparent Thin Film Transistors” by Yong-Young Noh (Department of Chemical Engineering, Pohang University of Science and Technology, Pohang, Republic of Korea). It was followed by a talk on “Aligned Silver Nanowire Transparent Electrodes for Displays

and Sensors” by Hyunhyub Ko (School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan, Republic of Korea).

After a short coffee break, Do Hwan Kim (Department of Chemical Engineering, Hanyang University, Seoul, Korea) gave a talk entitled *“High-resolution, solution-processed tandem organic electronics.”* The session ended with a talk on *“Organic-Inorganic Hybrid Materials for Advanced Functionality Development in Large Area Electronics”* by Myung-Gil Kim (Department of Chemistry, Chung-Ang University, Seoul, Republic of Korea).

After lunch, a tutorial by Slobodan Mijalkovic from Silvaco Europe Ltd., St. Ives, United Kingdom, was given on the topic of *“Verilog-A for Compact Modeling Implementation.”*

The second session of the day was chaired by Hyunhyub Ko and concentrated on the field of device and sensor design. The first talk on *“Parameterized Inkjet Printing for Computer-Aided Printed Electronics Design”* was given by Jimin Kwon (Future IT Innovation Laboratory and Department of Creative IT Engineering, Pohang University of Science and Technology (POSTECH), Republic of Korea). Afterwards a presentation on *“Design and Characterization of TFT arrays for IS-FET applications”* was held by Ashkan Rezaee (CEPHIS. Engineering School, Universitat Autònoma de Barcelona, Spain). The session ended with a talk on *“High gain depletion-load amplifiers based on source-gated transistors”* by Eva Besterlink (Advanced Technology Institute, University of Surrey, Guildford, United Kingdom).

The first day of the workshop ended with a gala dinner in Tarragona.

The second day of the workshop contained two sessions. The first session was focused on characterization and parameter extraction and was chaired by Benjamin Iñiguez and Fabrizio Torricelli. The initial talk on *“Characterization and Benchmarking of Organic and Emerging Material Thin-Film Transistors from Application Per-*



“Verification of a Charge-Based Capacitance Model for Staggered Organic Thin-Film Transistors” was presented by Jakob Simon Leise (NanoP, TH Mittelhessen University of Applied Sciences, Giessen, Germany)



“Analytical Model for VT, roll-off and DIBL Effect in Short Channel Staggered Organic Thin-Film Transistors” was held by Jakob Prüfer (NanoP, TH Mittelhessen University of Applied Sciences, Giessen, Germany)

spectives” was presented by Xiaojun Guo (Department of Electronic Engineering, Shanghai Jiao Tong University, Shanghai, China). The second talk, *“Dependence with illumination of the contact region of organic phototransistors”* was given by A. Romero (Universidad de Granada, Spain).

After a coffee break, the session continued with *“Analysis and parameter extraction in I-V characteristics in high mobility OTFTs from 150K to 350K”* by H. Cortes-Ordoñez (Universitat Rovira I Virgili, Tarragona, Spain) et al., *“Low Frequency Noise (LFN) Characterization of High Mobility Polymeric OTFT devices”* was given by Wondwosen E. Muhea (Department of Electrical, Electronics, and Automation Engineering, Universitat Rovira I Virgili, Tarragona, Spain). The session was closed by the talk *“An Improved Measurement Technique for the Characterization of Organic Thin Film Transistors”* by G. Dharbandy et al. (NanoP, TH Mittelhessen University of Applied Sciences, Giessen, Germany).

The second session was chaired by Slobodan Mijalkovic and Magali Estrada and focused on compact modeling. The session began with a talk by Antonio Cerdeira (SEES, Depto. de Ingeniería Eléctrica, CINVESTAV-IPN, Av. IPN 2208, CP 07360, Mexico City, Mex-

ico) on the topic *“DC and AC Modeling of Amorphous Oxide Semiconductor Thin Film Transistors.”* Afterwards, insights were given on *“Compact Physical-based Drain-Current Model of a-IGZO TFTs for Circuit Simulation”* by Fabrizio Torricelli (Department of Information Engineering, University of Brescia, via Branze 38, 25123 Brescia, Italy). *“Validity of Extended Gaussian Disordered Model for OFETs application”* was offered by Yongjeong Lee (LPICM, CNRS UMR 7647, Ecole polytechnique, IPParis, Palaiseau, France). Next the talk *“Verification of a Charge-Based Capacitance Model for Staggered Organic Thin-Film Transistors”* was presented by Jakob Simon Leise (NanoP, TH Mittelhessen University of Applied Sciences, Giessen, Germany). Finally, the presentation entitled *“Analytical Model for VT, roll-off and DIBL Effect in Short Channel Staggered Organic Thin-Film Transistors”* was held by Jakob Prüfer (NanoP, TH Mittelhessen University of Applied Sciences, Giessen, Germany).

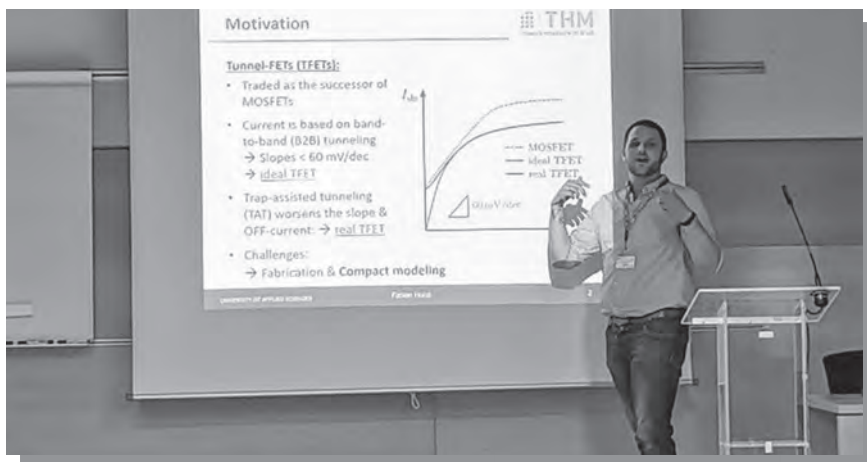
ED Spain—Graduated Student Meeting 2019

—by Benjamin Iniguez, Lluís Marsal and Mike Schwarz

The annual Graduate Student Meeting of the Department of Electronic,



Atieh Farokhnejad (THM, Germany) on the topic of "Study of Device Parameters Influence on Performance of TFET-Based Circuits Using a Compact Model"



Fabian Horst (THM, Germany) with his talk entitled "Closed-Form TAT Current Modeling Approach for an Implementation in Compact TFET Models"

Electrical and Automatic Control Engineering of the University Rovira i Virgili (URV) was held in Tarragona on July 12, 2019. This annual event includes both plenary talks given by internationally recognized experts and student oral and poster presentations.

In the 2019 edition there were a total of four invited presentations. Prof. Adrian Ionescu (EPFL, Switzerland) was one of the invited speakers, and as EDS DL gave a talk entitled "Edge Artificial Intelligence Electronic Technologies for Global Challenges."

The rest of plenary presentations also addressed topics related to electron devices and sensors. Prof. Joan Daniel Prades (University of Barcelona, Spain) targeted "New miniaturization trends for power efficient gas

sensors." Dr. Reza Salek (International Agency for Research on Cancer, Lyon, France) addressed "Data sharing, data standards and data analysis in metabolomics a FAIR approach." Finally, Dr. Beatriu Prieto-Simon talked about "Next generation of diagnostic tools: from microneedles to nano-channel arrays."

The first PhD student oral presentations were given by Atieh Farokhnejad (THM, Germany) on the topic of "Study of Device Parameters Influence on Performance of TFET-Based Circuits Using a Compact Model" and Fabian Horst (THM, Germany) with his talk entitled "Closed-Form TAT Current Modeling Approach for an Implementation in Compact TFET Models."

After a coffee break and the poster session the second PhD student oral

session were started by Juan Casanova (URV, Spain) on the topic "Gas Sensors based on Diamondoid Nanostructures" followed by David Garcia (URV, Spain) with "Active Battery Balancing Via a Switched DC-DC Converter: Description And Performance Analysis."

The final PhD student oral presentations were given after lunch, and were presented by Jakob Leise (THM, Germany) with his talk entitled "Charge-Based Compact Modeling of Intrinsic Charges in Staggered OTFTs" and Martí Boada (URV, Spain) with "NFC battery-less sensors using smartphones as a readers."

EDS Distinguished Lecture

On July 19th, Prof. Antonio Cerdeira (CINVESTAV, Mexico), EDS Distinguished Lecturer, conducted a lecture entitled "Capacitance modeling of Amorphous Oxide TFT" at the University Rovira i Virgili.

Transducers 2019—EUROSENSORS XXXIII

—by Christofer Hierold

The Transducers 2019—EUROSENSORS XXXIII conference (<https://transducers-euroensors2019.org>) was held in Berlin, Germany, June 23–27, 2019, sponsored by Hahn Schickard. The IEEE Electron Devices Society is the technical sponsor providing archival repository of the conference proceedings through IEEE Xplore. The General Chair and Program Chair were Prof. Christofer Hierold (ETH Zürich, Switzerland) and Prof. Jürgen Brugger (EPFL, Switzerland), respectively.

More than 1,200 attendees from more than 35 countries followed the scientific presentations in five parallel sessions, and the discussed latest research achievements with the poster presenters. There were 1,528 abstracts and late news submitted and evaluated by 164 renowned experts in the field. The final selection of 655 high quality oral and poster presentations was performed by 24 members of the Executive Program Committee



Transducers 2019—EUROSENSORS XXXIII conference, Berlin, Germany, June 27, 2019: Oral and Poster Presentation Award Winners (photo credit: Bildschön GmbH)

during a two-day meeting in Zurich. The major criteria for selection are novelty and scientific quality.

The conference included an extended Industrial Exhibition with more than 50 exhibitors, an Industrial Stage for company presentations and a novel Start-Up Session. At this point, we would like to thank all our benefactors, and in particular the “gold benefactors,” Innovative Sensor Technology, NXP, Bosch and Teledyne Dalsa for their great support of the conference.

We would like to thank all presenters, attendees and supporters of the conference and PMMI, represented by Sara Stearns and her team for meeting management support.

The 21st Transducers Conference will be held in 2021 in Orlando, Florida, USA. <https://www.transducers2021.org/>

Background information:

The Transducers Conference Series is an independent conference series, organized on behalf of the International Steering Committee by volunteers every second year in Europe/Africa, Asia/Oceania or the Americas, respectively. It is the largest scientific conference in the field of solid-state sensors, actuators, microsystems and related technologies, attracting typically more than 1,000 attendees from academia, research institutions,

and industries to exchange the latest advances in the field.

The Transducers Conference Series started in 1981 in Boston. In 2019 we celebrated the 20th edition of the conference by establishing the “Transducers Early Career Award,” sponsored by CSEM and Omega. The first awardee is Prof. Dana Weinstein, PhD, Purdue University, for her outstanding research in hybrid MEMS-IC devices for wireless communications, clocking and sensing applications.

Every six years, when Transducers is held in Europe, it is organized jointly with EUROSENSORS.

32nd International Symposium on Power Semiconductor Devices and IC's (ISPSD)

—by Mike Schwarz and Oliver Häberlen

The 32nd International Symposium on Power Semiconductor Devices and ICs is scheduled to be held in Vienna, Austria, May 17–21, 2020.

ISPSD is the premier forum for technical discussion in all areas of power semiconductor devices, power integrated circuits, their hybrid technologies, and applications. The ISPSD conference continues to grow in scale and stature year on year with a record of 600 attendees last year in

Shanghai. It is firmly established as the must-attend conference for the power semiconductor industry reflecting the growing importance of power electronics and power semiconductors for a sustainable world.

ISPSD 2020 will be held in the historical city center of Vienna, the capital of Austria. Vienna is a UNESCO World Heritage Site and also described as Europe's cultural capital. The metropolis with its unique charm, vibrancy and flair, historical treasures, music and arts will give this conference a unique atmosphere.

The ISPSD captures all areas of power semiconductor devices and power integrated circuits (low and high voltage devices & circuits, all semiconductor materials including Si, SiC, GaN, Ga₂O₃ and diamond, power semiconductor packaging). The conference offers an attractive short course program on Sunday covering important topics like modelling of package parasitics for fast switching devices, system level optimization of power converters, bipolar and super junction device concepts for SiC, GaN integrated circuit design, processes and devices with materials beyond SiC & GaN (e.g. AlN, Ga₂O₃), and last but not least silicon high power devices (IGBTs and Thyristors).

The main conference will be held Monday through Thursday starting with plenary talks on trends and challenges for the power semiconductor industry followed by talks and poster sessions organized along the following tracks:

- High Voltage Power Devices: High voltage silicon based discrete devices (>200V) such as super junction MOSFETs, IGBTs, thyristors, GTOs and pn-diodes
- Low Voltage Power Devices and Power IC Technology: Low voltage silicon based discrete power devices (≤ 200V) and power devices for power ICs of all voltage ranges
- Power IC Design: Circuit design and demonstration using power IC technology platform



- GaN and III/V Compound Materials: GaN and other III/V compound material (e.g. AlN, GaAs) based power devices, technology and integration, materials, and processing
- SiC and Other Materials: SiC and other material (e.g. Ga₂O₃, diamond) based power devices, technology and integration, materials, and processing
- Module and Package Technologies: Module and package technology for discrete power devices and power ICs

The conference is organized in non-paralleled sessions allowing the attendees to listen to all fields of power semiconductors, enabling new views beyond their own field of research.

Attendees recognize the following important dates:

- Early Registration Deadline (reduced fee): March 17, 2020
- On-line Late Registration Deadline: May 10, 2020

Further information can be found on the conference homepage <http://www.ispsd2020.com>

The ISPSD is organized by Dr. Oliver Häberlen (General Chair, Infineon Technologies, Austria), Prof. Nando Kaminski (Technical Program Chair, University of Bremen, Germany), Prof. Ulrike Grossner (Short Course Chair, ETH Zurich, Switzerland) and Pavla Hlinkova (Local Arrangements Chair, Guarant, Czech Republic). The conference is technically co-sponsored by IEEE and its societies EDS, PELS and IAS, as well as by ECPE and IEEEJ.

International Symposium on Memristive Systems (MEMRISYS)—3rd International Symposium on Memristive Systems in Dresden, July 8–11, 2019

—by Michele Lempke

The International Symposium on Memristive Systems (MEMRISYS), the largest scientific meeting on the theory and applications of memristor devices and systems was held from July 8–11, 2019, at the International Congress Center Dresden in Dresden, Germany.

The Symposium General Chairs were Prof. Ronald Tetzlaff (Technische Universität Dresden, Dresden, Germany), Dr. Ilia Valov (Forschungszentrum-Jülich-JARA, Jülich, Germany), and Prof. Themis Prodromakis (University of Southampton, Southampton, United Kingdom).



Some of the participants of the International Symposium on Memristive Systems (MEMRISYS)—3rd International Symposium on Memristive Systems in Dresden, July 8–11, 2019 (Photograph by Martin Weiher)

The Symposium Steering Committee was composed of the following scientists.

- Dr. Ming Liu (Institute of Microelectronics of Chinese Academy of Sciences, China)
- Prof. Themis Prodromakis (University of Southampton, Southampton, United Kingdom)
- Dr. Ilia Valov (Forschungszentrum-Jülich-JARA, Jülich, Germany)
- Prof. Huaqiang Wu (Tsinghua University, Beijing, China)
- Prof. Joshua Yang (University of Massachusetts Amherst, Amherst, Massachusetts, USA)
- Prof. Wei Lu (University of Michigan, Ann Arbor, Michigan, USA)
- Prof. Leon Ong Chua (University of California Berkeley, Berkeley, California, USA)
- Prof. Daniele Ielmini (Politecnico di Milano, Milan, Italy)
- Prof. Ronald Tetzlaff (Technische Universität Dresden, Dresden, Germany)
- Prof. Julio Georgiou (University of Cyprus, Nicosia, Cyprus)

The MEMRISYS was opened by Ronald Tetzlaff, who welcomed all the attendees.

More than 240 international well-known academic researchers attended the 7 Plenaries, 18 Keynotes, 12 invited talks and 32 Sessions.

We introduced the symposium activities of each morning and afternoon with one of the plenary lectures. Each plenary was followed by oral presentations from authors of submitted regular papers, which received a positive evaluation through a peer-review. The oral presentations allocated to each morning and afternoon were split into two parallel sessions, were introduced by an invited talk, and were classified into distinct topics such as

- Material Engineering
- Device Fabrication, Characterization, and Testing
- Memristor Theory
- Memory Development
- Neuromorphic Circuit and System Design
- Mem-Computing Architectures
- Sensory Applications
- Complex Memristive Networks

A Poster Exhibition Session and a “Live Demo” Session, featuring the active presentation of the latest hardware and software developments on memristors, rounded off the symposium program.

Information about MEMRISYS 2019 are available online at <https://www.iee.et.tudresden.de/mem2019/>

The upcoming MEMRISYS in 2020 will be in Tsukuba, Japan.

24th International Conference on Simulation of Semiconductor Processes and Devices (SISPAD 2019)

—by David Esseni

The 24th SISPAD conference was held September 4–6, 2019, in Udine, Italy.

The organizing committee consisted of David Esseni (University of Udine, Conference Chair), Pierpaolo Palestri (University of Udine, Technical Program Co-Chair), Denis Rideau (STMicroelectronics, Technical Program Co-Chair), Francesco Driussi (University of Udine, Publication Chairman).

The conference was hosted by the University of Udine in the beautiful Palazzo di Toppo Wassermann.



Opening of the SISPAD 2019 conference



Coffee break and poster exhibition during SISPAD 2019

The IEEE Electron Devices Society was a Technical Sponsor of the conference, that was also sponsored by Atomera, Global TCAD Solutions (GTS), Infineon Technologies, CEA-Leti, Samsung, Silvaco, Synopsys and the Fondazione Friuli (major local bank). Some of the sponsors had an exhibitor booth at the conference site.

The Technical Program Committee was formed by:

- Campbell Millar (Synopsys Inc, UK),
- Christoph Jungemann (University of Aachen, Germany),
- Geert Eneman (IMEC, Belgium),
- Susanna Reggiani (University of Bologna, Italy),
- Lado Filipovic (Technische Universität Wien, Austria),
- Jurgen Lorenz (Fraunhofer Institute for Integrated Systems and Device Technology IISB, Germany),
- Layla Martin-Samos Colomer (SISSA, Trieste, Italy),

- Pierpaolo Palestri (University of Udine, Udine, Italy),
- Sebastien Martinie (CEA-LETI, Grenoble, France),
- Denis Rideau (STMicroelectronics, France),
- Andreas Schenk (ETH Zurich, Switzerland),
- Andres Godoy (University of Granada, Spain),
- Victor Moroz (Synopsys, USA),
- Daniel Connelly (Atomera, USA),
- Sayed Hasan (Intel, USA),
- Guangrui (Maggie) Xia (The University of British Columbia, Canada),
- Sumeet Gupta (Purdue University, USA),
- William Vandenberghe (University of Texas at Dallas, USA),
- Seong-dong Kim (SK Hynix, South Korea),
- Kunikiyo Tatsuya (Renesas Electronics, Japan),
- Uihui Kwon (Samsung, South Korea),

- Yiming Li (National Chiao Tung University, Taiwan),
- Satofumi Souma (Kobe University, Japan),
- Jeff Wu (TSMC, Taiwan).

This year's conference program consisted of 3 plenary invited presentations, 3 invited talks, 64 contributed papers and 26 posters, that were selected out of 136 submitted abstracts. The presentations were arranged in 13 sessions and one poster session, with the conference program covering two and a half days. It opened on Wednesday, September 4th and closed after lunch on Friday, September 6th.

The conference program was augmented and complemented by a tutorial entitled "Atomistic simulations for nanoelectronic and optoelectronic devices" and a workshop "Leti seminar on Simulation and Modeling for Emerging Non-Volatile Memories," both of which were held on Tuesday afternoon, September 3rd.

The conference attendees were welcomed at the Wednesday evening reception, and enjoyed a Conference Dinner on Thursday evening at the Palazzo Kechler, in downtown Udine.

SMACD 2019 Conference in Lausanne, Switzerland

—by Ralf Sommer and Mike Schwarz

The 2019 SMACD conference was held from July 15th—18th in Lausanne, Switzerland.

This year it was sponsored by Dialog Semiconductor, AMS, Coilcraft, Melexis, and Springer. Technical sponsorship included IEEE, IEEE CEDA, IEEE CAS. Institutional sponsors and organizers were EPFL, Instituto Superior Tecnico, Instituto de Telecomunicacoes.

The conference hosted various presentations and posters on the topics of modeling, simulation, verification and test, synthesis, applications of modeling, simulation and synthesis. Additionally, the conference included four special talks: "Do you still handcraft your analog and RF layouts?," "Deep learning for analog EDA: Are we



Dr. Jean-Michel Sallese during his tutorial on "The concept of Inversion coefficient in Multigate FETs"

there yet?," "MEMS & Heterogeneous Systems: Which design tools and methodologies are missing?," "Cutting edge test solutions for analog, mixed-signal, and RF ICs."

The conference also included four tutorials on the topics of: "3D Smith chart high frequency circuits design" by Andrei A. Muller (Swiss Federal Institute of Technology in Lausanne), "Bio-Inspired Micro & Nano Electronic Systems for Robotics and Biomedical Applications" by D. Demarchi (Department of Electronics and Telecommunications (DET), Politecnico di Torino, Italy & EPFL Visiting Professor), "Challenges in Modeling and Simulation of Inertial MEMS" by Prof. Dr.-Ing. habil. Jan Mehner (Chemnitz University of Technology, Germany), and by Dr. Jean-Michel Sallese (EPFL, Switzerland) on the topic of "The concept of Inversion coefficient in Multigate FETs."

Plenary talks were presented by Prof. Andreas Burg (EPFL, Switzerland) with "Circuit and Systems Design and Innovation After the Happy Scaling Era," Prof. David Atienza (EPFL, Switzerland) with "Smarter Electronic Systems to Rescue the Internet of Things," and by Dr. Onur Kazanc (ON Semiconductor, Switzerland) with the presentation entitled "Efficient Power Conversion Techniques for Passive RFIDs and Wireless Sensor Systems."

~ Mike Schwarz, Editor

ED/MTT/AES Moscow Chapter

—by Timofey Shevgunov

The following report summarizes numerous activities undertaken/co-organized by the ED/MTT/AES Moscow Chapter for the period 2018–2019. They have not reported earlier. Thus, of necessity, the form of the report is concise.

The young scientists' forum and contest was held at the Moscow Aviation Institute twice: **X Youth and Future of Aviation and Astronautics** was on November 20, 2018 and **XI Youth and Future of Aviation and Astronautics** was on November 19, 2019. The forum is multidisciplinary, and includes a regular section on related topics. The events were addressed to young researchers from Russia and ex-USSR countries. Each time they attracted more than 200 attendees, including more than 20 IEEE members. In 2018, 88 poster reports (including 12 sectional posters) were presented at the forum.

The **12th All-Russian Conference "Radars and Communications"** was held in Moscow on November 26–28, 2018. This national scientific conference was devoted to radar, navigation, and communication systems, and signal processing. Sixty-three scientific papers were presented orally at the conference, which attracted 121 attendees, including 23 IEEE Members.

Next, the **6th All-Russian Microwave Conference** was held in

Moscow, in the Institute of Radioelectronics, Russian Academy of Sciences (IRE RAS), on November 28–30, 2018. This national scientific conference was devoted to the following topics: electromagnetic theory, microwave theory, techniques and devices, antenna theory and practice, and ultra-wideband applications. 59 scientific papers were presented orally at the conference, which attracted 114 attendees, including 22 IEEE Members.

An international scientific conference **2019 Systems of Signal Generation and Processing in the Field of On-Board Communications** was held in the Moscow Technical University of Communications and Informatics (MTUCI), on February 20–21, 2019. The conference was devoted to the following topics:

- components, circuits, devices and systems,
- general topics of transport engineering, avionics,
- signal processing and analysis.

One hundred nine scientific papers were presented orally at the conference, which attracted 115 attendees, including 29 IEEE Members.

The **13th All-Russian Conference “Radars and Communications”** was held in Moscow, in the Institute of Radioelectronics, Russian Academy of Sciences (IRE RAS), on November 25–27, 2019. The national scientific conference covered topics on radar, navigation, and communication systems as well as the signal processing. More than 60 scientific papers were presented orally at the conference, which attracted more than 130 attendees, including 27 IEEE Members.

The **6th International Conference on Engineering and Telecommunication (En&T)** was held in Dolgoprudniy (Moscow Region), in the Campus of Moscow Institute of Physics and Technology (MIPT), on November 21–22, 2019. The main focus of this event was on the latest developments in engineering and information technology in the context of the challenges posed by the Arctic region. More than 50 participants presented their talks.

Besides the conferences the Moscow Chapter organized technical meetings. Between May 2018 and June, nine Joint Electromagnetic Meetings were held monthly or bimonthly. Oral presentations on actual research topics were delivered by invited experts. Depending on the topics the seminars attracted 15–32 attendees including 8–16 IEEE Members. During the meeting on May 23, 2018, a talk on Leaky Wave Antennas was given by Prof. Jan Machac from Department of Electromagnetic Field, Faculty of Electrical Engineering, Czech Technical University in Prague, member of MTT-S.

Following the successful events mentioned above, the Moscow Chapter plans the following activities in 2020:

- Eight Joint Electromagnetic Meetings (frequency, monthly or bimonthly),
- 14th All-Russian Conference “Radars and Communications,” IRE RAS, Moscow, November 23–25, 2020,
- 7th All-Russian Microwave Conference, IRE RAS, Moscow, November 25–27, 2020,
- 2020 Systems of Signal Generation and Processing in the Field of On-Board Communications, MTUCI, Moscow, on March 19–20, 2020,

- 2020 22th International Conference on Digital Signal Processing and its Applications (DSPA), ICS RAS, Moscow, on March 25–27, 2020,
- A young scientists’ forum and contest XII Youth and Future of Aviation and Astronautics, Moscow, Campus of Moscow Aviation Institute, November 17, 2020; all the young contributors (<35) from any country are WELCOME to this event.

~ Daniel Tomaszewski, Editor

ASIA & PACIFIC (REGION 10)

ED Japan Joint Chapter—Report on EDTM-2019

—by Akira Nishiyama and Yuichiro Mitani

On July 12, 2019, the report session on the 3rd IEEE Electron Devices Technology and Manufacturing (EDTM-2019) Conference (<http://ewh.ieee.org/conf/edtm/2019/>) was held at Suzukakedai Campus, Tokyo Institute of Technology. Prof. Hitoshi Wakabayashi, Steering Committee of EDTM-2019 and Dr. Kazunari Ishimaru, International Advisory Committee of EDTM-2019,



Attendees of the EDS Japan Joint Chapter's report session on EDTM-2019

reported EDTM-2019 activities and the next EDTM-2020 plans. At the report session, the subcommittee members reported the trends of the respective technical sessions.

- Subcommittee on Si Devices, Dr. Masumi Saitoh (Toshiba Memory Corp.).
- Subcommittee on Process, Dr. Makoto Miura (Hitachi High-Tech-nologies Corp.).
- Subcommittee on Modeling, Prof. Dondee Navarro (Hiroshima University).
- Subcommittee on Package, Dr. Yoichiro Kurita (Toshiba Corp.).
- Subcommittee on Material, Prof. Hitoshi Wakabayashi (Tokyo Institute of Technology)

Afterwards, the topics of 2D FET and Materials selected from “3rd JST/CREST/2D Workshop,” which was held after EDTM-2019 at the same venue, were introduced and discussed.

The next EDTM (IEEE EDTM-2020) will be held at Hotel Equatorial Penang, Malaysia, on March 16–18, 2020 (<https://ewh.ieee.org/conf/edtm/2020/index.html>).

ED Tsinghua University Student Branch Chapter

—by Yancong Qiao

The ED Tsinghua University Student Branch Chapter held two invited talks in the third quarter of 2019. The first event was on September 11, 2019,

with Prof. Eric Pop of Stanford University, who gave his talk on, “Electronic, Thermal, and (Some) Unusual Applications of 2D Materials.” Prof. Pop presented recent highlights from research on two-dimensional (2D) materials including graphene, boron nitride (h-BN), and transition metal dichalcogenides (TMDs). The results span from material growth and fundamental measurements, to simulations, devices and system-oriented applications that take advantage of unusual 2D material properties. They have grown monolayer 2D semiconductors over large areas, including MoS_2 , WSe_2 , and MoSe_2 . They also uncovered that ZrSe_2 and HfSe_2 have native high- κ dielectrics ZrO_2 and HfO_2 , which are of key technological relevance. Improved electrical contacts led to the realization of 10 nm monolayer MoS_2 transistors with the highest current reported to date, near ballistic limits. These could play a role in 3D heterogeneous integration of nanoelectronics, which presents significant advantages for energy-efficient computation.

The second invited talk, given by Prof. Lingqian Chang of Beihang University, on September 25th was on “Nano-electroporation: Single-Cell Gene Therapy and Analysis,” which introduced in detail a novel nano-transfection technique, named nano-electroporation (NEP). The technique allows for high-throughput, and precise delivery of gene/drugs into living cells at single-cell resolution. They adopted cleanroom micro-/nano-fabrication to implement both silicon-based NEP chip and polymeric NEP. The in vitro applications of the NEP platform have been used for intracellular cancer biomarker heterogeneity in leukemic cells, cardiomyocytes, T lymphocytes and glioma stem cells. Their recent efforts have achieved in vivo cell reprogramming for on-body gene therapy and wound healing. The ongoing research of soft and wireless-controlled nano-transfection devices, with the aim to patient-specific gene



ED Tsinghua University Student Branch Chapter event with speaker, Prof. Eric Pop



ED Tsinghua University Student Branch Chapter's Invited Talk with Prof. Lingqian Chang

therapy and regenerative medicine, were discussed.

ED Peking University Student Chapter

—by Zhe Zhang

The ED Peking University (PKU) Student Chapter held two talks recently.

On Saturday, June 22, 2019, Prof. Paolo A. Gargini from Intel and IRDS, visited our laboratory and clean room to deliver a talk on “How to Successfully Overcome Inflection Points by using the Technology Roadmap Methodology.” He first gave an overview of the history of “Geometrical Scaling,” then some engineering methods, including strained silicon, HK/MG and FinFET were introduced for device “Equivalent Scaling.” He concluded with 3D integration and the new heterogeneous integration method to further extend Moore’s Law. There were about 40 attendees. Prof. Gargini later conversed with the students to share some points about the future of IRDS.

Dr. Anirban Bandyopadhyay from GlobalFoundries, Inc. was invited to deliver a Distinguished Lecture on Friday, July 26th, about “Silicon Technologies for 5G Enhanced Mobile Broadband Radio interface on mmWave,” in which he thoroughly introduced the silicon technologies for 5G used in GlobalFoundries. First, he gave a brief review on recent prog-

ress on 5G and the different usage scenarios of 5G application. Then, he presented various chip partitioning options and how different silicon technologies like partially and fully depleted SOI, SiGe BiCOM, can address the requirements and challenges for different mmWave 5G radio architectures. There were about 35 attendees and afterwards, Dr. Bandyopadhyay had a discussion with our members and some of the students.

ED Xi’an Chapter

—by Ranran Zhao

On August 30, 2019, Prof. Guobiao Zhang, a professor at Southern University of Science and Technology, presented a talk on “the past and future of 3D memory and 3D computation,” at Xidian University held by the ED Xi’an Chapter. Prof. Zhang said, at the 7nm node, transistors do not have many generations to go. As future scaling of transistors are expected to become stalled around year 2026–2030, 3D Integration is now considered as one of the most promising candidates. The 3D integration can be carried out at two levels, integrated circuit (IC) level (i.e. monolithic 3D IC) and packaging level (i.e. 3D packaging). He also talked about monolithic 3D IC and 3D packaging, concluding with several important milestones during the development of monolithic 3D IC and 3D packing.

This talk was attended by many students from the School of Microelectronics in Xidian University.

~Ming Liu, Editor

ED National University of Malaysia (UKM) Student Branch

—by K.Y. Chow, Y.L. Khong, and C.H. Loke

Technical Event: Circuit Theory II Clinic

A technical event called “Circuit Theory II Clinic for 1st Year Students” was organized by the ED UKM Student Branch on April 4, 2019, at the Meeting Room of the Faculty of Engineering and Built Environment (FKAB), National University of Malaysia (UKM). The event began at 5 PM and a total of 13 Electrical and Electronic Engineering undergraduate students attended the program. Volunteers from the ED UKM SB as well as lecturers from the Electrical and Electronic Engineering Program, Assoc. Prof. Dr. Badariah Bais, Dr. Wan Mimi Diyana and Dr. Aqilah provided guidance to students while they were trying to solve the question sets prepared. A Q&A session was also conducted for the students to clarify their doubts and uncertainties faced while studying Circuit Theory II. Light refreshments were provided for the participants and lecturers. The event ended successfully at 8 PM and constructive feedback was provided by the participants to further improve the program in the future.

Technical Talk on Machine Learning

A technical talk on “Introduction to Weka and Machine Learning” was successfully held at the Faculty of Engineering and Built Environment, UKM, on May 30, 2019, and organized by the ED UKM Student Branch. The speaker was Ts. Dr. Nor Samsiah Sani from the Faculty of Information Science and Technology, UKM and more than 50 electrical



ED Peking University Student Chapter, DL—Dr. Anirban Bandyopadhyay (3rd from the front left) with Prof. Ru Huang (4th from the front left), and other members of the chapter

and electronic engineering students attended the program. She started the session with an introduction to machine learning followed by Weka software for data mining tasks. She also explained the steps of software operation in detail. The participants found the workshop informative and hoped for more participation in similar activities in the future, to enhance their programming skills.

ED Indonesia Chapter

—by B.R. Alam and P.S. Menon

The Region 10 SRC Vice Chair and Past Chair of the ED Malaysia Chapter, Dr. P. Suthitha Menon accompanied by a few ED Malaysia members visited the ED Indonesia Chapter on July 18, 2019, at Institute Teknologi Bandung (ITB), Indonesia. The ED in-

donesia Chapter Chair, Prof Basuki, greeted the team and each chapter exchanged presentations on their respective chapters. Dr. Susi gave a short overview of EDS Region 10. The chapter requested a few Snap Circuits kits so that they may kick off programs on increasing electron devices knowledge among school children. Dr. Susi also shared her IEEE experience since 2011 and encouraged senior members to engage young members in organizing conferences, so that they may benefit from participation in EDS activities. She also highlighted the EDTM2020, which will be held at Equatorial Penang, Malaysia, March 13–15, 2020. Prof. Basuki invited all members to participate in the ED Indonesia flagship conference ISES2019., which was held in Bali, Indonesia on October 8–9, 2019.

ED Malaysia Kuala Lumpur Chapter

—by S.N. Ibrahim, S.N. Mohd Tawil, Z. Yusoff, A.A. Md Ralib, and P.S. Menon

IEEE Regional Symposium on Microelectronics and Nanoelectronics

The 12th IEEE Regional Symposium on Microelectronics and Nanoelectronics (IEEE – RSM2019) was successfully held from August 21–23, at The Everly Hotel Putrajaya. The conference was organized by the ED Malaysia Chapter, IEEE Malaysia Section, Universiti Putra Malaysia and the International Islamic University Malaysia (IIUM) and chaired by ITMA-UPM Director/ED Malaysia Past Chair; Associate Prof. Dr. Mohd Nizar Hamidon. There were 50 papers presented at the conference with 79 participants. The conference kicked off on August 21st with the welcoming address by the conference chair, Associate Prof. Dr. Mohd Nizar and it was followed by the opening ceremony talk from Prof. Dr. Muammer Yaylali from Erzurum Technical University, Turkey, and also a Member to the Council of Higher Education of Turkey. The topic presented by Prof. Dr. Yaylali is on the Higher Education System in Turkey. There were two keynote speakers on the first day; Dr. Basuki Rachmatul Alam from Institute Technology of Bandung, Indonesia, who spoke on “Broadband Design and



EDS Malaysia delegation to EDS Indonesia



Group Photo of RSM2019 at Everly Hotel Putrajaya Malaysia

Verification Approaches of RF Power Amplifier for 5G Front-End Transmission” while Prof. Dr. Bulent Cakmak from Erzurum Technical University, Turkey talked about “Investigation of Nanotechnology-Based Structures and Devices Developed at Advanced Technology Research and Development Center (YUTAM) in Erzurum Technical University.” On the second day, the other two keynote speakers; Prof. Dr. Anis Nurashikin Nordin from IIUM gave her speech on, “BioMEMS for Detection and Monitoring of Tropical Diseases” and Mr. Kok Mun Tang, the Managing Director of Rapid Genesis Sdn Bhd gave a talk on “Commercialization of Universities’ R&D – A Malaysian (And Possibility Asian) Perspective.” During the closing ceremony of the conference, Best Student Paper Awards, Best Student Presenter Awards and Student Travel Grants were also given away to selected participants. We hope all these efforts will enhance the interest in electron devices research in Malaysia.

EDS Membership Drive at INEC2019 in Kuching

The IEEE Region 10 SRC Vice Chair and Past Chair of the ED Malaysia Chapter, Dr. P Susthitha Menon attended the 9th IEEE International Nanoelectronics Conference (INEC2019) at Pullman Kuching Sarawak, July 3–4, 2019. The conference was organized by the Nanotechnology Chapter of the IEEE Singapore

Section and the IEEE Sarawak Sub-section of IEEE Malaysia Section, with the theme selected for this series as “Nanoelectronics and Digital Applications,” which aimed to focus on the translational from research outcomes into real applications. A total of 100-150 participants presented plenary, invited and oral papers. Dr. Susi gave an overview of EDS in Region 10 and encouraged the participants to become EDS members.

~ P Susthitha Menon, Editor

ED Indian Institute of Technology—Roorkee Student Branch Chapter

—by Sourabh Jindal

A Technical Talk by Dr. Biswajit Ray on “Hack-proof Non-volatile Memory System” was held at Electronics and Communication Department, IIT Roor-

kee on May 17, 2019. Dr. Ray discussed the operation of Non-volatile memory (NVM) such as flash technology and how they are becoming prime targets for cyber/physical attacks. About 33 students attended the lecture along with Professors and staff members.

A Technical Talk by Dr. Partha Pratim Pande, Boeing Centennial Chair in computer engineering at the school of Electrical Engineering and Computer Science, Washington State University, Pullman, USA on “Going Vertical: Energy-Efficient and Reliable Manycore Computing based on 3D Integration” was organized on July 15, 2019. He discussed advances in 3D integration to design radically new on-chip interconnection fabrics that can support exascale computing by integrating a very large number of embedded cores. About 30 students attended the lecture, along with Professors and staff members.



Technical talk at IIT Roorkee on May 17, 2019



Dr. Susi presenting the overview on EDS at INEC2019



Technical talk at IIT Roorkee on July 15, 2019

ED/SSC Bangladesh Chapter

—by Mahnaz Islam

The chapter and Department of EEE, BUET jointly organized a technical talk on “Ferroelectric and antiferroelectric oxides in the era of hyper-scaling” on June 12, 2019 at the Department of EEE, BUET. The event was conducted by Dr. Asif Islam Khan, Assistant Professor, School of Electrical and Computer Engineering, Georgia Institute of Technology. Total 30 participants with 22 IEEE members participated in the talk. Dr. Khan discussed the fundamental science and technology of emerging classes of phase transition materials, called ferroelectric and antiferroelectric oxides in innovating electronics in the era of hyper-scaling in multiple fronts.

The chapter and Department of EEE, BUET jointly organized a technical panel session. The first technical talk was on “Wearable Optoelectronic Devices Based on Multifunctional Carbon Nanotube Fibers” and the second technical talk was on “Emerging Nanoscale Electronic and Optoelectronic Devices” which were held on July 22, 2019 at the Department of EEE, BUET. The first talk was conducted by Dr. Ahmed Zubair, Assistant Professor, Department of Electrical and Electronic Engineering (EEE), Bangladesh University of Engineering and Technology (BUET) and the second talk was conducted by Dr. Mainul Hossain, Lecturer, Department of Electrical and Electronic Engineering (EEE), University of Dhaka. The total number of attendees was 33 including 19 IEEE members. The chapter and Department of EEE, BUET jointly organized a technical talk on “Secure Electronics—Deterrence or Innovation?” on July 29, 2019 at the Department of EEE, BUET. The event was conducted by Mehdi Anwar, Professor, Electrical and Computer Engineering, University of Connecticut, Storrs, Connecticut. He introduced the concept of THz spectroscopy as a possible technology platform for the identification of counterfeit electron-



Dr. Asif Islam Khan giving a talk at BUET



Attendees of August 4th seminar held at the University of Liberal Arts Bangladesh

ics followed by innovative methods designed to deter the production of counterfeits. The total number of attendees was 20 including 13 IEEE members.

A seminar on “The Art of Scientific Research: Semiconductor Device Modeling—A Case Study” was held at the University of Liberal Arts Bangladesh (ULAB) on August 4, 2019. The event was jointly organized with the Department of Electrical and Electronic Engineering (EEE), Department of Electronics and Telecommunication Engineering (ETE). Dr. Mehdi Anwar, Professor, Electrical and Computer Engineering, University of Connecti-

cut, Storrs, Connecticut, USA was the speaker. His talk encouraged the students to perform scientific research on semiconductor device modeling. The total number of attendees was 33 including 15 IEEE members.

ED Kalyani Government Engineering College Student Branch Chapter

—by Angsuman Sarkar

The Chapter organized a Technical Lecture program on August 26, 2019 by Dr. Chayanika Bose, Professor, ETCE Department, Jadavpur University, Kolkata on “Semiconductor



Attendees of the Technical Lecture by Dr. Chayanika Bose (center, front row)

Nanostructures.” Almost 100 UG, PG students attended this activity.

The Chapter also organized an EDS Distinguished Lecture on September 11, 2019. The DL talk entitled “OFET based devices and their applications” was delivered by Dr. Subir Kumar Sarkar, Professor, ETCE Department, Jadavpur University. More than 100 UG, PG students irrespective of the departments attended the program.

ED Netaji Subhash Engineering College Student Branch Chapter

—by Puja Roychowdhury, Ayush Thakur and Saheli Sarkhel

The chapter in association with the Department of Electronics and Communication Engineering organized an IEEE EDS hands-on workshop on “Applied Data Science in Biology” on April 4, 2019. Dr Parikshit Sanyal,

MBBS, MD, certified in Data Science and Bioinformatics and a pathologist at Govt. of India conducting the workshop where in he talked about the ways of dealing with noisy data found in the genome after slicing it. Students enthusiastically participated in the code-n-board works which marked the success of the workshop. Almost 25 participants attended the event including the members of the chapter and faculty members.

The Chapter in association with the Department of Electronics and Communication Engineering organized an IEEE EDS Distinguished Lecture by Dr. M.K. Radhakrishnan Vice-President, IEEE Electron Devices Society (Regions and Chapters) on “Circa 70—Si Device Progression and Challenges towards Nanoera” on September 2, 2019. The lecture session commenced with a brief introduction to IEEE membership

and various benefits provided by IEEE especially for students. The talk was very informative and provided a thorough insight to the advancement of the semiconductor industry. More than 60 participants including students and teachers attended the event.

ED Heritage Institute of Technology Student Branch, Kolkata

—by Mousiki Kar

Heritage UtsavTechfest 2019 was celebrated during April 1, 2019 to April 3, 2019. The IEEE EDS Center of Excellence HITK and the IEEE ED HITK SBC organized a plethora of events viz. Techtonic, Circuitricks, Game of Roads, Drift-o drop, League of Bots, Crossroads, innovation Challenge and Electrosprint. The events ranged from quizzing, competing with robots, solving puzzles, building circuits to presenting innovative ideas and concepts. In addition to the host Institution, participants from 12 different Institutes from across the state viz. Institute of Engineering and Management, Aliah University, University of Engineering and Management, St. Xaviers University, St. Thomas Institute of Technology, Techno India Institute of Technology, Meghnad Saha Institute of Technology, Techno International, Modern Institute of Engineering and Technology, Budge Budge Institute of Technology, RCC Institute of Information Technology, participated in the various events.

The IEEE EDS Center of Excellence, HITK organized a two-day Autonomous Robotics Workshop for the students of The Heritage School. It was attended by 14 students who were assisted by 7 IEEE student volunteers. In this workshop, the students learnt about robotics using a “hands-on” approach. The goal was to encourage them to consider Electrical and Electronics Engineering as a career and mostly understand that technology can be exciting. The Center was visited by Dr. M. K. Radhakrishnan, Vice



Participants and faculty members with Dr. Sanyal



Dr. Radhakrishnan (sitting in the middle in front row) with attendees



Snapshots of the events held during Heritage Utsav Techfest 2019



Photographs of the Lecture Session by
Dr. M. K. Radhakrishnan, on
September 3rd



Snapshots of the 2-DAY Autonomous Robotics Workshop

President, IEEE Electron Devices Society (Regions and Chapters) on September 3, 2019. He interacted with the students of the branch chapter as well as some beneficiaries of the Center.

The Department of Electronics & Communication Engineering, Heritage Institute of Technology in collaboration with IEEE Electron Devices HIT Student Branch Chapter organized a Distinguished Lecture Program on September 3, 2019 at Heritage Institute of Technology by Dr. M. K. Radhakrishnan, Vice President, IEEE Electron Devices Society (Regions and Chapters). The lecture was attended by 112 students.

ED/AP Bombay Chapter

—by Anil Kottantharayil

The IEEE AP/ED Bombay Chapter organized a talk on June 11, 2019 at IIT Bombay. The talk was delivered by Mr. Appu Paduthol, PhD candidate, University of New South Wales, Australia. Appu Paduthol in his talk titled, "Contactless solar cell characterization using photoluminescence" discussed the developments in the photoluminescence based characterization techniques that have been



Mr. Appu Paduthol responding to post-talk queries

widely adopted in photovoltaics. The main focus of his talk was about illumination wavelength dependence of the photoluminescence emission from a sample that was one aspect of photoluminescence characterization.

The chapter organized a talk by Dr. Jim Joseph John on August 1, 2019 at IIT Bombay. Dr. Jim Joseph John is a Sr. Researcher at Dubai Electricity and Water Authority (DEWA) R&D Center. Dr. Jim Joseph John in his talk titled, “*Solar Photovoltaics in the Middle-East: Status and Challenges*,” discussed his current status of solar PV penetration and factors that led to low-priced solar electricity projects in the Middle East.

ED Meghnad Saha Institute of Technology Student Branch Chapter

—by Adrija Mukherjee and Manash Chanda

The ED MSIT Student Branch Chapter in association with IEEE COMSOC MSIT Student Branch Chapter, IEEE PES MSIT SBC, IIEDC MSIT and MSIT Student Branch organized a Technical Symposium: “PARIDHI 2019” on March 30, 2019. The program was inaugurated by Chief Guest Prof. Chandan kr. Sarkar, Chairman, IEEE SSCS Kolkata Chapter. Prof. (Dr.) Sukumar Roy Chowdhury, Director, MSIT has delivered a welcome note on this occasion. Vote of thanks was delivered

by Dr. Manash Chanda. Dr. Amlan Chakroborty, Dean, AKCSIT, University of Calcutta delivered a technical talk on Embedded Designs and issues. The talk was for 60 minutes. Almost 30 IEEE student members and near about 45 non-IEEE student members along with the faculties attended the talk.

On April 1, 2019, the Chapter also organized Innovation challenge and Prototype contest in association with the IEEE MSIT SB and IIEDC, MSIT. Almost 20 teams having four members each have participated in this competition. Different innovative concepts

have been modeled and showcased in this competition. Almost 26 IEEE Student Members and 54 non-IEEE Student members have participated in this event. Mainly the projects were based on VLSI Circuits and Device; Communication and Networking; RF and Microwave Engineering, Antenna Design; Embedded System, FPGA and Image Processing.

A workshop was organized for the first-year students on June 10, 2019 to spread the awareness of IEEE membership and also to involve them in the research of VLSI Device and circuit design and modelling. Dr. Manash Chanda, Chapter Advisor, IEEE ED MSIT SBC and Dr. Swapnadip De, Counselor, Student Branch was the key person of this event. Twelve first-year students joined IEEE EDS due to this event.

A student paper contest has been organized by the IEEE EDS MSIT SBC in association with the Dept. of ECE, MSIT on June 16, 2019. Almost 31 papers were presented at this event. A total of 76 students participated, with 42 of them IEEE members. Twenty-six IEEE EDS student members attended the paper contest, which was organized to motivate the students towards research of VLSI device and circuits, communication,



Images from various events of IEEE EDS MSIT Student Branch Chapter

antenna propagations and IoT-Embedded system.

The ED MSIT Student Branch Chapter in association with the Department of ECE, MSIT organized the three days hands on training on device modeling and simulation from July 12–15, 2019. Mr. Dipanjan Sen and Mr. Savio Jay Sengupta delivered the training. Almost thirty students (including 15 IEEE student members) of the pre final year attended the training.

The ED MSIT SBC and IEEE MSIT SB, in association with the Dept. of ECE, MSIT organized the One Day IEEE EDS Industry Academia met on July 25, 2019 to motivate and enhance the technical knowledge of the final and pre-final year students of ECE Department. Mr. Priyanko Mitra, Manager, Mixed Signal Solution, Power Management Team, Sankalp Semiconductor delivered a technical talk on “An overview of analog VLSI industry” and also interacted with the students for their betterments. Almost 5 IEEE EDS members and 70 students attended (25 IEEE EDS Student members) the session.

The ED MSIT SBC and IEEE MSIT SB, in association with the Department of ECE, MSIT organized the one-week hands on training on IoT based embedded device and Arduino from August 16, 2019 to August 23, 2019. “Micropro” delivered the quality training on embedded systems. Fifty-three students attended the training wherein they learned the embedded language for programming IoT applications.

The chapter organized One Day Industry Academia meet by Mr. Chandan Das, TCS on August 22, 2019 at MSIT Seminar hall. The topic of the talk was “IoT Devices and Embedded Applications.” Almost 53 students (20 IEEE EDS student members) attended the event.

The ED MSIT SBC and IEEE MSIT SB, in association with the Dept. of ECE, MSIT organized the One Day IEEE EDS DL Talk on September 3, 2019 at Seminar hall, MSIT. Dr. Radhakrishnan, IEEE EDS Vice President (regions and Chapters), EDS DL delivered a DL Talk and motivated the students towards the various aspects of electron devices. Almost 110 students attended the DL Talk.

Prof. Chayanika Bose, Professor, Dept. of Electronics and Communication Engineering Department delivered an IEEE EDS technical Talk on “Quantum Nanostructure” September 6, 2019. The IEEE EDS Technical Talk

program has been organized by the IEEE EDS MSIT SBC, in association with the Department of ECE. About 35 students attended the event.

IEEE EDS NIST Student Chapter, Berhampur, Odisha

—by Ajit Kumar Panda

A technical lecture was organized on June 8, 2019 at National Institute of Science and Technology (Autonomous), Institute Park, Pallur Hills, Berhampur, Odisha on “Artificial Intelligence and Natural Language Processing.” Twenty Faculty members have attended the lecture by Prof. Chitta Baral, Dept. of Computer Science and Engineering, Arizona State University, USA. Prof. Baral focused on natural language understanding and answering, translating natural language, building of natural language interfaces. Also he discussed the bioinformatics applications, and mobile robot. He talked



Prof. Chitta Baral delivering his lecture in Odisha



Attendees, organizers and lecturer at National Institute of Science and Technology

about the problem-solving algorithms and different applications which gave us the new thought process for research. Faculty from all departments took interest to listen to him. He ended with an interactive session with faculties and students.

The Chapter organized a Hardware Model Contest for UG Category on April 20, 2019. An expert team from IIT-Bhubaneswar, PMEC-Berhampur and Berhampur University were invited. There were 8 different categories including all the streams of engineering. Students have come up with different problem statements in the area of renewable energy, waste management, embedded systems for physically challenged, VLSI Chip design with low power applications and many more. 48 projects were displayed after going for strong review by internal professors and experts out of 200 odd projects.

IEEE EDS NIST Student Chapter has organized a technical Lecture, August, 8, 2019 at National Institute of Science and Technology (Autonomous), Institute Park, Pallur Hills, Berhampur, Odisha on by Prof. Dhrubis Biswas. Dr. Biswas is working as a professor at the University of California, Berkeley Campus, USA. Dr. Biswas talked about nanotechnology and devices. He highlighted the devices with higher band gap and different compound semiconductor material. Dr. Sukant K. Mohapatra, Chairman, NIST-Berhampur addressed the faculties and research scholars for innovative IOT-Based solutions at the end. ED NIST Student Chapter acknowledges NIST and ECE Department for support.

ED NIT Silchar Student Branch Chapter

—by T. R. Lenka

IEEE ED NIT Silchar Student Branch Chapter organized DST-SERB and TEQIP-III sponsored five Days National Workshop on Modeling of Novel Nanoelectronic Devices and Circuits for ULSI Technology during April 26–30, 2019 at Dept. of Electronics

and Communication Engineering, National Institute of Technology Silchar, Assam, India. In this workshop 10 invited speakers (Prof. S. Dasgupta, Prof. S. Jit, Prof. J. Singh, Prof. S. Tiwari, Prof. N. R. Mahapatra, Prof. S. Baishya, Dr. S. A. Ahsan, Prof. B. Bhowmick) delivered talks on modeling aspects of novel nanoelectronics devices and circuits for ULSI technology and two industry experts delivered hands on training on Silvano TCAD and Tanner EDA tools. Prof. A. K. Panda delivered EDS DL Talk entitled “River Water Quality Monitoring System using IoT” on April 30, 2019. More than 50 participants comprising of IEEE EDS members/non-members and student members/non-members attended the workshop and made the event successful.

The Chapter also organized another TEQIP-III sponsored Five-Days National Workshop on “MEMS Engineered Medicine: Breaking Barriers in Medical Diagnostics” from April 12–16, 2019 at Dept. of ECE, NIT Silchar. The aim of the workshop was to bring together great minds in medicine, industry

and academia to enlighten and share knowledge to work in interdisciplinary fields. The medical doctors delivered their invaluable talks by identifying the flaws in the existing conventional education systems. The academic experts inclined towards introducing the future trends that are under research to find a solution to medical systems. Industrialists delivered the process of product development and benefits of industrializing the product. The distinguished speakers were Dr. Pratim Sengupta, Nephrologist, Kolkata, Dr. Arindam Dutta, Urologist, Kolkata, Dr. Ajay Agarwal, CSIR-CEERI Pilani, Prof. Suman Chakraborty, IIT Kharagpur, Prof. Sanket Goel, BITS Hyderabad, Prof. Soumen Das IIT Kharagpur, Prof. Nitin S. Kale, IIT Bombay. The participants were benefited by the amount of information regarding the human body system and internal working of biological cells for human survival. There were interesting discussions on lab-on-chip, body-on-chip, organ-on-chip and micro total analysis systems. The event was very successful with 35 number of participants.



Left to Right: Dr. P. Patnaik (Faculty), Dr. M. Kavicharan (Faculty), Dr. S. K. Tripathy (Faculty), Dr. T. R. Lenka (Chapter Advisor), Prof. A. K. Panda (EDS-DL), Dr. K. Guha (Treasurer)



Left to Right: Dr. K. K. Saikia (Co-Convenor), Dr. Arindam Dutta, Urologist, Kolkata, Dr. Pratim Sengupta, Nephrologist, Kolkata, Prof. Soumen Das, IIT Kharagpur, Dr. T. R. Lenka (Chapter Advisor), Dr. Koushik Guha (Convenor)



Student Volunteers with speaker and faculty members at Techno International Batanagar event

ED Calcutta Chapter

—by Angsuman Sarkar and Manash Chanda

IEEE Student Branch of Techno International Batanagar, jointly with the Department of ECE, organized a one day seminar on “Semiconductor Materials and Devices” in association with IEEE Electron Devices Society Kolkata Chapter on September 11, 2019. The session was addressed by Dr. Sanatan Chattopadhyay (Professor, Department of Electronic Science, University of Calcutta) who delivered a talk on “Strain engineering for mobility enhanced Metal-Oxide-Semiconductor Field Effect Transistors (MOSFETs).” Dr. Sunanda Dhar (Former Professor, Department of Electronic Science, University of Calcutta) shared his views on “Semiconductor materials and devices for optical communication.” Around 80 numbers of participants including faculty and students attended the session.

ED Uttar Pradesh Section—Kanpur Chapter

—by Amit Verma

The chapter organized a seminar on “Testability Issues in Nanometer Technology Nodes” on May 20, 2019. The lecture was delivered by Dr. Ankush Srivastava who is a Senior Member of Technical Staff in Qualcomm India Pvt Ltd. Dr. Srivastava highlighted the greater number of localized physical defects in the silicon during manufacturing in

the advanced technology nodes beyond 28nm and why such defects are growing concern in current FinFET and emerging gate all around (GAA) technologies. He also discussed efficient testing techniques for reliable screening of timing defects arising due to process and aging related variations. This lecture was attended by over 20 students and faculty members, which included 14 IEEE members.

ED Coimbatore Chapter (Madras Section)

—by D. Nirmal

Department of Electronics & Communication of SNS College of Technology (SNSCT) and ED Coimbatore Chapter (Madras Section) organized a Hands-on training session on “Embedded Systems with IoT” at the college premises during January 24–25, 2019. Mr. S. Suresh, Technical Team Leader, 3QTechnologies, Coimbatore

discussed about the basic knowledge of Embedded C language, Internet of Things (IoT) and ended with LED interfacing hands on training. Second day session was interactive with ADC, PIC controller, Sensor connection, Cloud link and practical examples. All the participants interacted with the Resource person and his team members, also clarified their doubts regarding their future scope in core sector. Over 60 students attended the session.

ED Delhi Chapter

—by Sneha Kabra

National Seminar on “Evolution of Electronics and VLSI Devices, Design and Modeling,” was organized by the Department of Electronics and Communication Engineering at Maharaja Agrasen Institute of Technology, Rohini, Delhi from April 4–6, 2019. The seminar was sponsored by IEEE EDS Delhi Chapter, DRDO, Ministry of Defence, Govt. of India and Society for Microelectronics and VLSI. The programme was inaugurated by Prof. Neelam Sharma, Director, MAIT, Prof. M.L Goyal Vice Chairman Academics, MAIT and Dr. Nand Kishore Garg, Founder & Chief Advisor MAIT. The Lecture series was delivered by Dr. V.K Jain, a distinguished Scientist and currently a Professor at Amity University, Noida, Dr. D.S Rawal, Scientist-G, SSPL, Delhi, Prof. S.A Loan, Professor at



Attendees of the Training session on “Embedded Systems with IoT”

the Department of Electronics and Communication Engineering, Jamia Milia Islamia University, Delhi, Prof. Mridula Gupta, Department of Electronic Science, University of Delhi South Campus, Delhi, Dr. Pika Jha, Scientist-G, SSPL, Delhi and Dr. S.K Tomar, Scientist-F, SSPL, Delhi. The idea of the seminar was to bridge the gap between the concepts being taught at the graduate level in the institute and the recent advancements that are taking place in the market, the relevant industrial requirements and the areas of research in the field of Electronics pertaining specifically to the VLSI domain.

Departments of Electronics Science, University of Delhi, India in Collaboration with IEEE Electron Device Society Delhi Chapter organized “One-Day Workshop on TNL Atomistic TCAD Tools for New Era Semiconductor Process & Device Technologies” on Saturday, April 6, 2019 at Room No. 115, Arts Faculty, University of Delhi South Campus, New Delhi, India. The resource person was Dr. Praveen Saxena, CEO & CTO, Tech Next Lab Private Limited, Lucknow, India. The lectures series focused on “MBE & MOCVD Reactors Modeling for Epitaxial growth Through EpiGrow Simulator,” “Full Band Analysis and Material Characterization through FullBand and ElecMob Simulators” and “Monte Carlo Particle Device Simulation for FD SOI MOSFET Technology.”

One-Week Faculty Development Program (FDP) on “VLSI Design and Modeling” (Intensive Short Course) was organized by Department of Electronics and Communication Engineering, Maharaja Agrasen Institute of Technology, during May 6–11, 2019 in collaboration with IEEE EDS Delhi Chapter. The program is sponsored by Society of Microelectronics & VLSI and IEEE EDS Delhi Chapter.

The objective of the Faculty Development Programme was to give an exposure to the faculty members on the subject VLSI DESIGN and Modeling. During the programme, experts



Prof. M. L. Goyal Vice Chairman and Faculty Experts along with organizers and participants of FDP



Dr. Manoj Saxena, Dr. Jasdeep Dhanoa, and other faculty members at IGDTUW

delivered illuminating and inspiring lectures on very important aspects of VLSI Technology. The course covered detailed theory, tutorials and laboratory practicals. Topics related to Evolution of electronics & VLSI Design, Very large scale integration—Monolithic and Hybrid IC, VLSI Design isolation, Oxide isolation, Diode Isolation, Building blocks, Layout of Passive element, Resistor geometry, Power dissipation, Power density, Tolerance, Design of semiconductor diffused resistors, thin film resistor and Monolithic Capacitor, Fabrication of thick oxide MOSFET and CMOS, Design of Silicon Integrated circuits, Concept of buried layer, Initial Artwork, Isolation Diffusion, Analytical modeling of MOS Devices in VLSI, Deep sub-micron modeling, Advance MOSFET Design Structure, CMOS Digital IC Design, Threshold Voltage of Digital IC, Inverter Design etc were covered. The program provided an

in-depth knowledge on both theory and hands—on training for industrial based tool like Silvaco TCAD.

The student branch of IEEE IGDTUW along with IEEE Delhi Section and EDS Delhi Chapter organized a Distinguished Lecture by Dr. Manoj Saxena, Associate Professor, Department of Electronics, Deen Dayal Upadhyaya College on August 20, 2019, on the campus of Indira Gandhi Delhi Technical University for Women (IGDTUW). He emphasized the need to stay in touch with the latest technology in Electronic Devices and also introduced the audience to societies like Semiconductor Industry Association where students could apply for research and keep themselves updated on current technology. The event saw a large footfall of over 70 students including those of colleges affiliated to GGSIPU and faculty members from IGDTUW.

~ Manoj Saxena, Editor

EDS MEETINGS CALENDAR



THE COMPLETE EDS CALENDAR CAN BE FOUND AT OUR WEB SITE:

[HTTP://EDS.IEEE.ORG](http://eds.ieee.org). PLEASE VISIT.

<u>2020 IEEE Latin America Electron Devices Conference (LAEDC)</u>	25 Feb – 28 Feb 2020	San Jose, Costa Rica
<u>2020 IEEE Electron Devices Technology & Manufacturing Conference (EDTM)</u>	15 Mar – 18 Mar 2020	Malaysia
<u>2020 21st International Symposium on Quality Electronic Design (ISQED)</u>	25 Mar – 26 Mar 2020	Santa Clara, CA USA
<u>2020 IEEE International Reliability Physics Symposium (IRPS)</u>	29 Mar – 03 April 2020	TX, USA
<u>2020 IEEE 32nd International Conference on Microelectronic Test Structures (ICMTS)</u>	06 April – 09 April 2020	Edinburgh, United Kingdom
<u>2020 IEEE 21st International Conference on Vacuum Electronics (IVEC)</u>	20 April – 23 April 2020	Monterey, CA USA
<u>2020 International Symposium on VLSI Technology, Systems and Applications (VLSI-TSA)</u>	April 20 – April 23 2020	Hsinchu, Taiwan
<u>2020 International Memory Workshop (IMW)</u>	17 May – 20 May 2020	Dresde, Germany
<u>2020 32nd International Symposium on Power Semiconductor Devices and ICs (ISPSD)</u>	17 May – 21 May 2020	Vienna, Austria
<u>2020 Baltic URSI Symposium (URSI)</u>	18 May – 21 May 2020	Vilnius, Lithuania
<u>2020 9th International Symposium on Next Generation Electronics (ISNE)</u>	27 May – 29 May 2020	Changsha, China

<u>2020 IEEE International Interconnect Technology Conference (IITC)</u>	1 June – 4 June 2020	San Jose, CA, USA
<u>2020 16th IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC)</u>	03 June – 05 June 2020	Hong Kong, China
<u>2020 IEEE 47th Photovoltaic Specialists Conference (PVSC)</u>	14 June – 19 June 2020	Calgary, AB Canada
<u>2020 IEEE Symposium on VLSI Technology</u>	16 June – 19 June 2020	Honolulu, HI
<u>2020 IEEE International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA)</u>	20 July – 23 July 2020	Singapore, Singapore
<u>2020 15th European Microwave Integrated Circuits Conference (EuMIC)</u>	13 Sept – 15 Sept 2020	Utrecht, Netherlands
<u>2020 IEEE 8th Workshop on Wide Bandgap Power Devices and Applications (WiPDA)</u>	25 Oct – 27 Oct 2020	Redondo Beach, CA USA
<u>2020 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS)</u>	08 Nov – 11 Nov 2020	Monterey, CA, USA
<u>2020 IEEE International Electron Devices Meeting (IEDM)</u>	10 Dec – 18 Dec 2020	San Francisco, CA, USA
<u>2020 IEEE 51st Semiconductor Interface Specialists Conference (SISC)</u>	16 Dec – 19 Dec 2020	San Diego, CA, USA



EDS VISION, MISSION AND FIELD OF INTEREST STATEMENTS

Vision Statement

Promoting excellence in the field of electron devices for the benefit of humanity.

Mission Statement

To foster professional growth of its members by satisfying their needs for easy access to and exchange of technical information, publishing, education, and technical recognition and enhancing public visibility in the field of Electron Devices.

EDS Field of Interest

The EDS field-of-interest includes all electron and ion based devices, in their classical or quantum states, using environments and materials in their lowest to highest conducting phase, in simple or engineered assembly, interacting with and delivering photo-electronic, electro-magnetic, electromechanical, electro-thermal, and bio-electronic signals. The Society sponsors and reports on education, research, development and manufacturing aspects and is involved in science, theory, engineering, experimentation, simulation, modeling, design, fabrication, interconnection, reliability of such devices and their applications.