



# IEEE ELECTRON DEVICES SOCIETY

## Newsletter

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## 75TH ANNIVERSARY OF THE TRANSISTOR

### HISTORY OF COMPUTATIONAL ELECTRONICS AND EMERGING TRENDS

STEPHEN M. GOODNICK AND DRAGICA VASILESKA

SCHOOL OF ELECTRICAL, COMPUTER AND ENERGY ENGINEERING  
ARIZONA STATE UNIVERSITY

Computational Electronics (CE) broadly spans topics related to the modeling and simulation of electronics and optoelectronics, although practically speaking, it mainly focuses on device modeling. It is closely related to Technology for Computer-Aided Design (TCAD), which hierarchically couples device and process simulation together with extraction of compact models for circuit simulation, as part of electronic design automation (EDA). Here we mainly focus on device modeling, which includes nanoscale transistor technology, beyond CMOS technologies (e.g. TFETs, spintronic devices, neuromorphic elements, etc.), wide bandgap power electronic devices, electromechanical devices (MEMS/NEMS), rf and high frequency devices, optoelectronic and energy conversion devices. The overarching goal of CE is to provide an understanding of the behavior of current device technologies and predictions of future new technologies.

Almost all approaches to device modeling require a self-consistent approach involving the simultaneous solution of coupled sets of equations representing charge/heat transport and the electromagnetic fields, solved over some spatial domain, as illustrated in Fig. 1. Here the transport kernel is informed by electronic structure and phonon dynamics. Transport includes both electronic transport and thermal transport, the latter being increasingly important in ultra-scale transistors and power electronics. For high frequency

(continued on page 3)



### YOUR COMMENTS SOLICITED

Your comments are most welcome. Please write directly to the  
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### NEWSLETTER DEADLINES

#### ISSUE

October  
January  
April  
July

#### DUE DATE

July 1st  
October 1st  
January 1st  
April 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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# HISTORY OF COMPUTATIONAL ELECTRONICS AND EMERGING TRENDS

(continued from page 1)

and optoelectronic devices, Maxwell's equations must be fully solved, whereas for most devices, the quasi-static solutions of Poisson's equation are sufficient. For device simulation, the transport and field equations are solved on a grid (structured or unstructured). Process simulation couples to define the structure, materials, doping, etc. defining the device. From simulation of the device characteristics (e.g. time dependent currents, potential and charge distribution), a nonlinear equivalent circuit model (compact model) may be extracted for use in circuit simulation at a higher level of abstraction beyond the CE approach.

The main differentiator between CE approaches is in the physical models used for the transport, illustrated in Fig. 2. While somewhat oversimplified, this figure reflects the tradeoff between increasing physical accuracy versus computational cost, going from classical continuum models to quantum mechanical descriptions [1]. The semi-classical description of transport is given by the Boltzmann transport equation (BTE), which describes the time evolution of the distribution function for the position and momentum of particles, including random scattering processes. Continuum models are derived from moments of the BTE [2], leading to partial differential equations for e.g. the charge density, which in its simplest form are the drift and diffusion-based semiconductor equations going back to Van Roosbroeck [3]. Monte Carlo particle-based simulation is the direct stochastic solution of the BTE at the semi-classical level. The most physically accurate models are based on quantum transport, which contains all the quantum mechanical correlations leading to non-classical behavior such as quantization, tunneling, and quantum interference, which we discuss in more detail below.

In the early days of semiconductor technology, the electrical device characteristics of MOSFET devices were described using simple analytical models, such as the gradual channel approximation, that relied on the drift-diffusion (DD) formalism. Numerical simulation of carrier transport in semiconductor devices was enabled by Scharfetter and Gummel [4], who proposed a robust discretization of the DD equations, which is still in use today. In the DD approach, the electron gas is assumed to be in thermal equilibrium with the lattice temperature, which is not true in nanoscale devices [5]. Due to the short dimensions, high fields, and short transit times, non-stationary (e.g. quasi-ballistic) transport may dominate, which is not described by the local DD equations. Bløtekjær [6] derived conservative hydrodynamic (HD) equations using higher moments of the BTE, which partially captures non-stationary effects like velocity overshoot. Since self-heating effects significantly influenced the transport characteristics of devices with channel lengths of 200 nm and below, heat flow equations have been added to the DD transport models, see for example Wachutka [5]. A fully thermal hydrodynamic model was introduced by Benvenuti and co-workers [7].

Historically, most CE software was developed at universities or corporate research laboratories, and later commercialized by TCAD companies, starting with DD/HD-based codes in the late 1970s and 1980s. The PISCES device simulation code [8] was developed at Stanford University (together with SUPREM for process simulation), and commercialized through Technology Modeling Associates (TMA) in 1979. At the same time, MINIMOS was developed at the Technical University of Vienna [9]. DESSIS [10], a fully hydrodynamic simulator developed between

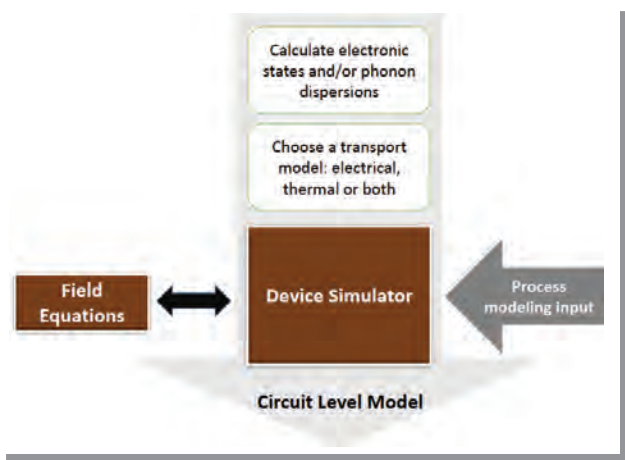


Figure 1. Components of a typical device simulation approach.

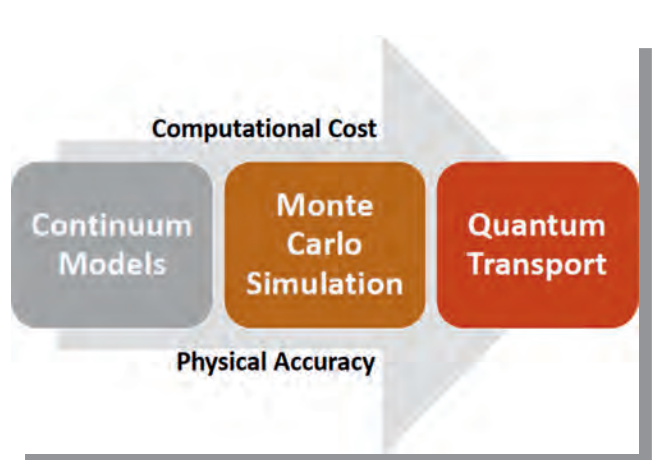


Figure 2. Hierarchy of transport simulation methods.

the University of Bologna, ETH Switzerland, and SGS-Thompson, was introduced in 1996. All these codes underwent continual improvements incorporating thermal modeling, 3D simulation capabilities, etc. Silvaco Inc. later licensed PISCES (then MEDICI) and SUPREM4 in 1989 to offer the fully integrated commercial platforms ATLAS and ATHENA, for device and process modeling. The successor to TMA was meanwhile acquired by Synopsys Inc., who later acquired the DESSIS code in the mid-2000s, resulting in the Sentaurus TCAD platform. Other TCAD companies include Comsol, Crosslight, Cogenda, Global TCAD, and others.

Ensemble Monte Carlo (EMC) methods were developed starting in the 1960s for the direct stochastic solution of the BTE to explain high-field phenomena such as the Gunn effect. The early developments of the method starting in the UK and Italy, have been extensively reviewed [11]. In contrast to the DD/HD approach, EMC is a microscopic simulation method, where the semi-classical trajectories of an ensemble of particles subject to driving fields are simulated using the computer random number generator, which is used to generate scattering events and the final state after scattering, based on the quantum mechanical probabilities due to different scattering mechanisms (phonons, impurities, etc.). Since transport is based on an underlying microscopic description, macroscopic observables such as carrier mobility and drift velocity are determined microscopically rather than from empirical models. Early work through the mid-1980s was based on simplified multi-valley band structures. Full-band EMC was first developed at the University of Illinois (see [12]), where the full electronic structure of materials was employed. DAMOCLES [13] was the most well-known full-band EMC code developed at IBM research labs in the early 1990s, which was also a device simulation tool. Device simulation with Monte Carlo is more complicated since one has to map a discrete charge representation into continuum solutions of Poisson's equations [14]. In full-band EMC, there is a computational bottleneck in determining the final state after scattering within a complicated energy band structure. Computational methods have subsequently been developed based on optimized search algorithms [15] and using pre-tabulated scattering rates across the full Brillouin zone of electronic states in a Cellular Monte Carlo (CMC) approach [16], where greatly improved computational speed is obtained by using significantly more memory.

A recent trend in full-band device simulation has been to leverage the rapid advances in *ab initio* structure calculations over the past decade. There are now several commercial/open-source based packages (e.g. VASP, Quantum Espresso), which in addition to providing first principles electronic (phononic) structure information, also increasingly provide information scattering processes, such as first principles electron-phonon interactions [17], and

impact ionization [18]. Full-band EMC is particularly important in recent years for wide bandgap semiconductors such as GaN and diamond for power electronic applications, where very high fields are experienced. Full-band simulation of non-bulk materials such as 2D materials and nanostructures is another trend in the field. Another recent trend has been to combine EMC and thermal transport. At nanoscale dimensions where dimensions are shorter than the phonon mean free path, Fourier's law fails, and more exact models for phonon transport are needed. One approach is to combine moment expansion of the phonon BTE with electronic EMC for electrothermal transport [19]. More recently, full dispersion particle-based simulation of phonon transport coupled to EMC for electrons and holes has been reported [20].

As the characteristic length scales in semiconductor devices have shrunk into the decanano scale, quantum mechanical effects associated with the wave nature of matter became important for dimensions shorter than the electron *phase coherence length* [21], where quantum mechanical effects such as quantum confinement, tunneling, and quantum interference start to dominate. Real electron devices must possess at least two terminals, contacts, or leads, and hence every device is an *open system* with respect to carrier flow [22].

In nanostructures [24], electron transport is often ballistic, where electrons are transmitted through the device without undergoing energy relaxation, which occurs in the contacts. Early on, the Landauer—Büttiker [23], [24] formalism provided a quantum flux-based description of current in terms of transmission probabilities to describe this ballistic regime. Various transfer and scattering matrix approaches were developed in the 80s and 90s for modeling mesoscopic devices, where appropriate scattering boundary conditions for open systems need to be employed [25]. An efficient variant of the scattering matrix approach is the Usuki method [26].

Due to their connection to scattering matrices, Green's function techniques were developed for quantum transport in mesoscopic systems, with the coupling to the leads being introduced via the self-energy. A very efficient and widely used algorithm is the recursive Green's function method [27], which became the basis of the NEMO 1-D code that was developed at TI/Raytheon [28] based on the nonequilibrium Green's function (NEGF) approach. It included full-band structure through the use of atomistic tight binding methods and elastic scattering processes, to successfully describe the behavior of resonant tunneling diodes. The incorporation of inelastic scattering processes into the NEGF formalism is critical for modeling real nanoscale technologies such as scaled CMOS, tunnel FETs, 2D materials, etc., and was implemented in NEMO-5 [29]. The NEMO-5 code was recently acquired by Silvaco TCAD for commercialization. Another important NEGF code was developed independently in Europe—the Atomistix



ToolKit later QuantumWise combined a NEGF transport simulator with first principles DFT [30]. QuantumWise was recently acquired by Synopsys for integration with their SentaurusTCAD products.

Finally, an alternate popular approach to quantum transport related to CE is based on the Wigner function approach [31], which is a kinetic equation approach similar to the BTE, except that the Wigner distribution is non-classical and can be negative. Scattering processes can be included through a collision integral similar to the BTE although non-local. The main advantage is that it is explicitly time-dependent and can describe entangled systems in general of relevance to recent advances in quantum information science.

To conclude, Computational Electronics has more than fifty years of history and continues to grow rapidly due to the enormous growth of computational power through hardware and efficient algorithms. We briefly touched on three main areas of active development in terms of continuum, particle-based, and quantum approaches to transport problems. A broad trend in recent years has been the emergence of TCAD companies and commercial tools, and the continued aggregation of tools across all levels of transport discussed in the present article, into commercial platforms. Certainly, new tools will emerge in the future to meet the challenges not only of a post-CMOS world but of dealing with the rapidly emerging quantum information technologies. It may even be the case that in the future, quantum computing-based CE tools will be developed to simulate what are presently intractable quantum problems.

## Biography

**Stephen M. Goodnick** (M 1987; SM 1990; F 2004) is currently the David and Darleen Ferry Professor of Electrical Engineering at Arizona State University. He received his Ph.D. degree in electrical engineering from Colorado State University, Fort Collins, in 1983, respectively. He was an Alexander von Humboldt Fellow with the Technical University of Munich, Munich, Germany, and the University of Modena, Modena, Italy, in 1985 and 1986, respectively. He served as Chair and Professor of Electrical Engineering at Arizona State University, Tempe, from 1996 to 2005. He served as Associate Vice President for Research for Arizona State University from 2006-2008 and presently serves as Deputy Director of ASU Lightworks as well as the DOE ULTRA Energy Frontier Research Center. He is also a Hans Fischer Senior Fellow with the Institute for Advanced Studies at the Technical University of Munich. Professionally, he served as President (2012-2013) of the IEEE Nanotechnology Council, and served as President of IEEE Eta Kappa Nu Electrical and Computer Engineering Honor Society Board of Governors, 2011-2012. Some of his main research contributions include analysis of surface roughness at the Si/SiO<sub>2</sub>

interface, Monte Carlo simulation of ultrafast carrier relaxation in quantum confined systems, global modeling of high frequency and energy conversion devices, full-band simulation of semiconductor devices, transport in nanostructures, and fabrication and characterization of nanoscale semiconductor devices. He has published over 450 journal articles, books, book chapters, and conference proceedings, and is a Fellow of IEEE (2004) for contributions to carrier transport fundamentals and semiconductor devices.

## References

- [1] D. Vasileska, S. M. Goodnick, and G. Klimeck, *Computational Electronics: Semi-Classical and Quantum Device Modeling and Simulation*. Taylor and Francis, UK, 2010.
- [2] S. Selberherr, *Analysis and Simulation of Semiconductor Devices*. New York: Springer-Verlag, 1984.
- [3] W. Van Roosbroeck, "Theory of the Flow of Electrons and Holes in Germanium and other Semiconductors," *Bell System Technical Journal*, vol. 29, pp. 560-607, 1950.
- [4] D. L. Scharfetter and H. K. Gummel, "Large-signal analysis of a silicon read diode oscillator," *IEEE Trans. Electron Devices*, vol. ED-16, pp. 64-77, 1969.
- [5] G. K. Wachutka, "Rigorous thermodynamic treatment of heat generation and conduction in semiconductor device modeling," *IEEE Trans. Computer-Aided Design*, vol. 9, pp. 1141-1149, 1990.
- [6] K. Bløtekjær, "Transport equations for electrons in two-valley semiconductors," *IEEE Trans. Electron Devices*, vol. ED-17, pp. 38-47, 1970.
- [7] A. Benvenuti, W. M. Coughran, and M. R. Pinto, "A thermal-fully hydrodynamic model for semiconductor devices and applications to III-V HBT simulation," *IEEE Trans. Electron Devices*, vol. 44, pp. 1349-1359, 1997.
- [8] C. S. Rafferty, M. R. Pinto, and R. W. Dutton, "Iterative Methods in Semiconductor Device Simulation," *IEEE Trans. Electron Devices*, vol. 32, pp. 2018-2022, 1985.
- [9] S. Selberherr, W. Fichtner, and H. Pötzl, "MINIMOS—A Program Package to Facilitate MOS Device Design and Analysis," in *Numerical Analysis of Semiconductor Devices and Integrated Circuits* (B. Browne and J. Miller, eds.), vol. I, (Dublin), pp. 275-279, Boole Press, 1979.
- [10] G. Baccarani, M. Rudan, M. Lorenzini, W. Fichtner, J. Litsios, A. Schenk, P. van Staa, L. Kaeser, A. Kampmann, A. Marmiroli, C. Sala, and E. Ravanelli, "Device simulation for smart integrated systems (DESSIS)," *Proceedings of Third International Conference on Electronics, Circuits, and Systems (ICECS'96)*, pp. 752-755, 1996.
- [11] C. Jacoboni and P. Lugli, *The Monte Carlo Method for Semiconductor Device Simulation*, Springer-Verlag, Vienna, 1989.
- [12] K. Hess, *Monte Carlo Device Simulation: Full Band and Beyond*, Kluwer Academic Publishing, Boston, 1991.

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## TECHNICAL BRIEFS

### EDS SUPPORTS GLOBALIZATION OF SOLAR ENERGY

JUZER VASI, LAWRENCE KAZMERSKI AND SARAH KURTZ

#### Introduction

In 2019, Dr. Fernando Guarin, President of EDS, attended the flagship EDS photovoltaics conference, IEEE Photovoltaic Specialist Conference (PVSC) in Chicago. EDS had supported 2 delegates to attend the conference—one from Guinea and one from the International Solar Alliance—to increase the diversity at the conference. Arising out of the positive responses from these delegates, the charge from the International Advisory Committee (IAC) of the World Conference on Photovoltaic Energy Conversion (WCPEC), of which the IEEE PVSC is a key part along with the European Photovoltaic Solar Energy Conference (PVSEC) and the Asia-Pacific PVSEC, to reach out to the lesser represented PV research communities, and also directly from other solar PV experts who were attending the conference, Dr. Guarin suggested that we should make a proposal for further globalization of solar energy, which could be supported by EDS. As a consequence, we (Juzer Vasi, Lawrence Kazmerski and Sarah Kurtz) submitted a proposal entitled ‘Photovoltaic Solar Alliance’, with the intention of utilising EDS infrastructure and expertise to disseminate solar PV globally. The proposal was approved in July 2019.

The project consisted of 2 major parts. The first part envisaged inviting PV personnel from less-represented countries to IEEE PVSC. This would allow them to interact with leading PV experts, but also inform the latter of the interest and aspirations of the ‘emerging solar’ countries. The 2020 (47th) IEEE PVSC which would have been held in Calgary in June 2020 was converted to a virtual conference. This provided an opportunity to have many delegates from countries of the International Solar Alliance (ISA) attend the conference on-line. We worked closely with ISA to seek participation from the ISA member countries, and received about 30 applications. Of these, 19 delegates were selected and registered for the conference. These included 1 from Australia (representing also the Pacific Island nations), 3 from Bangladesh, 1 from Cuba, 1 from Guinea, 1 from Namibia, 1 from Somalia, 3 from Sudan, 2 from Togo, 1 from Uganda and 5 from the ISA Secretariat. In addition, we also conducted a virtual GoTo-Meeting event, which was attended by most of the above 19 delegates, in addition to Dr. Seth Hubbard, Chair of the PVSC conference, the three proposers of this project (Juzer Vasi, Sarah Kurtz and Lawrence Kazmerski), together with several global PV experts. It was an excellent occa-

sion where the delegates could communicate their needs, and the global experts responded effectively.

The second part of the project consisted of creating a ‘Solar Roadmap’ for a country. This was perceived by the country delegates as well as PV experts to be an important step in planning the deployment of solar energy by any country. This would mobilise the EDS experts to work together with the solar representatives of that country to lay out their 8-10 year Roadmap for implementing solar energy. Working closely with ISA and the IAC, we decided to choose a specific country as a model, and the country chosen was Togo in West Africa. It was also decided that the process of creating the Roadmap should be well documented, which would serve as a template to be followed by other countries to create their respective Roadmaps. The rest of this report focuses on the creation of the Togo Solar Roadmap, and the procedure followed for it.

#### Setting up the Roadmap Team

In September 2019, at a meeting of the IAC of the World Conference on Photovoltaic Energy Conversion (WCPEC), Dr. Sarah Kurtz discussed strategies to enhance global dissemination of solar PV. A Sub-Committee was set up to identify methods for developing Solar Roadmaps, and several members were identified who volunteered to contribute. The following persons (including the 3 original proposers of the IEEE EDS project) were the volunteers: Lawrence Kazmerski, Sarah Kurtz, Philippe Malbranche, Stefan Nowak, Heinz Ossenbrink, Juzer Vasi and Pierre Verlinden.

This group had several on-line meetings starting in 2019. In the first meeting in October 2019, Stefan pointed out that IEA and ISA had just released a report entitled *Solar Energy: Mapping the Road Ahead* (available online at <https://www.iea.org/reports/solar-energy-mapping-the-road-ahead>), which described in detail the procedure which may be followed to create a Solar Roadmap. It was decided to use this as the procedure for Togo.

Since it was contemplated that the Togo Roadmap would also serve as a template for other countries, it was decided to involve ISA as well. It was fortunate that two members of the sub-Committee, Stefan and Philippe, had contributed to the IEA-ISA report, being closely associated with IEA and ISA respectively.

For further discussions, some persons from ISA were co-opted to the Roadmap Group. They were Akella Sastry and



Figure 1. Participants at one of the 9 meetings. (Clockwise from top left): Pierre Verlinden, Larry Kazmerski, Juzer Vasi, Amy Nabiliou, Todine Salifou, Sarah Kurtz.

later Aaishani Kabu. Obviously, it was critical to have people from Togo. The following persons were suggested by the Togo authorities: Todine Salifou and Amy Nabiliou. Later, Mataani Fabrice Alloula also participated in the discussion.

This 'Roadmap Group' met nine times during 2019-2022 to create the Togo Solar Roadmap until 2030, following the procedure laid out in the IEA-ISA report quite scrupulously. There was also a plan for 2 or 3 of the experts to visit Togo so as to make an 'on-the-ground' assessment. Unfortunately, due to the advent of Covid-19, and its prolonged impact on travel, the visits could not take place.

A screenshot of one of the meetings showing some of the participants is given in Fig. 1.

### Background of Togo

The Republic of Togo is a French-speaking country located in West Africa (Fig. 2). Its capital is Lomé, a port located on the Gulf of Guinea in the south. Togo covers 56,785 km<sup>2</sup>, with a population estimated to be ~8.5 million in 2022. As seen in Fig. 2, the country is narrow (width <115 km). Its coordinates are: 8.6° N and 0.8° E. Togo is a tropical sub-Saharan nation, and possesses excellent solar resources, and therefore an excellent potential for harvesting solar energy.

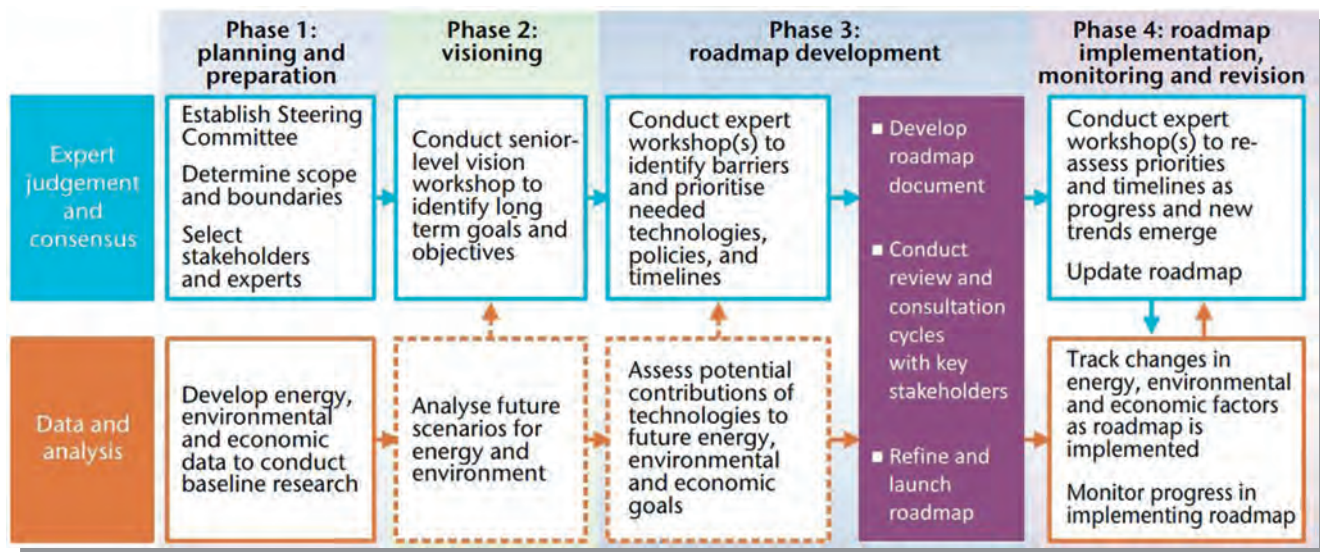
### The Roadmap Procedure of the IEA-ISA Report

The methodology proposed in the IEA-ISA report *Solar Energy: Mapping the Road Ahead* is described here briefly.



Figure 2. Republic of Togo, highlighting its position in West Africa.





Note: Dotted lines indicate optional steps, depending on available capabilities and resources.

Source: Adapted from IEA (2014a), Energy Technology Roadmaps.

Figure 3. The roadmap development process.

**ISA** INTERNATIONAL SOLAR ALLIANCE

As countries worldwide enhance their share of renewable energy, especially solar photovoltaics, it is essential to set ambitious yet realistic targets and, above all, to lay out the roadmap to reach them. This is crucial for all the countries with even more challenges for the 'emerging solar' countries.

## SOLAR ROAD MAPPING: TRANSITION TO ACTION

DATE: 28 SEPTEMBER 2022 | TIME: 13:30-16:45 CET  
VENUE: MILANO CONVENTION CENTRE, MILAN, ITALY  
ISA IS CO-ORGANISING A PARALLEL EVENT AT THE

**8<sup>TH</sup> WORLD CONFERENCE ON PHOTOVOLTAIC ENERGY CONVERSION (WCPEC)**

The event will feature

- Talks by global PV leaders and policy planners describing the formulation of a Solar Roadmap for a country
- Success stories of road mapping processes from select countries
- Focus on deriving concrete, pragmatic next steps that will trigger solar deployment efforts in specific country contexts
- An expert panel discussion with government officials

**REGISTER NOW**

You can attend the event in-person or virtually | For other parallel events, visit: [PEs Programme \(wcpec-8.com\)](https://www.wcpec-8.com)

For more details, contact:  
Philippe Malbranche | [philippemalbranche@isolaralliance.org](mailto:philippemalbranche@isolaralliance.org)

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Figure 4. Flyer for the Roadmapping Event at WCPEC-8.

There are 4 Phases in the methodology: Phase 1: Planning and Preparation, Phase 2: Visioning, Phase 3: Roadmap Development and Phase 4: Implementation, Monitoring and Revision. These are shown in Fig. 3.

In the first phase of **planning and preparation**, we examined the technological, market and public policy issues in Togo. Fortunately, Togo had recently embarked on its electrification plan, with solar being an important part, so some of the background was already available. However, we created an enhanced version using specific questions from the IEA-ISA Report. Our Group then assessed the Solar Resources and Technologies available for Togo, and also identified the Stakeholders to be consulted.

The second phase of roadmapping involves **developing a vision** for solar deployment in Togo upto 2030, with clear, realistic targets. The Group discussed the specific drivers for solarization for Togo. The Group then discussed the setting of the Targets. This was obviously a difficult aspect, because it meant looking into the future, without knowing exactly how solar technology and economics would develop in the coming decade.

The first step of the third phase, **roadmap development**, was to identify technical, economic, administrative or public acceptance barriers that may impede the achievement of the targets laid out in Phase 2, and to identify the actions to overcome these barriers. As a part of the Barrier Identification process, various stakeholders including solar project developers active in Togo, were contacted. The draft Roadmap Document was then prepared.



		Milestones by Year		
		2020	2025	2030
<b>Solar Technology Deployment</b>	Overall Electricity Access Rate	53%	75%	100%
	Overall Electricity Dependency Rate	60%	30%	0%
	Gigawatt hours (GWh) generated in Togo (all sources)	613.52 GWh	2080	2250
	Gigawatt hours (GWh) generated by solar in Togo (minigrid, solar plants) without SHS	4.45 GWh	404 GWh	470 GWh
	Share of solar energy (%) in total yearly electricity production	< 1%	18.5%	25.6%
	Overall Electricity MW capacity	200.56 MW	565 MW	630 MW
	MW capacity installed by solar—all systems	3.08 MW	239.2 MW	282.25 MW
	(i) Utility scale	0	197 MW	232 MW
	(ii) Mini-grids	0.61 MW (4 mini-grids)	31 MW (329 minigrids)	31 MW
	(iii) Solar Home Systems (SHS)	2.47 MW	11.2 MW (320,000 households)	19.25 MW (550,000 households)
	k. Share of solar capacity (%) in total installed power capacity	1.5% (solar)	42.3% (solar)	45% (solar)

Table 1. Solar Roadmap for Togo till 2030.

The fourth and final phase of roadmap development includes **monitoring** its implementation and **updating** as the technology and other situations change. This would be an ongoing activity till 2030.

An extensive Solar Roadmap for Togo for 2030, with an intermediate milestone for 2025 is now available. A *partial* version of this is given in Table 1. The strategy is to extensively use mini-grids and small solar home systems (SHS), which would provide electricity to parts of the population very quickly. There is also an emphasis on utility-scale power plants, necessary to provide the large capacities which would eventually be required; however, the roll-out of these is over a longer time span due to the requirement of enhancing the grid infrastructure. The percentage of installed electric capacity due to solar increases from 1.5% in 2020 to 45% in 2030. Besides the Roadmap for Solar Technology Development which is shown in Table 1, the Roadmap also generated the 2030 targets and 2025 milestones for the following 5 aspects: Financial Requirements, Processes (Workshops, Facilities), Policies, Socioeconomic/Environmental Aspects and International Collaborations.

## Conclusions

This EDS-sponsored activity on dissemination of solar PV knowledge, through involving participants from globally diverse regions in its flagship PVSC conference, and in creating a template of a Solar Roadmap for emerging solar countries has been extremely successful.

In particular, the Roadmap activity, described in this report, has far-reaching implications. As more countries globally adopt solar PV as their main source of energy for the future, and transition from fossil-based to renewable

sources, the need to have a good Roadmap becomes imperative. We have followed the procedures described in the 2019 IEA-ISA report *Solar Energy: Mapping the Road Ahead* to create an 8-year Solar Roadmap for Togo until 2030. The procedure described in this report can form the template for many other countries to adopt. In order to publicize this more widely, a fuller version of the methodology will appear soon as a paper in the open-access journal *Solar Compass* (<https://doi.org/10.1016/j.solcom.2023.100043>). It is hoped that this paper will be used as a guide by other emerging solar countries.

Arising out of this EDS initiative, a major parallel Event “Solar Road Mapping: Transition to Action” was organized at the 8th World Conference on Photovoltaic Energy Conversion (WCPEC) in Milan, Italy in September 2022. The WCPEC is held every four years, and IEEE PVSC is one of the 3 conferences which come together for this ‘world’ event. The parallel Event was jointly organized by ISA, WCPEC and EDS. This was very well attended by global PV experts as well as delegates from many emerging solar countries, both in person as well as on-line. The flyer for the parallel Event is shown in Fig. 4.

In conclusion, it is worth mentioning that the IEEE EDS took the forward-looking decision to support this globalization initiative several years ahead of the growing international need for global collaboration, which was highlighted at COP-26 in Glasgow and COP-27 in Sharm El-Sheikh. The foresight exercised by EDS was very appropriate given IEEE’s presence in over 160 countries. The Roadmap activity undertaken through this EDS project is likely to be very impactful, and, it is hoped, will serve many countries globally to make a transition towards clean electricity using solar PV.

## REVIEW OF THE 2023 IRPS

The IEEE International Physics Reliability Symposium (IRPS) has been the premiere conference for engineers and scientists to present new and original work in the area of microelectronics reliability for more than 60 years. Drawing participants from the Americas, Europe, Asia, and all other parts of the world, IRPS seeks to understand the reliability of semiconductor devices, integrated circuits, and microelectronic systems through an improved understanding of both the physics of failure as well as the application environment.

The 2023 IRPS was held in a hybrid format starting on 26 March until 30 March 2023. The virtual event was attended by almost 500 registered participants, which was 25% higher than the previous year and a record for recent years. The access to the recorded presentations was granted to the registrants for one year.

2023 IRPS special focus topics were:

- Embedded / In-product memory / neuromorphic compute: Reliability of emerging memory devices and design architectures with embedded memory as function/performance booster
- GAA, nanosheet, RibbonFET, Forksheets: TDDb, BTI, HCI, process charging, HV effects.
- 3D IC advanced packaging: 3D, 2.5D, interposer MIM, embedded bridge, hybrid bonding reliability.

The highlights of the 2023 technical program include

- 18 technical committees and 244 TPC members
- 4 keynotes, 28 tutorials, 10 workshops and 3 year-in-reviews
- 3-day technical sessions comprising 111 oral presentations, 81 poster presentations, 20 invited/focus talks
- 11 exhibitors and 23 patrons

The conference encompassed a wide range of topics, ranging from Circuit Reliability and Aging, Emerging Memory Reliability, ESD and Latchup, Failure Analysis, Gate/MOL/BEOL Dielectrics, MEMS, Beyond CMOS Device Reliability, Memory Reliability, Metallization/BEOL Reliability, Emerging memory Reliability, Packaging and 2.5/3D Assembly, Process Integration, Reliability Testing, RF/mmW/5G Reliability, Radiation Effect Reliability, Silicon Photonics, System Electronics Reliability, Transistor Reliability, to Wide-Bandgap Semiconductors-GaN and SiC.

This year, a 2-day tutorial session was offered prior to the technical sessions which gave the attendees greater flexibility to not only to listen to focused lectures from domain experts but also to learn about the latest research discoveries. Tutorials were given by instructors who are



authorities in their respective reliability fields—either veteran IRPS presenters for established topics or invited specialists in emerging topics. A total of 28 tutorials were offered on topics ranging from 3D integration, 5G/mmW/RF, GaN, memory reliability, automotive, advanced interconnect, cryogenic electronics,

design automation, ESD, Radiation Effect Reliability, to FinFET self-heating.

The 2nd day of tutorial ended with three Year-In-Review (YIR) talks, a segment always appreciated by IRPS attendees, allowing them to quickly catch up on recent developments in multiple areas. In this year's Year-in-Review several speakers covered the past year of literature on (YIR1) Soft Error in Planar, FDSOI, FinFET and GAA, (YIR2) Advances in Reliability Testing and Understanding for SiC Vertical Power MOSFETs, and (YIR3) FEOL reliability of FinFETs, Nanowire, and Nanosheet FETs.

The conference formally kicked off on 28 March 2023, with a welcome address by the General Chair Chris Conner, Intel, Inc., and an overview of the technical program by the Technical Program Chair Susumu Shuto, Toshiba. Each day started with a plenary keynote by industry executives listed below.

- Day 1: Dr. Ann Kelleher, EVP and GM of Technology Development, *Intel*  
"On the Advance of Moore's Law and Resulting Trends in Reliability"
- Day 1: Gary Hicok, SVP, *NVIDIA*  
"Transforming Industries with Trustworthy Cloud-to-Edge Compute Platforms"



IRPS General Chair Chris Conner (right) with Keynote speaker Ann Kelleher from Intel (left) and Keynote speaker Gary Hicok from Nvidia (middle).



Visitors and exhibitors in the exhibit foyer during IRPS 2023.

- Day 2: Mark Fuselier, SVP, Technology & Product Engineering, *AMD*  
"Reliability Challenges for the Next Decade of High-Performance Computing"
- Day 3: Rohit Vidwans, EVP and Chief Engineering & Manufacturing Officer, *Ampere*  
"Building Reliability into the Modern Cloud"

Technical session presentations consisted of 111 Oral (of which 20 were invited) and 81 Poster papers, previously selected by 18 subcommittees. Due to the virtual nature of the conference, the papers were typically presented as prerecorded video clips which resulted in higher quality presentations. Poster presenters were allotted limited time to introduce their work and, to emulate the poster session experience, they could discuss their work with interested audience members in separate video calls. Workshops were held on Day 2 where attendees enjoyed informal discussions on specific reliability topics with the guidance of experienced moderators. As an added perk for this year's attendees, all recorded talks were available after the conference.

The IRPS subcommittees highlighted the following contributed papers:

- S. Mukhopadhyay *et al.*, Intel Corporation, "A Unified Aging Model Framework Capturing Device to Circuit Degradation for Advance Technology Nodes"
- Y. Zhou *et al.*, UIUC, "Collector Engineering of ESD PNP in BCD Technologies"
- J. Mendoza *et al.*, UT Arlington, "Advanced Methods of Detecting Physical Damages in Packaging and BEOL Interconnects"
- A. Yamada *et al.*, University of Tokyo, "ReRAM CiM Fluctuation Pattern Classification by CNN Trained on Artificially Created Dataset"
- M. Asaduz *et al.*, Purdue University, "Transient Leakage Current as a Non-destructive Probe of Wire-bond Electrochemical Failures"
- Z. Gao *et al.*, University of Padova, "Thermally-activated failure mechanisms of 0.25 um RF AlGaIn/GaN HEMTs submitted to long-term life tests"
- S. Kim *et al.*, Samsung Electronics, "Reliability Assessment of 3nm GAA Logic Technology Featuring Multi-Bridge-Channel FET"
- P. Moens *et al.*, OnSemi, "The Concept of Safe Operating Area for Gate Dielectrics: the SiC/SiO<sub>2</sub> Case Study"
- In parallel with the technical sessions, an interesting exhibition was held with eleven exhibitors presenting their solutions for testing, data analysis and other reliability-related tasks.

Next year, IRPS 2024 will be from 14 April to 18 April 2024 in Dallas, Texas. Best Paper, Best Student Paper, Best Poster, People's choice Awards for IRPS 2023 will be announced prior to that in the EDS Newsletter. The latest information can be found on <https://www.irps.org/>.

Paula Chen  
IRPS 2023 Publicity Chair

## 2022 IEEE SEMICONDUCTOR INTERFACE SPECIALISTS CONFERENCE (SISC)

The 53rd IEEE Semiconductor Interface Specialists Conference (SISC) was held on 7-10 December 2022 with only on-site presentations at the Catamaran Resort Hotel, San Diego, CA. Despite the difficulties imposed by the COVID-19 pandemic, the 53rd SISC was a big success with a total of about 100 on-site attendees.

The meeting started with a Wednesday evening on-site tutorial by Prof. Ashraf Alam from Purdue University. A long-time reliability authority in the semiconductor de-

vice community, Prof. Alam educated the SISC audience on "Reliability Physics for PostMoore Era Electronics: An Integrated Material, Devices, and System Perspective". Prof. Alam used illustrative examples of self-heating in transistors, fluid stability of biosensors, shadow/corrosion physics of solar cells, fatigue/stiction in MEMS, and ion-transport due to chip-package interaction to explain how a new generation of predictive reliability models will ensure the reliability of postMoore era electronics.



After the tutorial, the conference continued with 43 contributed papers and 51 posters presented in 13 sessions. A total of 8 invited speakers gave an overview of the state-of-the-art in power electronics, memory technologies, cryo-CMOS, ferroelectrics, and oxide electronics. These talks are: Dr. Takashi Ando, IBM, USA, *Hardware Algorithm Co-optimization for Scalable Analog Compute Technology*; Dr. Hiroaki Arimura, imec, Belgium, *Gate Stack Technology for Advanced Logic and Memory Periphery Devices*; Dr. Nick Chiang, TSMC, Taiwan, *Device engineering and benefit maximization for advanced cryo-CMOS*; Prof. Cheng Gong, U. Maryland, USA, *Controlling 2D magnetism for efficient spintronics*; Prof. Asif I. Khan, GeorgiaTech, USA, *Reliability of ferroelectric field-effect transistors*; Prof. John Robertson, U. Cambridge, UK, *Reduced contact resistances for Moire Lattice Interfaces of MoS<sub>2</sub> and other Layered Compounds*; Prof. Gong Xiao, National University of Singapore, Singapore, *Oxide Semiconductor Back-end-of-line (BEOL)-Compatible Transistors and Memories*;

Prof. Grace Xing, Cornell University, USA, *Heterointerfaces in the AlN material system*.

A best student paper was established in 1995 in honor of Prof. E.H. Nicollian and the winner of the 2022 SISC Ed Nicollian Award is Jiaqi Chen from University of Cambridge. The winner of a new award, instituted in honor of Prof. T.P. Ma, the 2022 T.P. Ma Award for Best Student Poster goes to Joy Roy from University of Texas at Dallas.

With more than 100 on-site attendance, SISC was able to bring back its limerick contest in 2022. The limerick contest is a long-standing tradition at SISC.

The 2022 Executive committee consisted of Ex-Officio Wenjuan Zhu from the University of Illinois, General Chair William Vandenberghe from the University of Texas at Dallas, Technical Program Chair Peide Ye from Purdue University, and Arrangements Chair John Rozen from IBM.

Peide Ye  
2022 SISC Technical Program Chair

## HISTORY OF COMPUTATIONAL ELECTRONICS AND EMERGING TRENDS

(continued from page 5)

[13] M. V. Fischetti and S. E. Laux, "Monte Carlo analysis of electron transport in small semiconductor devices including band-structure and space-charge effects," *Phys. Rev. B*, vol. 38, pp. 9721-9745, 1988.

[14] R. W. Hockney and J. W. Eastwood, *Computer Simulation Using Particles*, Institute of Physics Publishing, Bristol, 1988.

[15] C. Jungemann, S. Keith, and B. Meinerzhagen, "Full-band Monte Carlo simulation of a 0.12  $\mu\text{m}$ -Si-PMOSFET with and without a strained SiGe-channel," *IEDM Tech. Dig.*, pp. 897-900, 1998.

[16] M. Saraniti and S. M. Goodnick, "Hybrid Fullband Cellular Automaton/Monte Carlo Approach for Fast Simulation of Charge Transport in Semiconductors," *IEEE Trans. Electron Devices*, vol. 47, pp. 1909-1916, 2000.

[17] S. Ponc , E. R. Margine, C. Verdi, and F. Giustino, "EPW: Electron-phonon coupling, transport and superconducting properties using maximally localized Wannier functions," *Computer Physics Communications*, vol. 209, pp. 116-133, 2016.

[18] T. Kotani, M. van Schilfgaarde, "Impact ionization rates for Si, GaAs, InAs, ZnS, and GaN in the GW approximation," *Phys. Rev. B*, vol. 81, pp. 125201 (1-5), 2010.

[19] K. Raleva, D. Vasilevska, S. M. Goodnick, and M. Nedjalkov, "Modeling Thermal Effects in Nano-Devices," *IEEE Trans. Electron Devices*, 55, no. 6, 1306-1316 (2008).

[20] F. F. M. Sabatti, S. M. Goodnick, and M. Saraniti, "Particle-Based Modeling of Electron-Phonon Interactions," *Journal of Heat Transfer* 142, 012402 (2020).

[21] D. K. Ferry and S. M. Goodnick, *Transport in Nanostructures*, Cambridge University Press, 1998.

[22] S. Datta, *Electronic Transport in Mesoscopic Systems*, Cambridge University Press, 1995.

[23] R. Landauer, Electrical resistance of disordered one-dimensional lattices, *Phil. Mag.*, vol. 21, pp. 863-867, 1970.

[24] M. B ttiker, Y. Imry, R. Landauer, and S. Pinhas, Generalized many-channel conductance formula with application to small rings, *Phys. Rev. B*, vol. 31, pp. 6207-6215, 1985.

[25] C. S. Lent and D. J. Kirkner, "The quantum transmitting boundary method," *Journal of Applied Physics*, vol. 67, pp. 6353-6359, 1990.

[26] T. Usuki, M. Saito, M. Takatsu, R.A. Kiehl and N. Yokoyama, "Numerical analysis of ballistic-electron transport in magnetic fields by using a quantum point contact and a quantum wire," *Phys. Rev. B*, vol. 52, pp. 8244-8255 (1995).

[27] R. Lake and S. Datta, "Nonequilibrium Green's-function method applied to double-barrier resonant-tunneling diodes," *Phys. Rev. B*, vol. 45, pp. 6670, 1992.

[28] R. Lake, G. Klimeck, R. C. Bowen, and D. Jovanovic, "Single and multiband modeling of quantum electron transport through layered semiconductor devices," *J. Appl. Phys.*, vol. 81, pp. 7845-7869, 1997.

[29] S. Steiger, M. Povolotskyi, H.-H. Park, T. Kubis, and G. Klimeck, "NEMO5: A Parallel Multiscale Nanoelectronics Modeling Tool," *IEEE Trans. Nanotechnology*, vol. 10, pp. 1464-1474, 2011.

[30] M. Brandbyge, J.-L. Mozos, P. Ordejo, J. Taylor, and K. Stokbro, "Density-functional method for nonequilibrium electron transport," *Phys. Rev. B*, vol. 65, 165401 (17 pp), 2002.

[31] D. K. Ferry and M. Nedjalkov, *The Wigner Function in Science and Technology*, IOP Publishing, 2018.

# UPCOMING TECHNICAL MEETINGS

## IEEE INTERNATIONAL ELECTRON DEVICES MEETING (IEDM) ANNOUNCES 2023 CALL FOR PAPERS

Under the theme “Devices for a Smart World Built Upon 60 Years of CMOS,” the 69th annual IEEE International Electron Devices Meeting (IEDM) has issued a Call for Papers seeking the world’s best original work in all areas of microelectronics research and development.

The 2023 IEDM is being planned as an in-person conference on 9-13 December 2023 at the Hilton San Francisco Union Square hotel, with on-demand access to recorded presentations after the event for those unable to travel.

The IEEE IEDM is the premier forum for technological breakthroughs in semiconductor and related device technology, manufacturing, design, physics, and modeling. Each year, the world’s leading technologists gather to participate in a technical program of more than 220 presentations, panels, focus sessions, tutorials, Short Courses, supplier exhibits, IEEE/EDS award presentations, and other events highlighting the industry’s best work.

IEDM 2023 encourages submissions in all areas, with special emphasis on:

- Neuromorphic computing/compute-in-memory/AI
- Quantum computing devices
- Devices for RF, 5G/6G, THz, and mmWave
- Advanced memory technologies
- Advanced logic technologies and power distribution network
- Novel materials for next-generation devices
- Non-charge-based materials, devices, and systems
- Advanced power devices, modules, and systems
- Sensors, MEMS, and bioelectronics
- Devices/circuits/system interaction
- Advanced packaging, and package-device level interactions
- Electron device simulation and modeling
- Reliability of electronic devices
- Robustness/security of electronic circuits and systems
- Optoelectronics, displays, and imaging systems

**The paper submission deadline is Thursday, 13 July 2023.** Authors are asked to submit four-page camera-ready papers. Accepted papers will be published as-is in the proceedings. A few late-news papers also will be accepted, covering only the most recent, most noteworthy developments. The late-news submission deadline is 21 August 2023.

The IEDM 2023 technical subcommittees are as follows:

- Advanced Logic Technology (ALT)



69th  
International  
Electron  
Devices  
Meeting

- Emerging Device and Compute Technology (EDT)
- Memory Technology (MT)
- Power, Millimeter Wave, and Analog Technology (PMA)
- Modeling and Simulation (MS)
- Optoelectronics, Displays, and Imagers (ODI)

- Neuromorphic Computing (NC)
- Reliability of Systems & Devices (RSD)
- Sensors, MEMS, and Bioelectronics (SMB)

The following experts were invited to deliver IEDM 2023 plenary talks:

- Siyoung Choi, President & GM, Samsung Foundry Business
- Björn Ekelund, Corporate Research Director, Ericsson
- Thy Tran, Vice President of DRAM Process Integration, Micron

IEDM 2023 will feature special Focus Sessions on the following topics:

- Sustainability in Semiconductor Device Technology and Manufacturing
- Logic, Memory, Package, and System Technologies for Future Generative AI
- 3D Stacking for Next-Generation Logic & Memory Scaling by Wafer Bonding and Related Technologies
- Neuromorphic Computing for Smart Sensors

The following IEDM 2023 Short Courses will be held:

- Transistor, Interconnect, and Chiplets for Next Generations of Low-Power & High-Performance Computing
- The Future of Memory Technologies for High-Bandwidth Memory and High-Performance Computing

For more information, visit the IEDM 2023 home page at [www.ieee-iedm.org](http://www.ieee-iedm.org).

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# SOCIETY NEWS

## MESSAGE FROM EDS NEWSLETTER EDITOR-IN-CHIEF



Daniel Tomaszewski  
EDS Newsletter  
Editor-in-Chief

Dear Readers, Members of the IEEE Electron Devices Society,

Welcome to the IEEE EDS Newsletter issue of July 2023.

Just before the appearance of the Newsletter issue of April 2023 with the note recollecting Prof. Goetzberger, we were touched by the very sad news that Gordon Moore died on 24 March this year. EDS President, Ravi Todi signed Gordon Moore's obituary presented in this Newsletter issue. Ravi wrote also the obituary of Alfred MacRae, former EDS President, who passed away on 15 February. The era of microelectronics pioneers passes away. In parallel, the future brings new perspectives with inevitable challenges and people who will have to face them.

Dear Readers, please find in the *Society News* a concise report on the recent mid-year EDS Board of Governors meeting and accompanying events that were held on 3-4 June in Cambridge, UK. During the meeting, the BoG recommended to change the number of the Regional Editors for Regions 1-7 from three to two. You may note this change on page 2.

I would like to draw your attention to the next articles celebrating the 75th Anniversary of Transistor, namely the 2nd part of the history of EDS by Samar Saha and the article on computational electronics by Stephen Goodnick and Dragica Vasileska. Obviously, the anniversary is highlighted also in several articles in *Regional* and *Chapter News*.

In the *Technical Briefs* section, please find the interesting article highlighting an important initiative supported by a number of PV-related communities, including EDS. The project is oriented toward the globalization of solar energy. Of great importance is that underprivileged countries actively participate. The article reports the model implementation of the project in Togo, Africa. I believe that this initiative will lead to a visible drop in the use of fossil

energy sources, thus pollution and heat emissions into the atmosphere. However, such an undertaking not only requires improvement of the PV cell efficiency, exploitation costs, and lifetime but must take into account an effect of the PV panel production on the environment and a need for better recycling methods.

In addition, the *Technical Briefs* and *Upcoming Technical Meetings* bring summaries of technical conferences: SISC 2022 and 2023 IRPS as well as updated information about the upcoming 69th IEDM 2023 Conference.

The *Women in Engineering* section contains a very interesting article in which Monica Blank presents some aspects of vacuum electronics and her career and works with those often not-micro-scale electron devices. Monica chairs the EDS Vacuum Electronics Committee and we had the privilege to present Monica Blank's report in the Newsletter issue October 2022. In the *Young Professionals* section, we present the interview that Manoj Saxena made with Dr. Girish Pahwa.

As usual, the *Chapter News* and *Regional News* sections bring information on the daily activities of EDS Chapters devoted to supporting schools and their students, as well as to the organization of technical meetings: lectures, and seminars.

At the end of this message, I would like to thank Rinus Lee for his two-term (six years) service and dedication as the Newsletter's Regional Editor for Regions 1-3. Our Editorial Team wishes Rinus a fruitful development of his professional career and luck in his personal life.

Dear Readers, if you have any suggestions, or comments regarding the Newsletter contents, please do not hesitate to contact us. We will be very glad to receive your feedback. Interesting views will be presented with the consent of the authors, along with our replies in the Letters to Editors section.

Sincerely,

*Daniel Tomaszewski*



## MID-YEAR BOARD OF GOVERNORS MEETING—2023

The mid-year meetings of EDS Board of Governors were held at the Moller Institute, University of Cambridge, UK on June 03 and 04, 2023. The meeting was attended by the elected Board members and EDS Forum members at the venue and a few joined online via Webex. Region 8 Chapters meeting held on the forenoon of June 03 had report presentations from 15 Chapters. The EDS Executive Committee meeting was held on the same afternoon. Highlights of the presentations and deliberations at the BoG meeting on June 04 include the following.

EDS President, RaviTodi welcomed the attendees of the Board of Governors meeting on June 04, and informed the overall status of the Society. Society remains in good financial health with many successes in the past year in all activities like Education, Publications, Conferences etc. Also, Society decided to enhance the awards' amounts. The number of Chapters reached 250 globally and Society member strength has increased above 12,000 with many student members joining. The 75th anniversary of transistor invention is being celebrated by Chapters as well as conferences.

Bin Zhao, President-Elect explained the challenges of the Society and changes required. These include organizational enhancement, new initiatives in technical activities as well as developing the needed platform for conferences. The 2024 mid-year meeting location is suggested to be Auckland, New Zealand, Region 10.

EDS Secretary's report and Newsletter Status was presented by MK Radhakrishnan including the motions for C&B changes. Roger Booth, EDS Treasurer, presented the financial status, reporting the healthy surplus in 2022, 50% of which can be utilized for new initiatives. Funding for special projects initiatives and technical committees in the year 2024 was projected.

EDS VP of Education, Navakanta Bhat reported the new initiative of Thematic Webinar series organized jointly with institutions. Successful thematic webinar series completed jointly with MIT had the theme new frontiers of biotechnology and the one jointly with Purdue was on changing the world with chips. EDS MEMS and Sensors webinar series and Manufacturing webinar series are in the pipeline. Four summer school proposals were selected for 2023 and one of them is in Kenya, first time ever in Africa. EDS outreach programs are organized successfully. And the certification program is progressing, all in line with the KPIs of the Education Committee.

Arokia Nathan, EDS VP for Publications and Products reported that the EDS journals EDL, TED and JEDS are doing well with a better performance than previous year. Among the co-sponsored journals J-PV, J-MEMS, T-SM, TDMR and J-FLEX are also performing well. A new open access Journal on Immersive Displays is in the pipeline. Brief reports on EDS Magazine were given by Joachim Burghartz, on Transactions on Materials for Electron Devices (T-MED) by



Francesca Iacopi, and on IEEE Electron Devices Reviews by Samar Saha. An anniversary volume about 75 years of transistors will be published soon.

VP for Technical Committees, John Dallesasse's report included the status of 16 Technical Committees. TC members are supporting EDS Webinars and Conferences and enhancing the interactions with conferences like IEDM and improving strategic connections within IEEE but outside EDS. VP for Strategic Directions, Douglas Verret informed that the strategic plan is dynamic and is being followed by each group along the lines of the performance indicators. Strategies for EDS new joint projects or collaborations with EDS standing committees and entities outside EDS were projected. This has a high value as there are distinct contacts from our membership base having cross membership interaction with many IEEE Societies and groups.

EDSVP for Meetings and Conferences, Kazunari Ishimaru informed the status of major EDS Conferences and gave a summary of EDTM 2023. IFETC update and future plans were suggested. Among the elevated KPIs for conferences, topical workshops on multidisciplinary areas targeting industry participants are being tried to implement. Yogesh Chauhan presented the plans and progress of EDTM 2024 to be held in Bangalore, India followed by Yang Chai informing the plans for EDTM 2025 in HongKong. Shuji Ikeda presented the plans for a new EDS Specialty conference.

Murty Polavarapu, EDS VP for Regions and Chapters gave an update about the Chapters globally. Currently out of the 250 EDS Chapters, 105 are Student Branch Chapters and growth is more concentrated in Region 10. Three new EDS Chapters in Africa have been formed in Kenya and Nigeria including one Student Branch Chapter. DL programs are progressing as planned with 61 DL talks held so far

this year and 9 MQs planned. A plan for reviving inactive chapters, especially in Regions 4-6 has been initiated.

EDS VP for Membership, Merlyne de Souza reported the latest member strength of EDS as 12,140, 13% growth from last year, which shows a good growth affected from various promotion activities in the strategic plan including promoting more women and students to join the Society.

WiEDS Chair Susthitha Menon reported the activities of the Women in EDS group informing a 3% growth of female members in the last one year which is on par with other IEEE Societies. Various WiEDS activities including special promotional workshops and sessions at conferences held and planned were discussed.

Mario Aleman, Chair of EDS YP Committee presented the YP status in the Society. YP promotional activities at each of the EDS conferences were reported which include networking and mentoring. Also, YP members constitute a social media ambassador forum at EDS events.

Cor Claeys presented the Humanitarian Activities report which included humanitarian and special projects funded by EDS. Out of the four humanitarian project proposals received for 2024, two are put through to get more info for approval. Fernando Guarin, EDS Fellows Committee Chair reported that 33 nominations were received this year and the review was organized by the committee. Cary Yang, Nominations and Elections Chair informed the 2023 BoG and officers election will take place during December BoG meeting and notifications for nomination will be published soon.

The meeting was concluded on time. RaviTodi thanked all the participants and attendees and adjourned the 2023 mid-year BoG meeting.

*MK Radhakrishnan*  
*IEEE EDS Secretary*

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## **IN MEMORIAM: ALFRED URQUHART MACRAE (1932-2023)**

Alfred (Al) MacRae was born in Brooklyn, NY in 1932 to Farquhar and Eliza (Urquhart) MacRae, originally from Ontario, Canada. He was the first generation in his family to finish high school and went on to earn bachelor's and doctoral degrees in physics from Syracuse University.

Upon completing his PhD in 1960, Al embarked on a 35-year career at Bell Telephone Laboratories in New Jersey. He started in basic research, studying the location of atoms on surfaces. In time, he pioneered the development of silicon integrated circuits and satellite communications tech-

nology, before retiring in 1995 as Director of the Satellite Communications Lab. He was an IEEE Fellow. He was EDS President in 1986-87. Prior to that, he served EDS in many senior volunteer posts. Al held 18 patents, and was published in numerous technical journals. He received awards for his scientific contributions, including IEEE's prestigious J.J. Ebers Award in 1994, and the 2012 Outstanding Alumnus Award from Syracuse University. He was most proud of being elected into the National Academy of Engineering in 2003. Al was very passionate about contributing a

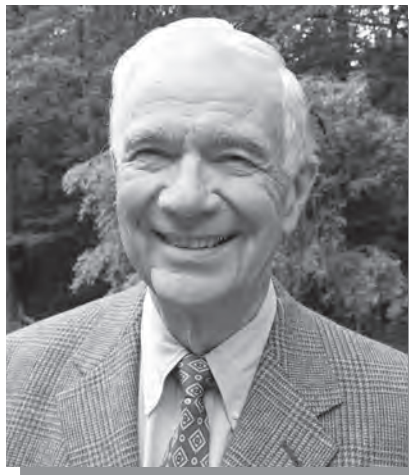
chapter to the commemorative book on the 75th anniversary of the invention of the transistor. Al authored and submitted the chapter in the book just before he passed away, which will be published in July 2023.

There was no doubt in Al's mind that his most valuable experience at Bell Labs was meeting Peggy, a biologist. They married in 1967 and were delighted when twin daughters, Pam and Susan, were born the next year.

Al was active in sports. His favorites included basketball, baseball, softball, tennis, hiking, rock climbing, canoeing, and skiing.

He was proud of his Highland Scottish heritage. As an undergraduate student, he learned to play the bagpipes, becoming Pipe Major of the Balmoral Highland Pipe Band. He later enjoyed teaching the pipes.

Al was an active member of Christ Church in Summit, NJ where he served in leadership roles and enjoyed being



*Alfred Urquhart MacRae (1932-2023)*

a "ding-a-ling" in the Handbell Choir with Peggy. He served as Chair of the Short Hills Ski Club, Chair of the Board of the Summit-area Red Cross, and President of the Old Guard.

Al and Peggy relocated to Seattle in 2012 to be closer to their daughters. In their active retirement community, Al helped lead the Science and Technology Group and "Hot Topics" group and actively participated in numerous other resident committees. Most important to Al was his time with Peggy, Pam, and Susan. They met often to enjoy meals and outings in Seattle and the Pacific Northwest as a family.

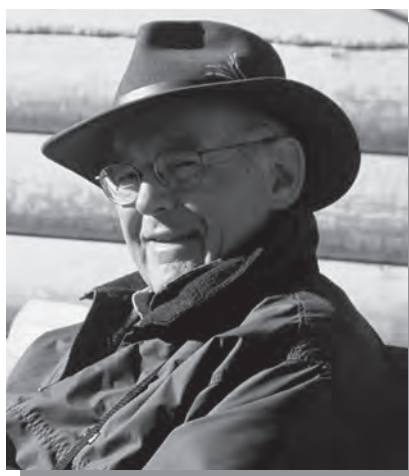
He passed away at home on 15 February 2023.

EDS would like to thank Alfred MacRae's daughter for kindly sharing a major part of contributions to this Memoriam.

*Ravi Todi*

## IN MEMORIAM: GORDON MOORE, 1929-2023

With his characteristic humility and word economy, Gordon Moore once wrote (<http://calteches.library.caltech.edu/3777/1/Moore.pdf>) "My career as an entrepreneur happened quite by accident." A brilliant scientist, business leader, and philanthropist, Gordon co-founded and led two pioneering technology enterprises, Fairchild Semiconductor, and Intel, and, with his wife, Betty, created one of the largest private grantmaking foundations in the U.S., the Gordon and Betty Moore Foundation. He could argue that his career as an entrepreneur had happened by accident, but his world-changing contributions did not. Never one to trumpet his own accomplishments, Gordon wasn't able to dissuade others from celebrating his wide and long-reaching legacy: the revolutionary technologies and breakthroughs, a long and generous history of philanthropy, and the very culture of experimentation, invention, and



*Gordon Moore (1929-2023)*

relentless progress that now defines Silicon Valley.

A fifth-generation Californian, Gordon Moore was born in San Francisco on 3 January 1929. He grew up in Pescadero, a small coastal community in San Mateo County that had been home to his family since the mid-nineteenth century. From an early age, Gordon had a passion for the natural world, science, and experimentation, and he pursued that with a bright inquisitiveness, appreciation, and sense of gratitude that would last a lifetime and become guideposts for his philanthropy.

By 1950, Gordon earned his bachelor's degree in chemistry after transferring to the University of California at Berkeley from San Jose State University. He was awarded his Ph.D. in chemistry from the California Institute of Technology in 1954. After graduating from Caltech, Gordon moved east for a job in research with the Applied Physics Laboratory



at Johns Hopkins University. In early 1956, he was recruited west again by William Shockley, the soon-to-be Nobel Laureate. By 1957, Gordon Moore and his seven colleagues left Shockley Semiconductor and formed Fairchild Semiconductor. Soon, Fairchild became a producer of the world's first microchips and one of the shining stars of the electronics industry. However, the Fairchild employees began leaving to create their own businesses. "Every time we came up with a new idea, we spawned two or three companies trying to exploit it," Gordon reflected. These "Fairchildren" included offshoots like Signetics, General Micro Electronics, Moletron, Four-Phase Systems—and, in 1968, Intel.

Three years earlier, in 1965, Electronics magazine approached Gordon to ask if he would contribute an article on the future of electronics. In "Cramming More Components onto Integrated Circuits," Gordon predicted that transistors' cost would decrease at an exponential rate as the number on each silicon chip doubled annually. "I never expected my extrapolation to be very precise," Gordon said later. "However, over the next ten years, as I plotted new data points, they actually scattered closely along my extrapolated curve" ("Understanding Moore's Law: Four Decades of Innovation" Edited by David C. Brock). In 1975, Gordon updated his prediction, now recognized as "Moore's Law," anticipating that the doubling would happen every two years for the coming decade. Moore's Law had become the cornerstone of the semiconductor industry, and of the constantly evolving technologies that depend on it.

The most famous of the "Fairchildren," Intel, was created in July 1968. Having left Fairchild Semiconductor and with financing help from Arthur Rock, Gordon, and Robert Noyce invested \$250,000 each in their new co-founded enterprise and raised another \$2.5 million. Their first hire was Andy Grove. The three together built a company that, by 1971, had brought to market the first microprocessor, and by 1991, become the world's largest semiconductor company. Gordon became Intel's president and CEO in 1975. Four years later, he was elected chairman and chief executive. He became chairman emeritus in 1997 and retired in 2006. Under Gordon's leadership, Intel became the world's highest-valued semiconductor chip maker. Intel also helped establish Silicon Valley's culture and ethos, eschewing bureaucracy, and rewarding innovation, loyalty, and the entrepreneurial spirit.

For his pioneering contributions, Gordon was recognized with many honors. Among them are the National Medal of Technology from President George H. W. Bush in 1990, and the nation's highest civilian honor, the Presidential Medal of Freedom, from President George W. Bush in 2002. Gordon served as a member of the board of directors of Conservation International and Gilead Sciences, Inc., and was a member of the National Academy of Engineering, a Fellow of the Royal Society of Engineers, and a Fellow of the IEEE. IEEE Electron Devices Society honored him as its celebrated member in the year 2017. He also served as chairman of the Board of Trustees of the California Institute of Technology

from 1995 until the beginning of 2001, when he continued as a LifeTrustee.

To Gordon Moore, the need for investment in discovery-driven science and philanthropy was a key impetus behind creating the Gordon and Betty Moore Foundation in 2000, especially in the context of a widening gap between rapidly increasing revenues of the electronic industry and investment in basic research and STEM education that is critical to human progress. Despite reaching a very high status, the Moores never lost touch with their small-town pragmatism or unassuming roots. The financial windfall made them even more focused on giving back to society, to try, as they expressed, to make the world a better place for their children and their children's children. Long before signing the Giving Pledge in 2012, Gordon and Betty had already given more than half of their assets to charitable causes. In 2017, they were recognized as California's most generous philanthropists. Beginning with individual gifts, many of them anonymous, then forming the Moore Family Foundation, and eventually, in 2000, creating the Gordon and Betty Moore Foundation "to create positive outcomes for future generations," Gordon and Betty have maintained a focus across their philanthropic endeavors on supporting universities, hospitals and other non-profit organizations working in environmental conservation, science, patient care, and the San Francisco Bay Area.

In 2015, he and Betty wrote their Statement of Founders' Intent (<https://www.moore.org/about/founders-intent>) to capture and immortalize their hopes and expectations for their philanthropy. "Betty and I established the Foundation because we believe it can make a significant and positive impact in the world," Gordon wrote. "We want the Foundation to tackle large, important issues at a scale where it can achieve significant and measurable impacts." But the man whose philanthropy would, he hoped, change the world for the better on a grand, meaningful scale—and whose observation of technological progress became "law"—also wrote this philanthropic guidance with characteristic humility, and just a touch of ironic self-deprecation: "Since it is impossible to predict the future with any certainty, the guidance cannot be very specific."

Reflecting on the contrast between the Moores' view of their own importance with Gordon's aspirations for his scientific and philanthropic endeavors, Moore Foundation President Harvey Fineberg observed, "There is nothing ostentatious or extravagant in the way they live their lives. Yet, there is a grandness and inspirational quality in their belief in the improvability of the human condition."

Gordon physically left this world on 24 March 2023 leaving his legacy, never-ending contributions to the semiconductor industry, and cherishing memories to all his friends, followers, and the professional community.

EDS would like to thank Gordon and Betty Moore Foundation for the major part of the contributions to this Memoriam.

*Ravi Todi*  
IEEE EDS President

# THE NEW IEEE ELECTRON DEVICES MAGAZINE

I am happy to inform you that the first (June'23) issue of the **IEEE Electron Devices Magazine (ED-M)** is just to be published. ED-M is the new initiative of the IEEE Electron Devices Society. It will be issued by IEEE with the full financial support of our Society.

The Magazine focuses on the publication of peer-reviewed tutorial and survey papers related to the wider field of electron devices and their applications. It may also include articles dealing with environmental, societal, and humanitarian issues. Besides, columns by renowned experts will be included, dealing with educational, research, industrial and open topics and sharing personal opinions in a compact format. Also, news related to the Electron Devices Society will be displayed in the Magazine, including the President's Column and conference reports.

The IEEE Electron Devices Magazine will be published quarterly, with issues appearing in March, June, September and December. Most issues of the Magazine will include a "focus section," that will feature topical articles invited by guest editors. Each issue will be displayed in light of the given focus topic. The nearest ones' leading themes will be:



- June 2023: 75th Anniversary of the Transistor
- September 2023: Neuromorphic Computing
- December 2023: Semiconductor Manufacturing
- March 2024: Large-Area and Flexible Electronics

In addition to the invited topical articles, contributed technical articles on all topics related to the field of electron devices will be presented. Their Authors are advised to try to match their submissions to the Editorial Calendar, though this is not a strict requirement.

I do hope that you, the readers of the Magazine, will find its contents interesting and may vividly react to them in the

letters to the Editor (ED-M-editor@ieee.org). I also strongly encourage you to contribute to the Magazine with your articles and personal opinions.

More information about ED-M, including information about paper submission, indexing, subscription, access, can be found at: <https://eds.ieee.org/publications/ieee-electron-devices-magazine>

Prof. Dr. Joachim N. Burghartz  
Founding Editor-in-Chief  
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## A BRIEF HISTORY OF THE IEEE ELECTRON DEVICES SOCIETY: PART II—PUBLICATIONS

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In the article, "A Brief History of the IEEE Electron Devices Society: Part I," appeared in the *IEEE Electron Devices Society Newsletter*, volume 30, no. 2, April 2023, the *origins* and *growth* of the *Electron Devices Society* (EDS) of the *Institute of Electrical and Electronics Engineers* (IEEE) were presented [1]. As described in [1] and shown in Fig. 1, on March 5, 1952 the *Institute of Radio Engineers* (IRE) *Professional Group on Electron Devices* (PGED) was established to interact directly with the *electron devices community* which on January 1,

1963 became the *IEEE Professional Technical Group on Electron Devices* (PTGED); on May 20, 1964 was renamed the *IEEE Electron Devices Group* (EDG); and on February 17, 1976 became the IEEE EDS. The Society's worldwide growth has been culminated by a diversified portfolio of journal publications within its *Field-of-Interest* (Fol). This article presents a brief history of Society's relentless pursuit in launching major journal publications within the technical areas of importance to its global community.

One of the major efforts of the IRE PGED during its formative years had been publication of a journal and a monthly newsletter. In pursuant of this effort, the Group launched its first publication, the *Transactions*, in 1952 and many more in the ensuing decades as described below.

## 1. Transactions

### A. Transactions of the IRE Professional Group on Electron Devices

Through relentless efforts of AdCom Subcommittee on Publications successive Chairmen *Herbert J. Reich* of Yale University, Connecticut and *John Saby* of General Electric (GE), New York, a quarterly journal titled, the *Transactions of the IRE Professional Group on Electron Devices* was published in November 1952 [2]. The contents of the first issue, PGED-1, November 1952, included five papers, one of which was presented at the *IRE Conference on Electron Tube Research*, Ottawa, Canada, June 16 and 17, 1952 and two were presented at the *IRE-AIEE (American Institute of Electrical Engineers) Conference on Semiconductor Research*, Urbana, Illinois, June 19 and 20, 1952 [2]. For the first few years, the Transactions was published *irregularly* depending on the availability of high quality papers, often from conferences or symposia that did not publish proceedings [2]. There was only a *single issue* in 1952, *three* in 1953, and *four* in 1954 [3], when AdCom approved to begin publishing the Trans-

actions *quarterly* on a regular basis. Also from the year 1954, the Transactions volume started as ED-1 [3].

After establishing the regularity of publication schedule, a formal editor was appointed in charge of the Transactions and it was renamed the *IRE Transactions on Electron Devices*.

### B. IRE Transactions on Electron Devices

In 1955, *Earl L. Steele* of GE, New York, was appointed as the *first* formal editor of the Transactions and the publication was renamed the *IRE Transactions on Electron Devices* [4]. Starting from the *IRE Transactions on Electron Devices*, volume ED-2, 1955, the quarterly publication continued till 1960, volume ED-7 [5]. From 1961, the Transactions became *bimonthly* [5]. After Earl L Steele's resignation publishing ED-8, issue 5, *Glen Wade* of Raytheon, Massachusetts took over as the editor bringing out Transactions, volume ED-8, issue 6, 1961, and all six issues of the last *IRE Transactions on Electron Devices*, volume ED-9, 1962 [5] before renaming the publication to the *IEEE Transactions on Electron Devices* in the year 1963 [6].

### C. IEEE Transactions on Electron Devices

The major publication of the IEEE PTGED was renamed the *IEEE Transactions on Electron Devices* (T-ED) in 1963 [6]. Glen Wade continued to serve as the editor through the 1960s, bringing on associate editors and incorporating numerous changes. Under his leadership, the T-ED

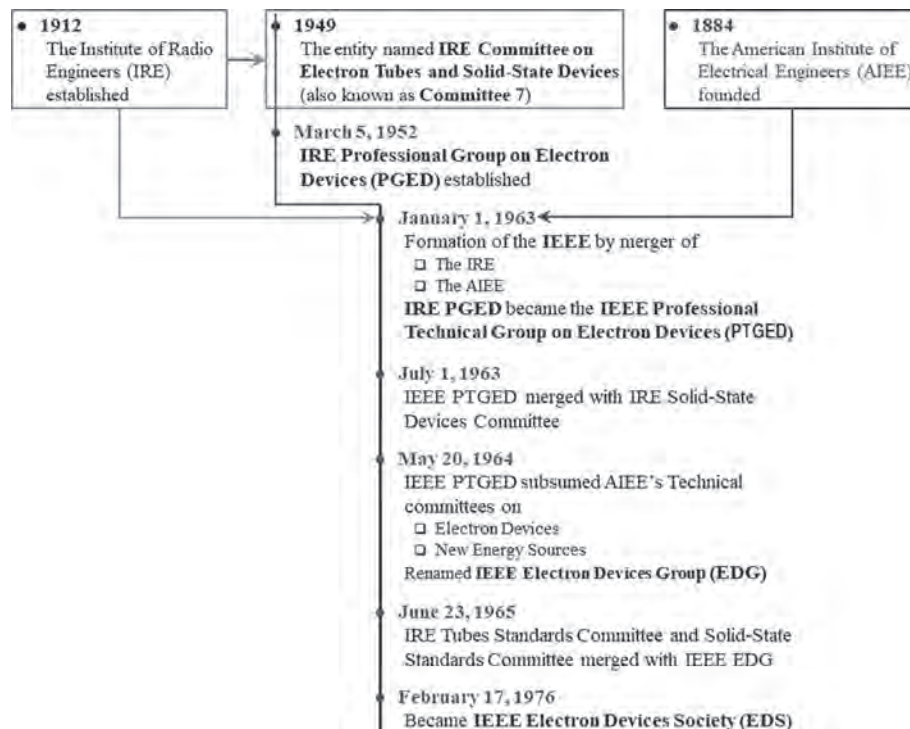


Figure 1. Origins of the IEEE EDS lie on March 5, 1952 as the IRE PGED. And, through mergers, subsuming different functionalities, and name changes in ensuing decades IRE PGED became the IEEE EDS on February 17, 1976 [1].



became a *monthly journal* in 1964, ED-11 [6]. The main reason for this expansion was the improvement in quality of the journal under Wade's editorship, which inspired many more authors to submit high quality papers for publications. Another reason being the increase in the number of submissions on emerging *quantum electronics* devices including masers and lasers [6].

Thus, the Society's first journal has been published as the *Transactions of the IRE Professional Group on Electron Devices* (1952–1954); the *IRE Transactions on Electron Devices* (1955–1962), and the *IEEE Transactions on Electron Devices* since 1963 [6].

In the 1970s, the IEEE T-ED continued to expand its editorial board with a growing number of high quality submissions. In 1971, Glen Wade stepped down as the editor and was quickly replaced by *John Copeland* of Bell Labs, who served until 1974. There was an extensive editorial board with associate editors within the EDS Fol including *bipolar devices*, *display devices*, *energy sources*, *electron tubes*, and *solid-state power devices*. Thus, a new editor could be readily appointed from these ranks whenever the existing editor decided to step down. So, Copeland was replaced by *Roland H. Haitz* of Hewlett-Packard in 1974, Haitz by *Karl H. Zaininger* of Radio Corporation of America (RCA) in 1977, Zaininger by *Stephen Knight* of Bell Labs in 1979, Knight by *David L. Carter* of Bell Labs in 1983, Carter by *Serge Luryi* of Bell Labs in 1987, Luryi by *Renuka P. Jindal* of Bell Labs in 1990, Jindal by *Doug P. Verret* of Texas Instruments in 2001, Verret by *John Cressler* of the Georgia Institute of Technology in 2012, Cressler by *Paul K. L. Yu* of the University of California, San Diego in 2015, Yu by *Giovanni Ghione* of Politecnico di Torino, Italy in 2016, and Ghione by *Patrick Fay* of the University of Notre Dame in 2023, all without any disruption in the quality and efficiency of publication [6], [7]. *Note that since February 1996, the Society's publication editor and associated editors are re-named as the Editor-in-Chief (EiC) and editors, respectively* [6].

During the 1970s, the Society's flagship publication, the IEEE T-ED established itself as a premier journal of the electron devices community. One memorable highlight of the 1970s has been the publication of the special issue on *Historical notes on important tubes and semiconductor devices*, T-ED, vol. 23, no. 7, July 1976 with *Gerald Pearson* of Bell Labs serving as a guest editor together with *Roland Haitz* [8]. This (1976) T-ED special issue commemorated the 200th anniversary of the founding of the US as well as closely coincided with the 25th anniversary of the EDS. Its authors included luminaries such as William Shockley writing on "The Path to the Conception of the Junction Transistor," Jack Kilby on the "Invention of the Integrated Circuit," and Rudolf Kompfner on "The Invention of the Traveling Wave Tube" as well as Leo Esaki and George Smith [8].

In the meanwhile, semiconductor industry leaders championed the goal for very large scale integration

(VLSI), in which the microchip device features in integrated circuits (ICs) would be as small as a micron and beyond [9]. The IEEE EDS strongly supported these efforts, often working jointly with the Solid-State Circuits Council and Japanese counterparts. In 1979, a special VLSI issue was published jointly by the IEEE T-ED and IEEE *Journal of Solid-State Circuits*, edited by *Hans Friedrich* of Siemens, *Walter Kosonocky* of RCA, and *Takuo Sugano* of the University of Tokyo [10]. The IEEE EDS's effort in supporting VLSI led to the cosponsored *Symposium on VLSI Technology* in the year 1980. Subsequently, the T-ED published special issues on VLSI technology and simulation in 1980, 1982, and 1983 [6]. By the mid-1980s, VLSI was rapidly approaching the submicron regime. The Society's flagship publication, the T-ED continued to diversify its editorial board to support the semiconductor industry's relentless pursuit of scaling to manufacture IC chips in the nanometer regime approaching 1 nm. And to this date, T-ED continues to publish at least two special issues annually on emerging topical areas within its Fol with leading experts serving as guest editors [6], [7].

## 2. IEEE Journal of Quantum Electronics

In the 1960s, there had been growing interest in the emerging quantum devices. In order to support these emerging activities, a new Quantum Electronics Technical Committee (TC) of the IEEE PTGED was created during the 1963 reorganization [1], [11]. And in October 1964, the IEEE approved publication of a new professional journal devoted to quantum electronics. The new publication named, the *IEEE Journal of Quantum Electronics* (JQE), was cosponsored by the IEEE EDG and *Microwave Theory and Techniques* group. Launching the publication in early 1965, *Robert Kingston* of the Massachusetts Institute of Technology (MIT) and Glen Wade (of Cornell University) served as the founding co-editors along with two associate editors [12]. The JQE, volume 1, issue 1 was published in April, 1965 [12]. However, due to reorganization of the EDS's Quantum Electronics Council as a separate *IEEE Group on Quantum Electronics and Applications* in 1977, the IEEE JQE became a solely sponsored publication of this new Group from the year 1978 [1], [11].

## 3. Newsletter of the Electron Devices Group

The IRE-PGED's effort to publish a quarterly newsletter was realized in the year 1966. The first issue of the *Newsletter* of the IEEE EDG was published in June 1966 edited by *Jan M. Engel* of International Business Machines (IBM) Research in San Jose, California, USA [11]. The first issue provided a convenient forum for recent news of the organization and its day-to-day operation, beyond the scope of the Transactions. It included the highlights of AdCom meetings, reports from conferences and other professional gatherings, and information of the forthcoming meetings of interest to members. In 1970, Jan

Engel stepped down and the EDG Newsletter continued without interruption with *John Szedon* of Westinghouse as the editor. Under Szedon, the Newsletter was published *bimonthly* for a few years; however, reverted to *quarterly* in 1974. The Newsletter also had an *editorial board with associate editors* [11].

*In the year 1984, the quarterly EDS Newsletter was replaced by the new Division I publication entitled, "Circuits and Devices Magazine," due to reorganization of the IEEE Division I. However, EDS AdCom reinstated the Newsletter in 1994* [7], [11], [13].

#### 4. IEEE Journal of Solid-State Circuits

In the year 1966, the IEEE EDG co-sponsored publication of the *IEEE Journal of Solid-State Circuits* with three other professional group: *Circuit Theory, Computers, and Microwave Theory and Techniques* [14]. The joint-committee overseeing the new journal were Solid-State Circuit Council Chairman *John Linvill* of Stanford University and Vice Chairman *Gordon Moore* of Fairchild. The editorial board consisted of the founding editor *James Meindl* of the US Army Electronics Command and four associate editors [14].

#### 5. IEEE Electron Device Letters

With rapid advances in electron devices technology during the 1980s, it was extremely crucial for Society's flagship publication to keep parity with the fast-moving microelectronics industry. However, the slow rate of publication, typically 40-weeks from submission of an article to its publication in the IEEE T-ED, became a growing concern of AdCom. In order to address this issue, a quick-turnaround journal, the *IEEE Electron Device Letters* (EDL) was launched in January 1980 with *George E. Smith* of Bell Labs as the founding Editor [15]. Note that *Smith is a co-recipient of 2009 Nobel Prize in physics "for the invention of an imaging semiconductor circuit—the CCD sensor."* The inaugural issue of the new journal appeared in January 1980, containing five briefs. With Smith's efforts, the time to publish dropped dramatically to 10–13 weeks. It is to be noted that recently, *the average time from submission to online-publication in EDL is about 4-weeks, the fastest in the IEEE publications* [7], [15]. After Smith stepped down, *Simon M. Sze* of Bell Labs was appointed in the year 1986; Simon was replaced by *John R. Brews* of Bell Labs (later, the University of Arizona) in 1990; John was replaced by *Yuan Taur* of IBM (later, the University of California, San Diego) in 2000; Taur was replaced by *Amitava Chatterjee* of Texas Instruments in 2012; Amitava was replaced by *Tsu-Jae King Liu* of the University of California, Berkeley in 2016; Tsu-Jae was replaced by *Jesus del Alamo* of MIT in 2019; and Jesus by *Sayeef Salahuddin* of the University of California, Berkeley in 2023, thus publishing EDL uninterrupted [7]. Again, *since February 1996, the EDL editor and*

*associated editors are re-named as the EiC and editors, respectively.*

#### 6. IEEE/OSA Journal of Lightwave Technology

In the 1980s, the EDS continued to diversify into new areas creating *Opto-electronics* TC with *James Harris* of Rockwell as the first chairman in 1980 [11]. In order to support the emerging *fiber-optic communications*, EDS joined with nine other IEEE societies and the *Optical Society of America* (OSA) to start publishing a new journal, the *IEEE/OSA Journal of Lightwave Technology* (J-LT) from March 1983 with *Thomas G. Giallorenzi* of Naval Research Laboratory as editor (1983–1985) along with six associate editors [16]. This journal has become one of the leading authoritative publications on *optical fibers, components, networks, and systems*. Currently, the J-LT is an IEEE/OPTICA Publishing Group publication with *Gabriella Bosco* of the Politecnico di Torino, Torino, Italy as the EiC [17].

#### 7. Division I Circuits and Devices Magazine

The Division I *Circuits and Devices Magazine* was launched in 1984 divisional realignment [11], [18]. In this realignment, the *Electron Devices; Circuits and Systems; Components, Hybrids and Manufacturing Technology; and Lasers and Electro-Optics* Societies as well as the *Solid-State Circuits Council* were under Division I. The Magazine began publishing *bimonthly* from the year 1985 with *Guy Rabbat* of V R Systems, A Tektronix Company, Austin, Texas as the EiC along with five editors, one from each Division I member. The Magazine replaced the quarterly EDS Newsletter. However, *the Magazine was unsuccessful in spite of considerable time and effort by AdCom and EDS Newsletter was reinstated in 1994* [7], [11], [13]. Finally, the magazine was sunset after publishing vol. 22. No. 6., November/December 2006 [18].

#### 8. IEEE/TMS Journal of Electronic Materials

By the year 1986, the publishing efforts of the Society continued as usual. The EDS started joint publication, the *IEEE/TMS Journal of Electronic Materials* with *The Metallurgical Society* (later renamed *The Minerals, Metals and Materials Society*) [7], [11].

#### 9. Transactions on Semiconductor Manufacturing

Continuing with multi-society publication, AdCom member *David Hodges* of the University of California, Berkeley, proposed a new journal, the *Transactions on Semiconductor Manufacturing* (TSM) in the year 1987 to publish all aspects of manufacturing complex microelectronic components, primarily for VLSI applications. The TSM was cosponsored by the *EDS, Solid-State Circuits Council, Components, Hybrids and Manufacturing Technology Society, and the Reliability Society* with David as the founding editor (1987–1990). The first issue of the IEEE

TSM appeared in February 1988 [19]. After David stepped down Gary Cheek of Analog Devices, Massachusetts was appointed as the editor in 1991; Gary Cheek was replaced by Gary May of the Georgia Institute of Technology, Georgia in 1998; Gary May by Duane S. Boning of MIT in 2001; Duane by Sean Cunningham of Intel in 2012. Currently, Reha Uzsoy of North Carolina State University is the EiC of the TSM [19].

## 10. IEEE Journal of Microelectromechanical Systems

In an effort to diversify EDS publications in new technical areas within its FoI, AdCom member Richard Muller of the University of California, Berkeley proposed a joint publication with *American Society of Mechanical Engineers* (ASME). In the year 1990, AdCom approved the proposal of this new joint-publication on microelectromechanical systems (MEMS) with the ASME. In March 1992, the new *IEEE/ASME Journal of Microelectromechanical Systems* began publication with the *IEEE Robotics and Automation Society* (RAS) and *Industrial Electronics Society* (IES) collaborating along with this effort. Richard served as the founding editor along with a number of associated editors [20]. Since 2013 (vol. 22, no. 2), the journal is only sponsored by the IEEE and renamed as the *IEEE Journal of Microelectromechanical Systems* (JMEMS) with EDS, RAS, and IES as the co-sponsors using subscription-based sponsorship model [7], [20]. After Richard stepped down Christofer Hierold of ETH Zurich, Switzerland was appointed as the EiC in 2013; Christofer was replaced by Gianluca Piazza of Carnegie Mellon University in 2019 [7], [20].

## 11. IEEE Electron Devices Newsletter Reinstated

The quarterly EDS Newsletter which was the forum for communications between the Society's leadership and its global community was replaced by Division I Circuits and Devices Magazine in the year 1985. However, in order to improve the deteriorating financial position of the Society, AdCom unbundled the Division I Circuits and Devices Magazine from the standard membership package in the year 1990. As a result, communications between the Society's leadership and its global membership had often been difficult [7], [12]. Thus, in the December 1993 meeting, AdCom decided to *reinstate* publication of a quarterly newsletter for EDS members, starting 12 pages and increasing on-demand. Thus, from 1994 the EDS Executive Office began publishing the *IEEE Electron Devices Newsletter* again with six regional editors and Krishna Shenai of the University of Wisconsin, Madison as the Editor-in-Chief [13]. Currently, Daniel Tomaszewski of the Lukasiewicz-Institute of Microelectronics and Photonics, Poland is the EiC and Manoj Saxena of the University of Delhi is the associate EiC along with 11 regional editors [7].

## 12. Electronic Editions

During the late 1990s, the Society continued to support publishing a growing diversity of professional journals within its FoI while placing increased emphasis on *electronic editions*. In support of electronic publication, AdCom approved the first completely electronic EDS new publication, the *IEEE Journal of Technology Computer Aided Design* in 1995, and started publishing the journal in the beginning of 1997 [7]. Furthermore, the Society's two flagship publications, the EDL and TED became available on CD-ROM in 1997 for subscription [7].

## 13. IEEE/ECS Electrochemical and Solid-State Letters

In the year 1997, AdCom approved an agreement with the *Electrochemical Society* (ECS) to jointly publish a journal, the *IEEE/ECS Electrochemical and Solid-State Letters* (ESL) [11], [21]. It featured briefs with rapid turn-around time submission-to-publication in both paper and electronic editions. The volume 1 of the ESL contained six issues and the first issue appeared in July 1998. The final issue of the ESL was volume 15, number 6, April 2012 [21].

## 14. IEEE Transactions on Device and Materials Reliability

With the global race to miniaturization of metal-oxide-semiconductor (MOS) field-effect transistors (FETs) and complementary MOS (CMOS) technology [9], the materials reliability and fabrication process-induced device reliability became critical for microelectronics industry. Recognizing the importance of rapid dissemination of information critical to manufacturing high reliability products, the EDS *Device Reliability Physics* TC, under the major efforts of Lu Kasprzak, joined the *IEEE Reliability Society* to launch a new online quarterly publication, the *IEEE Transactions on Device and Materials Reliability* (TDMR) in 2001 [7], [22]. The inaugural issue of TDMR, volume 1, no. 1 appeared in March 2001 with Anthony S. Oates of Agere Systems, Florida as the EiC (2001-2018) [22]. In 2019, Edmundo A. Gutiérrez of the Instituto Nacional de Astrofísica Óptica y Electrónica, Mexico was appointed as the EiC [7], [22].

## 15. EDS Archival Collection on DVD

In the year 2004, the Society released the *Archival Collection* of the major publications on a set of DVD (Digital Video Discs) through the effort of AdCom Vice President (VP) of Publications Renuka Jindal of the University of Louisiana at Lafayette, Louisiana. This included a collection of two DVD-sets with contents of all issues of T-ED (1954-August 2004), EDL (1980-August 2004), and *all technical digests of the International Electron Devices Meeting*, IEDM (1955-2004) as well as the EDS 50th anniversary celebration commemorative booklet [23]. However, with the online availability of all EDS publications, the archival Collection on DVD is discontinued [7].



## 16. QuestEDS

The IEEE *QuestEDS* was launched as an online *question and answer* member benefit service managed by the EDS Executive Office. This online publication was initiated by VP of Publications, Renuka Jindal and started in the year 2007 with Compact Modeling TC chair, Samar Saha of DSM Solutions, California as the founding EiC [23]. In this publication process EDS members can submit questions online within the EDS Fol and can view the answers provided by EDS experts online. The target turnaround time from the date of submission of online questions to the date of online posting of answer to the question was *two* weeks. Since 2020, this publication is discontinued [7].

## 17. IEEE Journal of Photovoltaics

In the year 2011, through the efforts of 2011-2012 President Renuka Jindal, VP of publications Samar Saha, and Timothy (Tim) Anderson of the University of Florida, Florida, the Society launched the multi-society publication, the *IEEE Journal of Photovoltaics* (J-PV) [7]. The need for a new publication in this area was initiated via an email from EDS representative *John Meakin* of the University of Delaware, Delaware, to Bill van Der Vort, the Executive Director of EDS and Renuka in October 2008. The inaugural issue of the J-PV was published in July 2011 with Tim as the founding EiC along with an editorial board of associated editors [24]. After Tim stepped down *Angus Rockett* of the Colorado School of Mines was appointed as the EiC of J-PV in January 2021.

## 18. Journal of Electron Devices Society

In the mid-2000s, there was a strong mandate from law makers worldwide to have open access to all publications resulting from government or publicly funded research projects to any readers around the globe irrespective of their societal membership status. In order to address this changing publications paradigm, in December 2011 AdCom in Washington D.C., the senior leadership including 2011-2012 President Renuka Jindal, Junior Past President Cor Claeys, and President-Elect Paul Yu, approved to launch an EDS open access (OA) journal and Renuka was given the responsibility to champion this Open Access idea further. Through timely effort by VP of Publications, Samar Saha in creating and presenting periodical proposals as well as guidance by ExCom members and publications EiCs, the IEEE Periodical Committee (PerCom) approved the EDS OA publication, the *Journal of Electron Devices Society* (J-EDS) in June 2012. In January 2013, the first issue of the J-EDS appeared with Renuka as the founding EiC along with *five* editors [25]. After Renuka stepped down, *Mikael Ostling* of the KTH Royal Institute of Technology, Sweden was appointed in 2017 and Mikael was replaced by *Enrico Sangiorgi* of the University of Bologna, Italy in 2020 without interruption of publication cycle and processes [7].

## 19. IEEE Journal of Flexible Electronics

In an effort to increase EDS activities in IEEE Region-7 (Canada), the *IEEE Flexible Electronics Technology Conference* (IFETC) was launched in August 2018 through the major efforts of 2016-2017 President Samar Saha, and *Gaozhi (George) Xiao* and *Ta-Ya Chu* of the National Research Council Canada, Canada. In order to complement the IFETC, BoG approved a new publication on flexible electronics at the December 2018 meeting in San Francisco. Following the approval, a proposal for *IEEE Journal on Flexible and Printed Devices* was submitted to IEEE PerCom by EDS President-elect *Meyya Meyyappan* of National Aeronautics and Space Administration (NASA), California. Coincidentally, the IEEE Sensor Council, also submitted a proposal for a *Flexible Electronics Journal on Sensors*. By the advice and effort of the IEEE PerCom, the two proposals were merged into one and approved by PerCom in 2021 creating the multi-society publication, the *IEEE Journal on Flexible Electronics* (J-FLEX) with equal financial sponsorship between EDS and Sensor Council (45% each) and 10% sponsorship by the Circuits and Systems Society. The inaugural issue was published in January 2022 with *Ravinder Dahia* of the University of Glasgow as the founding EiC. In January 2023, Paul Berger of the Ohio State University was appointed as the EiC of the IEEE J-FLEX [7], [26].

## 20. IEEE EDS Magazine

Though the Division I Circuits and Devices Magazine was unsuccessful, ExCom contemplated publishing Society's own magazine with a broad scope of publishing tutorial and review articles, reviews of new books, and so on within the EDS's Fol for the benefit of students and young professionals. In the year 2022, the publication of a Society's own magazine was finally realized through the efforts of 2020 President Meyya Meyyappan, 2021-2023 President *Ravi Todi* of Rivos, California, and VP of Publications and Products Committee (PPC) *Joachim N. Burghartz* of the Institut für Mikroelektronik Stuttgart, Germany. In the same year, the IEEE PerCom approved the publication. The first issue of the *IEEE Electron Devices Magazine* (EDM) was published in June 2023 with Joachim as the founding EiC [7], [27].

## 21. Open Journal on Immersive Displays

Under the leadership of 2021-2023 President Ravi Todi and the PPC VP *Arokia Nathan* of Darwin College, Cambridge, UK, the EDS proposal for an *Open Journal on Immersive Displays* was approved by the IEEE PerCom in November 2022. The inaugural issue is scheduled to be published on January 1, 2024 with Arokia as the founding EiC [7], [28].

## Conclusion

Since the formative years, the Society continues to launch new professional journals on diverse topical areas

of interest to its memberships as well as electron devices global community not only to satisfy their needs for publishing within the electron devices Fol but also to share their expertise with students, engineers, and researchers worldwide. Similar to journal publications, *the Society continues to diversify its conference portfolio within its Fol through sponsorship as well as co-sponsorship, which will be presented in the October 2023 issue of this Newsletter.*

## References

- [1] S.K. Saha, "A Brief History of the IEEE Electron Devices Society: Part I," *IEEE Electron Devices Newsletter*, vol. 30, no. 2, pp. 25-30, 2023. Online: [https://eds.ieee.org/images/files/newsletters/Newsletter\\_Apr23.pdf](https://eds.ieee.org/images/files/newsletters/Newsletter_Apr23.pdf).
- [2] All Issues, *Transactions of the IRE Professional Group on Electron Devices*, vol. PGED-1, pp. c1-c1, Nov., 1952. Online: <https://ieeexplore.ieee.org/xpl/issues?punumber=4639141&isnumber=31540>.
- [3] Table of contents, *Transactions of the IRE Professional Group on Electron Devices*, vol. ED-1, no. 1, pp. c1-c1, Feb., 1954. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1471805>.
- [4] Table of contents, *IRE Transactions on Electron Devices*, vol. ED-2, no. 1, pp. c1-c1, Jan., 1955. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1471914>.
- [5] All Issues, *IRE Transactions on Electron Devices*, 1955-1962. Online: <https://ieeexplore.ieee.org/xpl/issues?punumber=4639142&isnumber=31582>.
- [6] All Issues, *IEEE Transactions on Electron Devices*, 1963-present. Online: <https://xplqa30.ieee.org/xpl/issues?punumber=16&isnumber=10081247>.
- [7] IEEE EDS, "About," online: <https://eds.ieee.org/about-eds>, 2023.
- [8] G.L. Pearson and R.H. Haitz, "Foreword: Historical Notes on Important Tubes and Semiconductor Devices," *IEEE Transactions on Electron Devices*, vol. 23, no. 7, pp. 595-596, Jul., 1976. Online: <https://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=31752&punumber=16>.
- [9] S.K. Saha, *FinFET Devices for VLSI Circuits and Systems*, 1st edition, CRC Press, Taylor & Francis Group, Boca Rotan, 2020, doi: <https://doi.org/10.1201/9780429504839>.
- [10] H. Friedrich, W.F. Kosonocky, T. Sugano, "Foreword," *IEEE Transactions Electron on Devices*, vol. 26, no. 4, pp. 257-258, Apr., 1979. doi: 10.1109/T-ED.1979.19422.
- [11] IEEE EDS, "50 years of electron devices: The IEEE electron devices society and its technologies, 1952-2002," online: [https://eds.ieee.org/images/files/About/eds\\_anniversarybooklet.pdf](https://eds.ieee.org/images/files/About/eds_anniversarybooklet.pdf), 2002.
- [12] R. Kingston, G. Wade, E.L. Gordon, and A. Yariv, "Editorial," *IEEE Journal of Quantum Electronics*, vol. 1, no. 1, pp. 1-3, April 1965. Online: <https://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=23054&punumber=3>.
- [13] M.S. Adler, "Message from the outgoing president," *IEEE Electron Devices Newsletter*, vol. 1, no. 1, pp. 3-5, 1994; online: [https://eds.ieee.org/images/files/newsletter/Newsletter\\_July94\\_color.pdf](https://eds.ieee.org/images/files/newsletter/Newsletter_July94_color.pdf).
- [14] *IEEE Journal of Solid-State Circuits*, vol. SC-1, pp. f1-f1, September, 1966. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1049744>.
- [15] G.E. Smith and R.W. Dixon, "Editorial," *IEEE Electron Device Letters*, vol. 1, no. 1, pp. 1-1, Jan. 1980. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1481066>.
- [16] T.G. Giallorenzi, "Announcement," *IEEE/OSA Journal of Lightwave Technology*, vol. LT-1, no. 1, p. 1, March, 1983. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1072093>.
- [17] *Journal of Lightwave Technology*. Online: <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=50>.
- [18] *IEEE Circuits and Devices Magazine*, online: <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=101>.
- [19] *IEEE Transactions on Semiconductor Manufacturing*, vol. 1, no. 1, 1988. Online: <https://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=240&punumber=66>.
- [20] *IEEE Journal of Microelectromechanical Systems*, vol. 22, no. 2, April, 2013. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6490356>.
- [21] All Issues, *Electrochemical and Solid-State Letters*. 1998-2012. online: <https://iopscience.iop.org/journal/1944-8775>.
- [22] All Issues, *IEEE Transactions on Device and Materials Reliability*, 2002-present IEEE Xplore. Online: <https://ieeexplore.ieee.org/xpl/issues?punumber=7298&isnumber=9970744>.
- [23] R.P. Jindal, "EDS Publications Committee report," *IEEE Electron Devices Newsletter*, vol. 15, no. 2, p. 14, 2008. Online: [https://eds.ieee.org/images/files/newsletters/newsletter\\_apr08.pdf](https://eds.ieee.org/images/files/newsletters/newsletter_apr08.pdf).
- [24] R.P. Jindal, "Capturing the solar wind," *IEEE Journal of Photovoltaics*, vol. 1, no. 1, pp. 1-2, Jul., 2011. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6055242>.
- [25] R.P. Jindal, "Editorial," *IEEE Journal of Electron Devices Society*, vol. 1, no. 1, pp. 1-8, Jan., 2013. Online: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6471856>.
- [26] *IEEE Journal of Flexible Electronics*, vol. 1, no. 1, 2022. Online: <https://ieeexplore.ieee.org/xpl/issues?punumber=9552934&isnumber=10033126>.
- [27] *IEEE Electron Devices Magazine*, 2023-. Online: <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10035030>.
- [28] *IEEE Open Journal on Immersive Displays*. Online: <https://eds.ieee.org/publications/open-journal-on-immersive-displays>.

## CALL FOR NOMINATIONS—EDS BOARD OF GOVERNORS

The IEEE Electron Devices Society invites nominations for election to its Board of Governors—BoG (formerly AdCom) members-at-large. The next election will be held after the BoG meeting on Sunday, December 10, 2023. This year, eight out of the twenty-two members will be elected for a 3-year term.

A member can only serve for a maximum of two terms as a BoG member in a lifetime. Therefore, the eligibility will be verified for all nominees who will be voted on by the EDS BoG. All electees begin their term in office on January 1, 2024. The nominees need not be present to run for the election.

Any EDS member who has served for a minimum of one year as an EDS Officer, Vice-President, Standing & Technical Committee Chair/Member, Publication Editor and Chapter Chair is eligible to be nominated, unless otherwise precluded from doing so in the EDS Constitution and Bylaws. The electees are required to attend at least one BoG meeting every year. While the December meeting is organized in conjunction with the IEEE International Electron Devices Meeting,

the mid-year meeting is frequently held outside the US. Partial travel support is available to attend BoG meetings.

All nominees must be endorsed by one current BoG member, i.e., one of the four officers (President, President-Elect, Treasurer or Secretary), the Jr. or Sr. Past President or one of the 22 current BoG Members-at-Large. It is the responsibility of the nominators and the endorsers to make sure that, if elected, the nominee is willing to actively serve in the position as a BoG member-at-large. Self-nomination is acceptable.

Please submit your EDS BoG nomination by October 15, 2023 by using the online nomination form at <https://app.smartsheet.com/b/form/33efde6c279c4670ac4f276886d67491>

If you have any questions, please feel free to contact Laura Riello ([l.riello@ieee.org](mailto:l.riello@ieee.org)) with a copy to me at [cyang@scu.edu](mailto:cyang@scu.edu).

*Cary Yang*

*Chair of EDS Nominations & Elections*

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## EDS BOARD OF GOVERNORS (BoG) MEMBERS-AT-LARGE ELECTION PROCESS

The Members-at-Large (MAL) of the EDS Board of Governors (BoG) are elected for staggered 3-year terms. The EDS Constitution and Bylaws mandates the number of elected MAL to be a total of 22 members with at least two members from each of the following geographic areas: Regions 1-7 and 9; Region 8; and Region 10. Our Constitution and Bylaws also requires that at least one elected BoG member is a Young Professional (YP—formerly Gold member). A Young Professional member is defined by IEEE as a member who graduated with his/her first professional degree within the last fifteen years. It is also required that a slate of nominees for members-at-large comprising a minimum of 1.5 times the number of vacancies to occur. We also have a two-term lifetime limit for a volunteer to serve as a BoG Member-at-Large, which must be considered for nominations. All nominees will be voted on by the EDS BoG in its meeting in December 2023. All electees begin their term in office on January 1, 2024. The nominees need not be present to run for the election. In 2023, eight positions will be filled.

The election procedure begins with the announcement of Call for Nominations in the *EDS Newsletter*. The slate of nominees is developed by the EDS Nominations & Elections Committee. Nominees are asked to submit a two-page

biography and an optional 50-word personal statement in a standard format.

Any EDS member who has served for a minimum of one year as an EDS Officer, Vice-President, Standing & Technical Committee Chair/Member, Publication Editor & Chapter Chair is eligible to be nominated, unless otherwise precluded from doing so in the EDS Bylaws. All nominees must be endorsed by one BoG member, i.e., one of the four officers (President, President-Elect, Treasurer or Secretary), the Jr. or Sr. Past President or one of the 22 current BoG MAL. Self-nomination is allowed. Endorsers should submit their online endorsement form by the deadline. Please note that there is no limit to the number of candidates that a full voting BoG member can endorse.

The deadline for Nominations will be October 15, 2023. The biographies and endorsement letters will be distributed to the BoG prior to the December BoG meeting. The election will be held in-person on December 10, 2023 immediately after the BoG meeting adjourns, and the results will be announced at the BoG Award Dinner that evening.

*Cary Yang*

*Chair EDS of Nominations & Elections*



## ANNOUNCEMENT OF 2024 EDS CHAPTER SUBSIDY PROGRAM

The Electron Devices Society (EDS) is offering financial support to our chapters for serving local members through the EDS Chapter Subsidy Program for 2024.

A chapter desiring a subsidy for the upcoming year must submit a chapter subsidy request form by 1 October 2023. The request should contain a brief description of activities for which the funds will be allocated, the existing and previous sources of funding for such activities, a budget including the specific amount requested from EDS, chapter's membership growth during the past two years, and the anticipated benefits for the chapter and EDS. If the Chapter has received a subsidy in the previous two years, details of its utilization and benefits received through technical meetings, outreach programs as well as the resultant membership growth need to be highlighted.

Please note that it is imperative that all chapters submit chapter activity reports, DL feedback form and MQ feedback form since EDS will be using this information in determining the funds that chapters will receive through the EDS chapter subsidy program, EDS distinguished lecturer and mini-colloquium programs.

Activities that are considered fundable include Chapter meeting expenses, membership promotion, travel allow-

ances for invited speakers to chapter events, and support for EDS student activities at local institutions. **These activities should be focused on EDS fields of interest.**

The funded amount for each requesting EDS chapter may vary based on the Chapter size, planned activities, total available subsidy budget and the total number of requests. But the amount does not exceed \$1000 for EDS only chapters and \$500 for Chapters jointly sponsored by EDS and any other IEEE society(ies). Final decisions concerning chapter subsidies will be made by December 2023. Once the decision is made, all requesting chapters will be notified of the results by the Executive Office. The funds will be disbursed in January 2024. In some instances, the funds will need to be transferred to local Sections and in such cases the Chapters will need to work with the Sections to have access to funds.

If you would like further information on this program, please contact Stacy Lehotzky (s.lehotzky@ieee.org). On behalf of IEEE and the EDS, I would like to thank you for your time and efforts devoted to the missions of IEEE and EDS.

*Murty Polavarapu*  
*EDS Vice President of Regions/Chapters*

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## LETTER TO THE EDITOR ON CREATION OF THE EDS LOGO



Many thanks to Manoj Saxena for his idea of articles in the newsletter on the history of SSIT to celebrate the 75th anniversary of the invention of the transistor, and to Dr. Samar Saha for the very detailed and exciting Part 1 in the April Newsletter. It brought back many memories of an exciting and productive time in my life, and also reminded me of a number of excellent EDS volunteers that I had the great fortune to interact with over that time.

I thought there might be interest in the creation of the EDS logo. As I recall, this happened about the time I was coming in as EDS President. My first idea was to depict the earth (represented by a blank circle) with the path of the moon going around it, but with the moon replaced by the symbol for an electron, to demonstrate the universality of electronics. That quickly led to the electron path going through the D in the word "Devices", to demonstrate the tie into EDS (and a bit of humor).

At this point, I had made some pencil sketches, and I went to a designer in the IEEE Publications Department

to get a firm version. He chose the font for the "Electron Devices Society" lettering (an excellent choice) and filled in continents in the Earth circle to show it was Earth.

It was very good, but I realized there was a problem. At that time, there were major areas of electron devices work—North America, Europe, and Asia. I felt it was important that none were omitted from the logo because they all were critical to the field—so the designer moved the continents around to make all visible—though, in fact, there is no view of the world from space where the continents are visible as they are seen in the logo!!

Again, thanks again for a wonderful article.  
LewT.

*Lewis Terman*  
*IEEE SSIT Secretary*  
*2008 IEEE President*  
*2013-2014 IEEE Awards Board Chair*

## AWARDS AND CALLS FOR NOMINATIONS

### 2023 IEEE WILLIAM CHERRY AWARD WAS PRESENTED AT THE 50TH IEEE PVSC TO JENNY NELSON

**Jenny Nelson** is a Royal Society Research Professor based in the Physics Department at Imperial College London, where she researches novel materials for solar energy conversion. She holds degrees in physics from Cambridge and Bristol Universities. She started research into photovoltaic materials in 1989 when she joined Imperial as a post-doc to study III-V semiconductor heterostructures for use in solar cells. She moved on to investigate the electronic and optical properties of dye-sensitized solar cells when an EPSRC Advanced Fellow, and later to explore organic semiconductors and solar cells. Her consistent goal has been to understand how the different material systems and device architectures achieve photovoltaic action, and how performance can be optimized. Her current research is focused on understanding structure-property relationships in molecular and hybrid semiconductor materials and how these relationships influence the mechanisms of solar energy conversion. This work combines basic experimental (electrical, spectroscopic and structural) measurements with simulation of materials and devices. She also works with the Grantham Institute for Climate Change at Imperial to evaluate the carbon emissions mitigation potential of renewable energy technologies. She is an ISI Highly Cited Researcher and has published over 300 articles, several book chapters, and a book on the physics of solar cells. She has received several awards including the 2009 Joule Medal and 2016 Faraday Medal from the Institute of Physics and the 2012 Royal Society Armourers and Braziers Company prize. She was elected as a Fellow of the Royal Society in 2014 and an Honorary Fellow of the Institute of Physics in 2021.



*Image: (left to right) Conference Chair Mariana Bertoni, IEEE EDS President Ravi Todt, IEEE William Cherry Award winner Jenny Nelson, Christiana Honsberg, and Program Chair Jeremiah McNatt.*

#### About the Award

This award is named in honor of William R. Cherry, a founder of the photovoltaic community. In the 1950's, he was instrumental in establishing solar cells as the ideal power source for space satellites and for recognizing, advocating, and nurturing the use of photovoltaic systems for terrestrial applications. The William R. Cherry award was instituted in 1980, shortly after his death. The purpose of the award is to recognize an individual engineer or scientist who devoted a part of their professional life to the advancement of the science and technology of photovoltaic energy conversion. The nominee must have made significant contributions to the science and/or technology of PV energy conversion, with dissemination by substantial publications and presentations. Professional society activities, promotional and/or organizational efforts and achievements are not considerations in the election for the award.

## 2023 EDS Chapter of the Year Award — Call for Nominations

The IEEE EDS Chapter of the Year Award is given each year based on the quantity and quality of the activities and programs implemented by the chapters during the prior July 1st – June 30th period (for 2023 activities and programs between July 1, 2022 and June 30, 2023). Virtual events can also be included.

EDS recently revised our Chapter of the Year Award to award one non-student chapter and one student chapter in any geographic location.

Nominations for the awards can only be made by Regions/Chapters Committee Members, SRC Chairs/Vice-Chairs, or self-nominated by Chapter Chairs. Please visit the EDS website to submit your nomination form (<https://ieeeforms.wufoo.com/forms/eds-chapter-of-the-year-award-nomination-form/>).

Each year each winning chapter (maximum 2) will receive a plaque and check for \$500 to be presented at an EDS chapter meeting of their choice. Travel reimbursement will not be provided. A chapter that has previously received the Chapter of the Year Award is eligible for re-nomination only after three years from the year of previous award.

The schedule for the award process is as follows:

Action	Date
Call for nominations e-mailed to chapter chairs, SRC Chairs, SRC Vice-Chairs and Regions/Chapters Committee	August
Deadline for nominations	September 29th
Regions/Chapters Committee selects winners	October
Award presented to chapter representative at requested chapter meeting	December



# WOMEN IN ENGINEERING

## A PERSONAL HISTORY WITH VACUUM ELECTRONICS AND GYROTRONS

By MONICA BLANK

It is both a privilege and a pleasure to have the opportunity to contribute to the Women in Engineering series. My education and career journeys have been fairly straightforward, marked by a lot of good fortune, and I have been in the field of electrical engineering and, specifically, vacuum electronics, for a very long time now. Anyone who knew me as a teenager would be stunned and full of questions upon learning that I have chosen a career in science and engineering. I don't think I was necessarily weak in math or science as a high school student, but I was certainly much more interested in literature, history, foreign languages, and humanities. However, in the early 1980s, as I was finishing high school, the US economy wasn't in good shape and unemployment was historically high. Being very practical even at such a young age, I decided that engineering would be a good subject to study since the job prospects were strong even in a weak economy. So, I chose electrical engineering and I have never once regretted that decision.

I earned my Bachelor's degree at The Catholic University of America (CUA), a school better known for acting and opera than engineering. Despite the fact that not everyone considers CUA the most prestigious engineering school in the US, where I got an excellent education that carried me through the rest of my schooling and career very nicely. At CUA, the curriculum was comprehensive, practical, and taught by some extremely smart and dedicated professors, many of whom had worked in the industry for a long time. It was there that I came to the realization that electromagnetics was what interested me most.

With my solid foundation from CUA, I went on to MIT for MS and Ph.D. degrees in electrical engineering. In the biggest stroke of luck that ever befell me, I landed in a group working on a somewhat obscure version of a vacuum electron device, the gyrotron, at what was then called the MIT Plasma Fusion Center. In the Beams and Waves Division, I learned everything I know today from my thesis supervisor, the staff scientists, and the other students, and I consider that group to hold some of the smartest and most interesting people with whom I have ever been associated. Following the examples of those

I worked with, I learned much more than just how to design and build a gyrotron. In the gyrotron group, I learned how to be a scientist; how to break down and tackle a problem; how to measure, record, and analyze complex data; how to keep working productively and in a positive direction even when nothing made sense; and especially how to stay focused and persistent while working on difficult tasks. And of course, I also learned how to design and build a gyrotron. The late 1980s and early 1990s was an important era of advancement in the history of gyrotron, as new enabling technologies, including large-bore high-field superconducting magnets, advanced mode converters for the high-order-modes employed in modern gyrotron, and synthetic diamond windows were becoming widely available. At MIT, even as a student, I was able to make small, but I hope important, contributions to the field at this exciting and transitional stage in the gyrotron's life.

After finishing my Ph.D., I got very lucky again in landing a job at the Naval Research

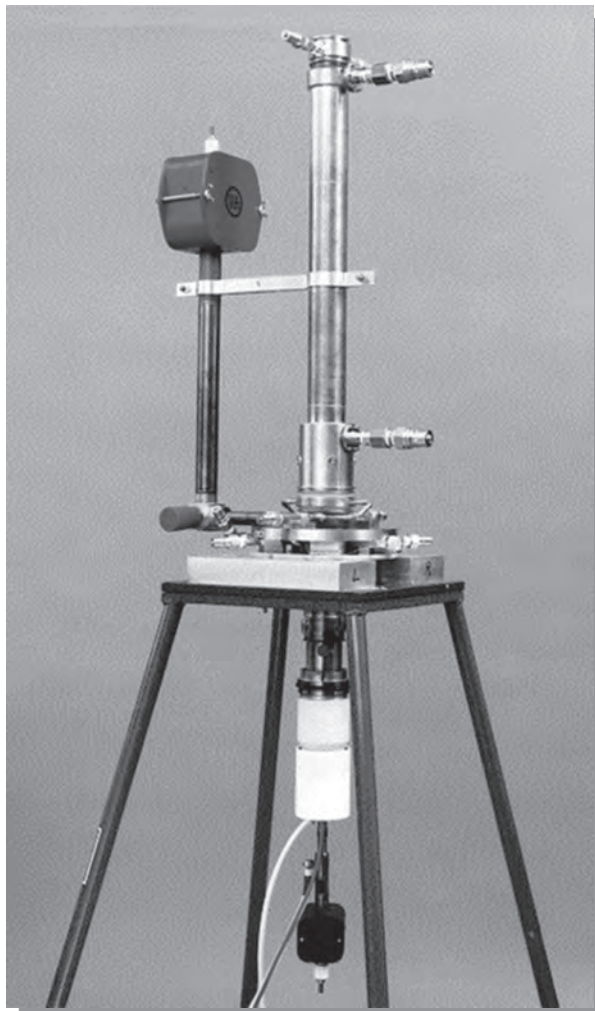


Figure 1. A 94 GHz, 100 kW peak power, and 10 kW average power gyro klystron amplifier for radar applications developed by an NRL-led team of which I was a member in the late 1990s and early 2000s.

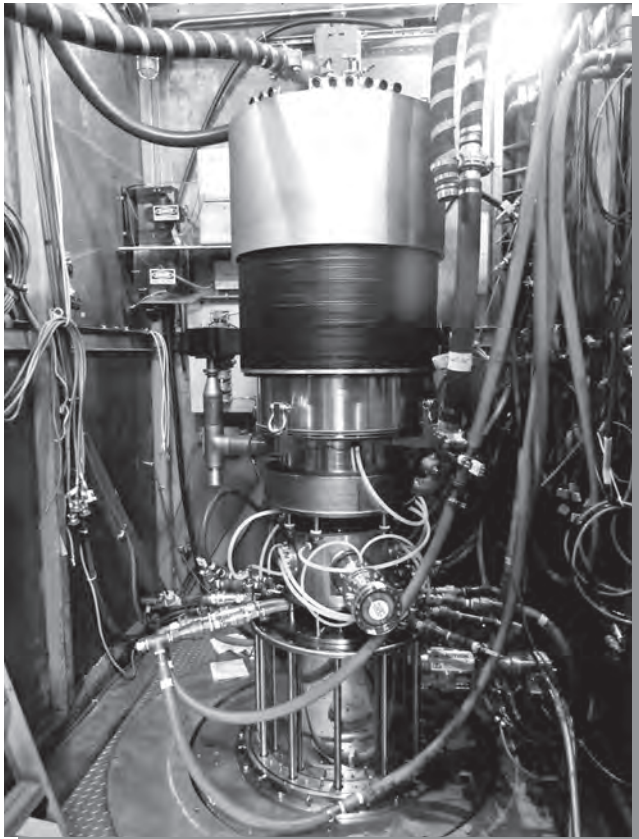


Figure 2. A recently developed 110 GHz, 1 MW gyrotron oscillator for electron cyclotron resonance heating of fusion plasmas in test at CPI.

Laboratory (NRL) where groundbreaking work on gyrotron amplifiers for radar applications was being carried out. In a short number of years, the gyrotron amplifier team at NRL, another group of outstanding scientists and engineers, was able to design, build, and test several millimeter wave devices that, at the time, were amongst the most advanced ever demonstrated. One of the gyro klystron amplifiers developed by the team during my tenure at NRL, a 10 kW average power 100 kW peak power 94 GHz device, is shown in Fig. 1.

The work at NRL was interesting and challenging, and I'll always admit my success there was mostly the result of being in the right place at the right time. Eventually, after spending nearly two full-time years at the facility of NRL's industrial partner where some of the devices we designed were built and tested, I made the jump to actually work for Communications and Power Industries (CPI) and I have been here ever since. I can truthfully say that, once again, I found my way into a small group of extraordinary scientists and engineers, with whom I have had the pleasure of working for nearly 25 years now. Our group develops, among other things, ever more advanced megawatt power level gyrotron in the 100–200 GHz range for fusion heating, millimeter wave gyrotron for non-lethal weapons, gyrotron amplifiers for radar, and recently, very high-frequency gyrotron for

nuclear magnetic resonance enhancement. Figure 2 shows a photo of a recently developed 110 GHz, 1 MW power level, long-pulse gyrotron oscillator for fusion applications during a demonstration at CPI.

Fortunately for us, there are, it often seems, an infinite number of gyrotron physics problems to solve as well as increasingly ambitious and exacting specifications and demands on gyrotron from system developers. Thus, I am confident I can finish out my career as I started 35 years ago, chipping away at the challenges presented by modern-day gyrotrons and doing my best to contribute to the advancing state-of-the-art in the field of vacuum electronics.

I am not sure that I am successful enough for anybody to want advice from me, but if I was to give it, my advice would be to take advantage of as many professional opportunities as possible. Sometimes these opportunities may feel like hardships, but I would still recommend volunteering and participating whenever an invitation to run for a position on an IEEE technical committee, or to sit on a panel to review a program, or serve as a conference chair comes your way. I have found that if I can overcome my natural instincts to say no and agree to such a request, the rewards of taking part in these community activities nearly always outweigh the burdens by many orders of magnitude, and I recommend that everybody take on as many of these extracurricular roles and functions as possible.



**Monica Blank** received a B.S. degree (Electrical Engineering) from the Catholic University of America, Washington, D.C. in 1988, and her M.S. and Ph.D. degrees (Electrical Engineering) in 1991 and 1994, respectively, from the Massachusetts Institute of Technology, Cambridge, MA. In 1994 she joined the Vacuum Electronics

Branch of the Naval Research Laboratory, where she was responsible for the design and demonstration of high-power millimeter wave vacuum electronic devices for radar applications. Since 1999, she has been a member of the gyrotron team at Communications and Power Industries (formerly Varian) where she continues her work on high-frequency gyrotron amplifiers and oscillators. Dr. Blank is an IEEE Fellow and has received several professional awards, including the 1998 Alan Berman Publication Award at Naval Research Laboratory, the Robert L. Woods Award for Excellence Vacuum Electronics Technology in 1999, an R&D 100 Award in 2015, and the 2020 IEEE Plasma Science and Application Award. She is currently an Associate Editor for the IEEE Transactions on Electron Devices and the chair of the IEEE Electron Device Society Vacuum Electronics Technical Committee. Dr. Blank has previously served several terms on IEEE Plasma Science and Applications Executive Committee, served one term on the IEEE Nuclear and Plasma Sciences Society Administrative Committee, and was a Senior Editor for the IEEE Transactions on Plasma Science from 2009–2015.



# SSCS WiC AND EDS WiEDS DIVERSITY PANEL LUNCHEON

*"How Does Diversity Impact Productivity in Your Organization?"*

By P. SUSTHITHA MENON, N V VISVANATHAN, PEI-WEN LI, AND KAZUKO NISHIMURA

The 2023 Symposium on VLSI Technology and Circuits sponsored by Japan Society of Applied Physics, IEEE Electron Devices Society (EDS), and IEEE Solid-State Circuits Society was held at RIHGA Royal Hotel Kyoto, Kyoto, Japan from 11–16 June 11–16. During the conference, the Diversity Panel Luncheon (co-sponsored by SSCS WiC & WiEDS) with the thematic of "How Does Diversity Impact Productivity in Your Organization?" was held on June 13th. It was moderated by SSCS WiC committee members, Kazuko Nishimura and Farhana Sheikh. A total of 40 attendees were there to hear the insights from outstanding panelists from the academic and semiconductor industry: Pei-Wen Li (National Yang Ming Chiao Tung University), Kentaro Yoshioka (Keio University), Alvin Loke (NXP Semiconductors), and Zeynep Toprak Deniz (IBM T. J. Watson Research Center). They all unanimously agreed that an organization with high monotonicity is easier for management

and making quick, near-term progress, whereas diversity requires more inclusive management and mutual understanding between members and will definitely create long term impactful profit. Diversity is not limited to gender, but also includes nationality, expertise, and mindset. You will get better nutrition when you embrace diversity. "Top-down" strategy is key to fostering an inclusive and diverse culture/environment in organization and in daily life. They shared the strategy deployment of their organizations and how the ambience of their working environment influence their productivity. The session was remarkable because of active participation by the senior semiconductor professionals and international students who were able to interact freely and share their insights/experiences for well over an hour on topics such as bridging the divide, understanding local cultures, fostering the inclusive mindset and most importantly, how to embrace diversity.

## Diversity Panel Luncheon

2023 Symposium on VLSI Technology and Circuits  
13 June 2023, 12:00-14:00, Kyoto, Japan







### Diversity Panel Luncheon: How Does Diversity Impact Productivity in Your Organization

An exciting panel discussion on how diversity has positively impacted product innovation, execution, and quality in corporations. In the case of academia, we ask our panelists how diversity has impacted research output and innovation.

We also encourage audience participation and bring their diversity success stories to share with the panel and attendees.

**Tuesday, 13-June**  
**Time: 12:00 to 14:00**

**All are welcome!**  
**Registration is required.**








# EDS YOUNG PROFESSIONALS

## INTERVIEW WITH DR. GIRISH PAHWA

The Young Professional guest in this issue of the Newsletter is Girish Pahwa, IEEE Electron Devices Society's 2022 Early Career Award winner and is an assistant professional researcher in the Department of Electrical Engineering and Computer Sciences (EECS) at the University of California (UC) Berkeley. His perceptions about EDS and views regarding professional development and career growth are reflected in the discussion. Here are the excerpts of the interview made by Manoj Saxena, the Newsletter Associate Editor-in-Chief, with Girish Pahwa.

**Manoj Saxena (MS):** What was the specific temptation, if any, which made you join EDS which is the largest professional organization in the globe, at first?

**Girish Pahwa (GP):** During my Ph.D., I learned about Transactions on Electron Devices and Electron Device Letters, two of the most prestigious journals in which semiconductor experts would publish. I was also introduced to the IEDM as one of the biggest conferences of our profession by my Ph.D. supervisor. I found out all of these were associated with a society called EDS and several prominent researchers were already a part of this. Another notable event at that time was the EDS Early Career Award which was presented to a professor from India for the first time. I decided to explore the EDS and got to know about its multiple perks, such as chapter activities, access to journals, and discounts at conferences, among others. This is why I decided to become a member of the ED community.

**MS:** You won the prestigious EDS Early Career Award, an honor most young professionals aspire. How do you consider this recognition and what are your plans to further develop your research career?

**AD:** I've seen some of the most recognized young researchers in the semiconductor field get this award, and being one of the EDS Early Career Award recipients is truly an honor. This award has been extremely motivating, and it will significantly increase the visibility and reach of my work. With a focus on upcoming and emerging semiconductor technologies, I work in the areas of device modeling, simulation, and device-circuit co-optimization. I will continue to research cryogenic CMOS operations for quantum computing and cold electronics applications, ferroelectric devices for computing and memory, high voltage devices



2022 IEEE EDS Early Career Award Winner  
Department of Electrical Engineering and Computer Sciences,  
University of California, Berkeley.

for the automotive sector, and industry-standard models of Gate-all-around, FinFET, and FDSOI technologies. I've recently begun investigating the oxide semiconductor-based thin film transistors as well, which are widely used for display applications and are now being explored for their integration in the 3D back end of the line.

**MS:** As a Young Professional, how do you position your interest in your own field with the activities and services you perform as an EDS member/volunteer?

**AD:** My scientific interests match closely with those of the EDS. I publish extensively in EDS journals and conferences and regularly review articles for these journals. Lately, I was invited to multiple EDS webinars as well as a panel discussion, which provided me with opportunities

to display and discuss my research work as well as share my perspectives with professionals from academia and industry. I've also volunteered to help organize EDS short courses on device modeling and simulation.

**MS:** What are your thoughts about the EDS membership and its paybacks? Whether the EDS membership benefited you at any time in your career growth? If so, how?

**AD:** The EDS membership has been beneficial to me in different ways. The EDS conferences have given me several networking opportunities to engage with eminent academic and industrial individuals from across the world. The EDS publications, lectures, and webinars have also been quite educational and have helped me understand many research areas well. As I mentioned earlier, this membership also allows you access to EDS publications and discounts at conferences that cover a wide variety of topics from semiconductor technology, device physics and modeling, and reliability to photovoltaics. For local support and networking, EDS has regional chapter communities and activities one can participate in. EDS also has several technical committees to ensure the coverage and development of all its research areas.

**MS:** As a YP, how do you consider the ED Society as a whole and what are the changes or developments you would like to see in evolving this professional body as a group devoted to humanity and its causes?

**AD:** The ED society has been doing an excellent job of bringing together researchers worldwide through its various chapters and programs. One EDS initiative I'd like to mention is the EDS podcasts with semiconductor luminaries, which I listen to regularly and really enjoy. I would recommend that EDS produce more similar podcasts in the future and broaden this program to cover more areas of interest.

**MS:** What are your suggestions and recommendations for those young professionals who may aspire to join EDS?

**AD:** EDS without a doubt is a great supportive society to join and has so much to offer to its members. I strongly recommend all the young professionals working in electron devices and related fields join EDS.

**MS:** As an EDS Young Professional and a young researcher in the field, how do you consider the prospects of sci-

entific research in this field for the progress of Humanity as a whole?

**AD:** EDS since its inception has played a key role in shaping the semiconductor innovations that have immensely benefited humanity. In the coming years, I see huge prospects for scientific research in electron device domains as we adopt more and more artificial intelligence-based solutions to various applications, which will require unprecedented global demand for more powerful computing and memory resources. As a result, several novel computing and memory technologies are emerging, non-von Neumann architectures are being investigated, and quantum algorithms are now being analyzed. The semiconductor industry has already started chip production with the Gate-all-around technology, marking yet another significant milestone since the launch of FinFETs in 2014. So, there is a lot to contribute to the research on electron devices, which will have profound economic and social implications.

**Girish Pahwa** is an assistant professional researcher in the Department of Electrical Engineering and Computer Sciences (EECS) at the University of California (UC) Berkeley. He is also the executive director of the Berkeley Device Modeling Center (BDMC) at UC Berkeley where he advances the BSIM (Berkeley Short Channel IGFET model) suite of compact models as the industry standard models for the design technology co-optimization of upcoming and emerging technologies. He has developed the first industry-standard cryogenic FinFET and FDSOI models for the CMOS control ICs used in quantum computing applications. He has also contributed extensively to the physics and modeling of ferroelectric devices, and the development of the industry-standard BSIM high-voltage MOSFET model. Girish is a member of the IEEE and the EDS and serves as a reviewer of several journals. He has over 50 technical publications in prominent journals and conferences. He received the outstanding Ph.D. thesis award from IIT Kanpur in 2020 for his contributions to ferroelectric-based transistors. He also received the best paper award at the IEEE International Conference on Emerging Electronics (ICEE), Mumbai, India, in 2016. Girish received his Ph.D. and master's Degrees in Electrical Engineering from the Indian Institute of Technology (IIT) Kanpur in 2020, and his B.Tech. Degree in Electronics and Communication Engineering from Delhi Technological University in 2014. He also worked as a post-doctoral scholar at the Department of EECS, UC Berkeley, and as the manager of the BDMC.

## POST-PANDEMIC STEM ROBO PROJECT FOR SECONDARY SCHOOL STUDENTS IN WEST JAVA, INDONESIA

By BASUKI R ALAM

Prof. Budi Mulyanti, a member of the ED Indonesia Chapter, led a team to conduct workshop camps on STEM post-pandemic Robo projects for middle, high, and vocational school students in West Java. The primary focus of the STEM projects is to trigger students' creativity, critical thinking, and problem-solving skills in developing solutions for the COVID-19 pandemic by utilizing robots controlled by Arduino Uno processor modules. The post-pandemic Robo workshop camps involve collaboration among schools, parents, and the university community. The Robo camp utilized Arduino Uno processor modules and 4Dframes as media to create post-pandemic robots. A total of 630 students from 6 middle schools, 510 students from 5 high schools, and 556 students from 5 vocational high schools in Bandung, its surrounding rural areas, and satellite cities, participated in the Robotics project camps in their own schools. The students collaborated in groups to assemble their robot project using modular 4Dframes controlled by Arduino-Uno modules after receiving theoretical and hands-on lectures from assigned tutors and designated faculties of Pedagogical University of Indonesia (UPI).

The student's programs for controlling the robots were uploaded under the supervision of their tutors, faculty members, or expert technicians of the Robo project. The tutor team includes five IEEE EDS members, namely Prof. Budi Mulyanti, Dr. Roer Eka Pawianto, Dr. Arjuni Budi Pancawati, Dr. Lilik Hasanah, and Dr. Wawan Purnama, and five student members of the Student Branch.



*Students of State High School 3 of Sumedang, West Java with their robot creation and tutors.*



*Students of State Middle School 2 of Padalarang, West Java with their robot creation and Prof Budi Mulyanti.*

~Sharma Rao Balakrishnan, Editor



## CHAPTER NEWS



### IEEE DAYTON SECTION STEM EVENT AT VERSAILLES HIGH SCHOOL

By AHMAD E. ISLAM

Microelectronics has recently drawn significant interest around the world. Although the technology has been evolving over the last five decades, the ever-increasing demand for inexpensive and lightweight equipment with a higher percentage of electronic components has recently pushed the microelectronics industry to scale up production. This is resonated in the signing of multiple legislations around the globe to increase microfabrication and has resulted in a higher demand for the workforce experienced with microfabrication. The workforce on microfabrication is however limited, as students are more interested in pursuing careers in computer science, artificial intelligence, robotics, bioscience, etc.

To encourage students in pursuing careers in microfabrication, the IEEE Dayton Section from IEEE Region 2 organized a two-day STEM event on "Introduction to Microfabrication—the enabler for Microelectronics" at Versailles High School, Versailles, Ohio, on 1 December 2022 and on 10 March 2023. These events were sponsored by IEEE EDS, were organized by Dr. Ahmad Ehteshamul Islam of Air Force Research Laboratory (AFRL)—Sensors Directorate, and hosted by the science teachers Mrs. Margie Treon and Mrs. Jenny Stammen at Versailles. These two events were

attended by ~110 and ~60 junior and senior level high school students. The speakers for these events were Dr. Katherine Burzynski (from AFRL), IEEE Dayton Section Chair Dr. Charles Cerny (from AFRL), Dr. Islam, Prof. Guru Subramanyam (from the University of Dayton), Prof. Weisong Wang (from the Wright State University) and Versailles 2020 Alumni Mr. Alexander Grilliot (from the Wright State University). The speakers provided an introduction to semiconductor, microelectronics, and microfabrication and also highlighted the national and local efforts in enhancing microelectronics awareness. The speakers additionally demonstrated different steps of microelectronics device design and microfabrication that enables us to enjoy the benefit of microelectronics in everyday life. The speakers plan to organize similar events at Versailles every year and also plan to repeat these activities in other Dayton, Ohio area high schools.

The speakers Dr. Ahmad Ehteshamul Islam (Back, right) and Prof. Weisong Wang (Back, left), the hosts Mrs. Margie Treon and Mrs. Jenny Stammen (holding the event banner in the back, right and left, respectively) and the attendees during the STEM event titled "Introduction to Microfabrication—the enabler for Microelectronics" that took place on 10 March 2023 at Versailles High School, Versailles, OH, United States.



Participants of IEEE program at Versailles High School, Ohio, USA.



# BASIC HANDS-ON TRAINING OF SCHOOL CHILDREN IN ELECTRONICS—SEEKHOTRONICS

PROJECT OF IEEE EDS KANPUR CHAPTER

By S. SUNDAR KUMAR IYER

Building actual physical circuits goes a long way in learning electronics and appreciating its beauty and nuances. However, due to lack of facilities and resources (funds and time), electronics often remains a theoretical exercise. With the development of inks for pens that can trace conducting and insulating lines on paper, the task of wiring and building circuits can become simpler and easier to implement. At the National Centre for Flexible Electronics (FlexE Centre at IIT Kanpur), safe and fast drying inks for conducting and insulating inks have been developed (<http://www.ncflexe.in/functional-inks.php>). Based on these, an electronics training kit has been developed and workshops to help children learn the basics of electronics are conducted. A start-up that came out of the FlexE Centre, called Likhtronics (a portmanteau of 'likho' that means 'write' in Hindi and some other Indian languages, and 'tronics' from electronics), has been spearheading these efforts (<https://www.iitk.ac.in/flexe/likhotronics/>). Dr. Sudheendra Rao from Likhtronics and his colleagues offer courses for school children, in Kanpur and cities nearby. The courses are called Seekhotronics (another portmanteau—of 'seekho' that means 'learn' in Hindi and 'tronics') and the kit is called Seekho-Cirkit.

The schools that requested Likhtronics to conduct courses in the past were typically financially well off. For poorer schools, even if there was intent to conduct such courses, it was always lower in priority due to the cost of conducting the course. Hence, late last year, on encouragement from Prof. Navakanta Bhat, Vice President of EDS Education Activity Committee, a proposal was submitted by the Kanpur EDS Chapter to offer Seekhotronics training courses to some of the less privileged schools around IIT Kanpur. It was also proposed to provide a set of Seekho-Cirkit training kits to the schools so that the teachers in the school could use them to continue to train other children as well.

The training sessions in four schools were conducted in November and December, 2023. The content of the hands-on course and the training were prepared and conducted by Dr. Sudheendra Rao and his team members from Likhtronics.

Four schools in the vicinity of IIT Kanpur were selected for the training—(i) Swami Vivekananda Vidyalaya located at Lodhar village (SVV); (ii) Opportunity School located within IIT Kanpur (OSIIT); (iii) Vinyaas Public School in Amiliha (VPS); and (iv) Asha Trust Kanpur Chapter in



Students, teachers, and trainers at ATKC during the final concluding session on 25 Dec. 2022.



*Training sessions in two different schools.*

Tatiyagunj (ATKC). The first and second schools have children from underprivileged sections of the community in the area. The third school has children representing diverse economic backgrounds. The last one is a resource centre and a hostel for children of migrant labourers who work in brick-kilns around that area. These children are first generation literates. None of the schools have significant, if any, electronics training facilities.

The schools when contacted were willing to facilitate the training for their students. The school principal and teachers were requested to help identify students who could participate in the training programme. The students were chosen from those studying in class 6 and above. They were selected based on some objective measurable academic criteria, while ensuring diversity in the background of the students. A total of at least six sessions were planned at each school between 19 November 2022 and 27 December 2022. The specific dates were chosen for each school depending on the individual school timetable, while working around specific pre-planned school events.

The training sessions were conducted as per the schedule planned with the schools and were received enthusiastically by the students and teachers. During the course, the students were provided with (i) basics of electronics; (ii) concepts of resistors and use of multimeter; (iii) LEDs

and the circuit to power it up; (iv) series and parallel circuits; and (v) sensors used in electronics. In the final session of the course in each school, the students built a “robotic bug”. There was enthusiasm among the students during the hands-on training. The joy and satisfaction among the participating students when the “robotic-bug” that they built hopped around, was palpable.

Following the training sessions, 10 kits were handed over to each school principal to be passed on to the science teachers who were present during the training sessions. The teachers were happy to receive the kit as it would be useful for them in the future to help the students to learn basic concepts of electronics.

We thank IEEE EDS for supporting this initiative to expose children in the four schools to the excitement of electronics. It is all the more valuable since most of the children who benefitted (and are likely to continue to benefit from the donated kits) might never have had the chance otherwise to build actual electronic circuits and systems. We are thankful to Prof. Navakanta Bhat for envisioning the project and guiding us in planning it at the conceptual level. The prompt support and encouragement of the IEEE EDS chapter, especially Prof. Yogesh Singh Chauhan, in operating the project at the chapter level, is gratefully acknowledged.



*Circuits built with conductive pens and components on paper with guiding diagrams (left); Robotic bugs built by students moving in a line (right).*

# REPORTS ON ANNUAL MEETINGS OF EDS JAPAN AND THE EDS KANSAI CHAPTERS

## ED Japan Joint Chapter

—by Nobuyuki Sugii and Naoki Watanabe

On 16 February 2023, the annual meeting of the EDS Japan Joint Chapter was held in a hybrid style, at the University of Tokyo and via Webex. Dr. Nobuyuki Sugii, the Chair of the Japan Joint Chapter, and Prof. Tetsu Tanaka, the Vice-Chair, reported on summaries of 2022 activities and plans for 2023 of the Chapter. After the meeting, the 2022 EDS Japan Joint Chapter Student Award (VLSI 2022 & IEDM 2022) was presented to four students. The students made excellent presentations at the VLSI Symposium 2022 and IEDM 2022. The list of award winners was posted on the Japan Joint Chapter's

webpage ([http://www.ieee-jp.org/japancouncil/chapter/ED-15/ed15\\_award-e.htm](http://www.ieee-jp.org/japancouncil/chapter/ED-15/ed15_award-e.htm)).

## EDS Kansai Chapter

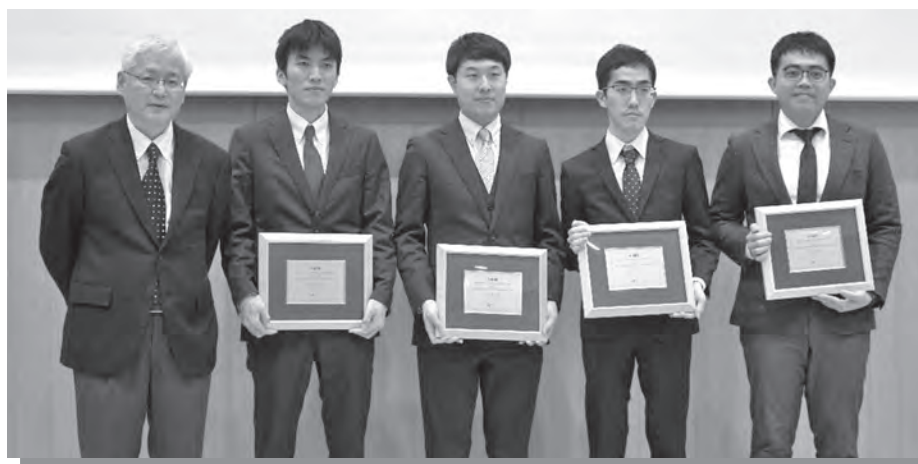
—by Tokiyoshi Matsuda

### The Annual General Meeting

The annual general meeting of the EDS Kansai Chapter (EDSK) was held on 12 January 2023. At this meeting, the list of new officers of the chapter, including Chair, Vice Chair, Secretary, and Treasurer) was announced. Several chairs of Committees were also assigned, including the new members of the chapter. Also, we reviewed the chapter activities of 2022 and discussed the activity plans for 2023. A total of 27 EDSK members joined this online meeting.

### Upcoming Events

Three technical meetings are planned for the year 2023. First, the round table meeting will be held in Spring, organized by the EDSK Industry Committee. The EDSK Education Committee is also planning to hold a Distinguished Lecture. Last, IMFEDK 2023 (The 2023 International Meeting for Future of Electron Devices, Kansai) will be held on 14–17 November 2023. (<https://www.ieee-jp.org/section/kansai/chapter/eds/imfedk/>)



21st EDS Japan Joint Chapter Student Award winners, together with Dr. Nobuyuki Sugii, the Chair, on 16 February 2023, Tokyo.



# REGIONAL NEWS

## USA & CANADA (REGIONS 1-6 & 7)

### World Changing Materials & Technologies

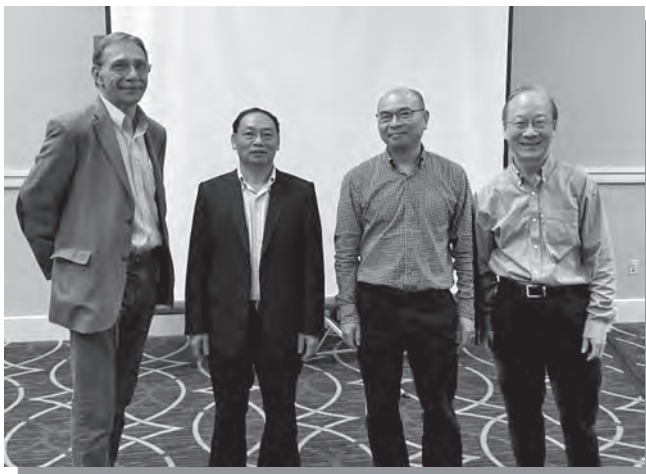
#### Electron Devices & Solid-State Circuits Baltimore/ Washington Chapter Meeting

—by Paul A. Potyraj

The Baltimore Chapter of Electron Devices and Solid-State Circuits and the recently-reformed Washington/Northern Virginia Chapter of Electron Devices, Solid State Circuits, and Electronic Packaging collaborated to host their first technical seminar of 2023.

Chapter leadership opted for an in-person meeting to facilitate personal networking and break free of the pandemic-induced isolation, and opted out of a hybrid meeting since that makes defaulting to remote participation too tempting. The in-person format presented multiple challenges -- in addition to the struggle of encouraging live attendance in the post-pandemic world, chapter officers had to find a new venue since their original meeting site (the National Electronics Museum), which the Baltimore chapter had used since it was founded in 1998, was forced to relocate last year.

The presenter for the evening was Dr. Zhifeng Ren of the Texas Center for Superconductivity at the University of Houston. Dr. Ren addressed a collection of topics on materials and technologies with world-changing potential: Thermoelectric Materials, wide-bandgap Boron Arsenide (BAs), and a novel take on Superconductor Levitation.



From left: Baltimore Chair Dr. Paul Potyraj, Guest Speaker Dr. Zhifeng Ren, Washington / Northern Virginia Chair Dr. Tony Guo, and Baltimore Vice-Chair and event organizer Dr. Richard Fu.

Additional information on the speaker and his talk can be found on vTools (<https://events.vtools.ieee.org/m/350779>).

The meeting was held on 5 April, from 5:30 PM to 7:30 PM EST. Light refreshments were served since the meeting was held during dinner hours. Twenty-seven attendees from local industry and academia made for lively discussion after the seminar. A meeting room at the Sheraton hotel near the BWI airport comfortably accommodated all attendees.

~Michael Adachi, Editor

#### ED Santa Clara Valley and San Francisco Joint Chapter (SCV/SF)

—by Imran Bashir

The IEEE Electron Devices Society (EDS) San Francisco / Santa Clara Valley joint Chapter held its first webinar of 2023 on January 27th with Dr. Youseung Lee who is currently a Postdoctoral Researcher at Nano-TCAD group of Integrated Systems Laboratory, ETH Zürich, Switzerland. The lecture titled "Atomistic Quantum Transport Modeling for Emergent 2D Material-based Device" described the latest development of Non-Equilibrium Green's Function (NEGF) formalism to model various emerging 2D materials-based devices such as tungsten disulfide,  $WS_2$ , and molybdenum disulfide,  $MoS_2$ . The total attendance for the event was 19.

The IEEE EDS SCV/SF Mini-Colloquium hybrid event was held on Friday, 24 March in the Engineering Building at San Jose State University (SJSU). The first speaker was Dr. Debbie G. Senesky who is an associate professor at Stanford University and the principal investigator of the



IEEE EDS SCV/SF Mini-Colloquium hybrid event in the Engineering Building at San Jose State University.



EXtreme Environment Microsystems Laboratory (XLab). In her presentation titled, "Semiconductors in Extreme Environments," Dr. Senesky discussed the benefits of Gallium nitride's (GaN) two-dimensional electron gas (2DEG) over silicon's p-n junction for space exploration applications in terms of tolerance to radiation and extreme temperatures. The second speaker of the event was Prof. Tsu-Jae King Liu who is the Dean of the College of Engineering at the University of California, Berkeley. In her lecture, "Sustaining the AI Revolution: Transistor Scaling and Beyond" Dr. Liu described three dimensions of IC technology advancement, namely, transistor scaling, new computing architectures and new computing paradigms to usher in the Age of Ambient Intelligence. The third speaker of the event was Dr. Lou N. Hutter who is the Principal of Lou Hutter Consulting LLC. Dr. Hutter detailed the evolution of analog technology from the 1970s to today and beyond, highlighting the many design constraints that have led to the diverse technology portfolio and rich component sets used today. The event attracted great interest from people in industry, academia and especially the IEEE Student Branch at SJSU bringing the total attendance for the event to 79.

Please visit our website @ <https://site.ieee.org/scv-eds/> and join the email list to receive notification of future events and instructions on joining remotely through Zoom.

*~Lawrence Larson, Editor*

## EUROPE, MIDDLE EAST & AFRICA (REGION 8)

### Symposium on Schottky Barrier MOS Devices 2023

*—by Mike Schwarz*

Researchers, scientists and young professionals are welcome to join the seventh Symposium on Schottky Barrier MOS devices.

The first meeting was held in the summer of 2016. It was a spontaneous workshop organized by Mike Schwarz, this time being part of Robert Bosch GmbH, who met Tillmann Krauss, being part of TU Darmstadt and John P. Snyder from JCap, LLC. They discussed the challenges, benefits and possible future projects of these devices. In the meantime, Laurie Calvet and Alexander Kloes joined the organization team and the workshop was established. It moves from year to year to different locations in Europe and combines in general different aspects/focus of SB devices.

This year the joint R&D chapter event will be held from 28-29 September. It is sponsored by the École Polytechnique, Institut Polytechnique de Paris and the IEEE EDS

France and Germany Chapters, and organized by Dr. Laurie Calvet, Dr. Denis Tondelier and Prof. Yvan Bonnassieux (École Polytechnique, Institut Polytechnique de Paris, France), Prof. Mike Schwarz and Prof. Alexander Kloes (NanoPTHM, Germany).

The Symposium on Schottky Barrier MOS devices is free, no fees are required. The attendance does not include accommodation and transport. The registration takes place by the vTools of IEEE. The following link is provided: <https://events.vtools.ieee.org/m/353459>

For further information see: <http://ssbmos.blogspot.com>

### Celebration of 75 Years of Invention of Transistor at the University of Bologna

*—By Susanna Reggiani*

On 26 April 2023, the day after the Marconi Day celebrations, a technical meeting took place at the University of Bologna, organized by the ARCES Research Center and IEEE EDS Italy Chapter. The EDS Eminent Lecturer Prof. Hiroshi Iwai was invited to join the event and deliver a lecture on the invention of the transistor and on the future steps in nanoelectronics. His talk was followed by a very interesting presentation on microelectronics and globalization held by Prof. Alessandro Paccagnella from the University of Padova.

During the event, the speakers had the opportunity to share their insights and experiences with our audience, as well as to answer many questions from attendees.

The event saw a significant participation of the young PhD students, Post-docs, and early-stage researchers along with Professors Giorgio Baccarani and Massimo Rudan, the leading IEEE Electron Device Luminares of our University of Bologna, who had the chance to connect while attending the very interesting presentations of the invited speakers. A very fruitful mentoring event!



*On-site participants with the invited speakers.*

## The Marconi Foundation Celebrates the 75th Anniversary of The Transistor

—By Susanna Reggiani and Giovanni Emanuele Corazza

On 25 April 2023, the Guglielmo Marconi Foundation and the IEEE EDS Italy Chapter co-organized the Marconi Day, a communication-focused event to honor the memory of Guglielmo Marconi in his birthday and this occasion was taken to celebrate the seventy-fifth anniversary of the invention of the transistor. The event took place in Villa Griffone, located in Sasso Marconi (Bologna, Italy), the main residence of the Marconi family, now hosting a museum dedicated to the scientist who was awarded the Nobel prize for physics in 1909. It was here, in his family residence, that Guglielmo Marconi set up his first workshop and performed his first radio experiments, giving birth to the age of wireless.

The Marconi Day is promoted every year by the Guglielmo Marconi Foundation in collaboration with the Italian Ministry of Culture, the Municipality of Sasso

Marconi and of Bologna. This year, the EDS Eminent Lecturer Prof. Hiroshi Iwai was invited to join the event and deliver a lecture connecting the history of communication technology to the invention of the transistor, based on his outstanding expertise in electron devices and microelectronic technologies.

About 130 people attended the event in person. After greetings from Prof. Giovanni Emanuele Corazza, President of the Guglielmo Marconi Foundation, Prof. Hiroshi Iwai together with Alessandro Aresu (collaborator of the Ministry of University and Research, Italy) and Davide Nejoumi (founder and CEO of the Delta Space Leonis) shared their insights and experiences on the history of technology, a role of the semiconductor industry in actual geopolitics and innovation in telecommunications. Prof. Iwai also gave a speech underlining historical facts in a progression from Guglielmo Marconi's first analog equipment to modern digital electronics, with the invention of the transistor as a grand turning point that was an important change of the engineering paradigm. The speech was very interesting, particularly for the EDS community members.

In the second part of the event, the Marconi Foundation awarded the "Marconist of the 21st century" title to Prof. Hiroshi Iwai in presence of Princess Elettra Marconi, Guglielmo Marconi's daughter.

## 75 Years of the Transistor - Trends and Challenges in Micro- and Nanoelectronics for the Next Decade by Prof. Cor Claey

—by Mike Schwarz

The EDS Germany Chapter organized on 21 April 2023 a hybrid distinguished lecture entitled "Memories from Storage to Computing." The lecture was given by Prof. Cor Claey from KU Leuven, IEEE Fellow, and was organized by Prof. Alexander Kloes and Prof. Mike Schwarz from the Competence Center for Nanotechnology and Photonics (NanoP) of THM - University of Applied Sciences, Germany. The DL was attended by 26 IEEE participants, as well as 56 non IEEE members onsite and via Zoom video conference system.

After a warm welcome by Prof. Schwarz, Prof. Claey started with an overview of the evolving microelectronics history. Afterwards, actual numbers and examples of the investments of new wafer fabs were given against the evolution of 300mm fabs in the last decades. Prof. Claey highlighted different aspects of the wafer fab investment and its management required to bring revenue. From that point of view more details of scaling approaches to cope with Moore's Law were presented with its different implications for the technology. These result finally in advanced silicon devices from planar FETs to stacked nanosheet (NS) or forksheet (FSH) FETs.

Afterwards, Prof. Claey gave insights into germanium devices and their most important challenge: defects. He



Prof. Giovanni Emanuele Corazza awarding the "Marconist of the 21st century" title to Prof. Hiroshi Iwai in presence of Princess Elettra Marconi.



IEEE EDS delegates with invited speakers at the Marconi Museum entrance. From left to right: Dr. Alessandro Aresu, Prof. Elena Gnani, Prof. Hiroshi Iwai, Prof. Enrico Sangiorgi and Prof. Susanna Reggiani.



Prof. Cor Claeys during his lecture 75 Years of the Transistor - Trends and Challenges in Micro- and Nanoelectronics for the Next Decade.



Prof. Cor Claeys and Prof. Benjamin Iniguez celebrating the 75 Anniversary of the Transistor in front of the audience.

finally allowed them to develop the technologies one may find in today's applications.

~Mike Schwarz, Editor

referred to the stacks of germanium devices to control defects, gave some examples on the feasibility of Ge-Technology at device level and many famous examples. Then the next topic focused on III-V on Silicon with its aspects on lattice mismatch, resulting defects and measures to improve device performances. Many examples of state-of-art devices were given. A comparison between the progress in GaN and SiC was also discussed.

Finally, Prof. Claeys offered the impact of increased system functionality and density achieved by 3D integration based on Through Silicon Vias (TSV) and/or monolithic or 3D sequential integration on a Si substrate. He discussed the evolution, trends and challenges imposed on materials and devices for different integration technologies.

### History and Evolution of the Thin Film Transistors by Prof. Benjamin Iniguez

—by Mike Schwarz

A hybrid distinguished lecture entitled "History and Evolution of the Thin Film Transistors" by Prof. Benjamin Iniguez from URV, IEEE Fellow, was held on 21 April 2023. It was organized by Prof. Alexander Kloes and Prof. Mike Schwarz from the Competence Center for Nanotechnology and Photonics (NanoP) of THM - University of Applied Sciences, Germany and attended by 82 participants.

Prof. Iniguez gave an overview starting from the history in the early 80s of the last century to approaches nowadays. Details on their properties, benefits and applications were presented as well as characterization data presenting the evolution of Thin Film Transistor.

The distinguished lecture was embedded in the celebration of the 75 anniversary of the transistor and offered one of the many use cases that evolved in the last decades. The participants were surprised by the fact that the invention

## LATIN AMERICA (REGION 9)

### ED UNICAMP, Campinas Student Chapter

—by Lucas Zucchi and Jacobus Swart

The 17th Workshop on Semiconductors and Micro & Nano Technology—SEMINATEC 2023 was held on March 29-31, 2023 at the State University of Campinas (UNICAMP), Brazil. The purpose of SEMINATEC is to promote the interaction among industry, academia, research and development centers, government and students, all looking for real opportunities towards improving semiconductor and micro & nano technologies, research, and education. A total of 110 persons attended the Workshop, although 180 were registered on-line and on-site. Because registration was free, some did not appear on-site. This year, SEMINATEC was organized by the EDS Student Chapter at UNICAMP, with additional support and funding from EDS and SSCS South Brazil chapters, EDS Student Chapter at FEI and OPTICA Student Chapter at UNICAMP. Each of these five chapters invited a Distinguished Lecturer (DL) to visit them and, following, to participate at SEMINATEC and deliver a keynote talk. The four DLs and titles were as follows:

- "Materials and devices for energy efficient spiking neuromorphic hardware" — Prof. Dr. Adrian M. Ionescu, EPFL (EDS/IEEE—invited by EDS Student Chapter at UNICAMP)
- "Evolution of MOSFETs toward nanoelectronics" —Prof. Dr. Adelmo Ortiz-Conde, USB, Venezuela (EDS/IEEE—invited by EDS South-Brazil Chapter, at USP)
- "Reliability of Nanoscale Semiconductor Devices, focusing on but not limited to Noise and Bias Temperature Instability" —Prof. Dr. Gilson Wirth, UFRGS, RS (EDS/IEEE—invited by EDS Student Chapter at FEI)



- *"Circuits and technologies for implantable biomedical devices"* —Dra. Carolina Mora Lopez, imec, Belgium (SSCS/IEEE—invited by the South Brazil Chapter at USP)
- *"Nonlinear Photonics Based on Thin-Film Lithium Niobate"* —Prof. Dr. Mengjie Yu, USC Viterbi, USA (OPTICA—invited by OPTICA Student Chapter at UNICAMP).

These talks covered the state-of-the-art new devices, models, circuit design, photonic ICs and applications, making the event of interest to members of both EDS, SSCS and OPTICA communities. Adrian Ionescu and Mengjie Yu gave the talk virtually, while all others participated in person. In addition, company leaders, R&D leaders and government officers gave presentations about local activities and challenges in the field of micro- and nanoelectronics, especially companies doing IC design and packaging. A list of these companies and institutions that gave presentations and/or participated in panels was as follows:

- *"The CORDIC Algorithm and its Application in the Implementation of Digital Communication Systems in FPGA and ASIC"* —Eduardo Lima, Eldorado, SP
- *"Status and challenges of the semiconductor industry in Brazil"* —Rosana Casais, ABISEMI, Brasília
- *"Governmental plans to foster semiconductor activities in Brazil"* —Guilherme de Paula Corrêa, MCTI, Brasília



SEMINATEC 2023—Distinguished Lecturers and organizing committee members, from left to right, first row: Carolina Mora Lopez, Carla Sampaio, Adelmo Ortiz, Joao Martino, Marcelo Pavanello, second row: Gustavo Wiederhecker, Gilson Wirth, Newton Frateschi, Jacobus Swart and Marcos Puydinger.

- *"Status and Challenges of IC Design in Brazil"* —Cesar Dueñas (HCL), Julio de Oliveira (Lumentum), Marcelo Silva (CADENCE) and Eduardo de Lima (Eldorado) as panel mediator.



SEMINATEC 2023 - Visit to the telephone museum during the social event.



### ED Indonesia Chapter

#### Distinguished Lecture—Prof. Paul Berger

—by Basuki R Alam

In commemoration of the 75th year Anniversary of the Invention of the Transistor, the ED Indonesia Chapter organized on 7 December 2022, a Distinguished Lecture (DL) titled “Fully Printed Flexible Electronics: Low Voltage TFTs and Novel NDR Devices,” by Prof. Paul Berger of Ohio State University/Tampere University.

The lecture was held virtually and was attended by 85 participants, mainly students, and some faculty members from universities in Indonesia and Malaysia. Professor Berger’s talk highlighted some significant milestones in the research of flexible electronic devices, including a new low-voltage thin-film transistor (TFT) and a new tunnel diode (TD) made from polymer that enables a hybrid TD-TFT circuit. The talk provided insights into a new paradigm of discrete and integrated electronics implemented using flexible materials such as polymer-printed film on flexible film, textile, and thin flexible metal substrates instead of rigid silicon wafer. The devices and circuits based on flexible materials can be manufactured at low temperature with metal, dielectric, or semiconductor-based inkjet printers. He also encouraged the audience to become IEEE members and highlighted the benefits of membership with the student branch chapters in Indonesia and the region. The lecture concluded with an interactive Q&A session where Prof. Berger answered questions from the audience regarding the new flexible electronic devices and their low-temperature and low-cost manufacturing based on printing technology.

#### Distinguished Lecture—Prof. Patrick Fay & Prof. Huili Grace Xing

—by Basuki R Alam

In December 2020, the ED Indonesia Chapter organized two Distinguished Lectures featuring EDS Distinguished Lecturers, Prof. Patrick Fay from the University of Notre Dame, and Prof. Huili Grace Xing from Cornell University, to commemorate the 75th year anniversary of the invention of the transistor.

The first lecture, delivered by Prof Patrick Fay, titled “III-N MM Wave Transistor Linearity, Efficiency and Reconfigurability,” highlighted the significant progress made in developing highly linear AlGaIn/GaN HEMT using a gradual doping-structure wide band-gap semiconductor of HEMT for broadband front-end. The second lecture was presented by Prof Grace Xing, titled

- “Challenges to foster education, R&D&I and collaboration on Semiconductor Technologies in the State of São Paulo” —José Alexandre Diniz (FEEC), Newton Frateschi (LPD/IFGW), Gustavo Wiederhecker (CCSNano), João Antonio Martino (EPUSP), Michelly de Souza (FEI), Fernando Ely (CTI), Rodrigo Capaz (LNNano) and Linnyer Ruiz (UEM) as panel mediator.

These additional presentations added value to SEMINATEC, attracting students and promoting discussions about possible collaborations. A poster session was held on the last day and about 40 selected papers were presented. Two DLs and an invited researcher reviewed the submitted papers and the respective presented posters to select one for the best paper award. The committee could not decide between two best ranked papers. For this reason, two best papers were selected: “Barrier layer properties influence on the MISHEMT channels activation voltages,” presented by B. G. Canales, J. A. Martino and P. G. D. Agopian and “Relationship between transconductance and mobility variability in nanowire transistors” presented by L. M. B. da Silva and M. de Souza.

The first day of the event was dedicated to virtual short courses. 4 lectures were delivered on-line:

- “Introduction to CMOS technology,” by José Alexandre Diniz (FEEC/UNICAMP)
- “Introduction to ASICS,” by Daniel Lazari, LUMENTUM
- “Photonic Integrated Circuits (PIC),” by Dr. Felipe Vallini, INTEL
- “Technology Innovation and Entrepreneurship,” by Prof. Newton Frateschi, UNICAMP

The purpose of these short courses was to provide basic background and attract new students to the areas of micro- and nanoelectronics, and photonics. A good audience to these short courses was observed with 60 to 70 participants at each course module.

More details on SEMINATEC 2023 are available at the website: <https://www.ccs.unicamp.br/seminatec/>

A social event during SEMINATEC 2023 was organized on 30 March. This program was a journey to the past, consisting of a 30 min ride in the 18th-century train to a nearby train station where a guided visit to a telephone museum was offered. The visit to one of the world’s first telephone switching stations was followed by a nice cocktail.

To cover the organization expenses, including the social event and coffee breaks, we got some sponsorship from a few companies, as can be read on the website. Noteworthy was a cooperation among different EDS chapters and two others, as well as a cooperation between the main universities and R&D centers in the region (State of São Paulo). This cooperation was one of the reasons for the success of the event. Next year, SEMINATEC 2024 will be held at the University of São Paulo.

~Paula Ghedini Der Agopian, Editor

"Gallium oxide Semiconductors: Recent Progress and Future Prospective," who discussed the superiority of the wider band-gap  $\text{Ga}_2\text{O}_3$  oxide-semiconductor compared to well-known SiC and GaN semiconductors for power device applications.

The lectures were conducted virtually and were attended by 72 participants, including students, faculties, and engineers from the industry. After the lectures, there was an interactive Q&A session, where the Distinguished Lecturers entertained questions regarding the unique crystal property of  $\text{Ga}_2\text{O}_3$ , and prospective students engaged in a discussion about graduate studies and research on wide band-gap semiconductor technology in respective US universities. The Distinguished Lectures series, including the interactive end-session with the Distinguished Lecturers, was concluded by a three-hour lecture series.

~Sharma Rao Balakrishnan, Editor

## ED/SSC Nanjing Chapter

—by Weifeng Sun

The Nanjing ED/SSC Joint Chapter and the School of Integrated Circuits, Southeast University held special invited DL talks on 28 March through the Webinar. The event was hosted by Prof. Zhongyuan Fang, who represented Prof. Weifeng Sun, the IEEE ED/SSC Nanjing Chapter Chair. The invited expert, Ms. Viola Schaffer, is the Distinguished Member of Technical Staff at Texas Instruments. Ms. Viola gave a speech entitled "Transistor diversity: looking beyond CMOS to improve analog performance".

During the lecture, Ms. Viola indicated that although CMOS transistors are dominating integrated circuits, some other transistor types such as the bipolar junction transistor (BJT), its variant, the super-beta BJT, the junction gate field-effect transistor (JFET), and laterally diffused metal-oxide-semiconductor field-effect transistor (LDMOS) continue to thrive in specific applications. The talk revisited the discovery of these different devices, their operating principles, key characteristics, and circuit examples that benefit from these characteristics. Ms. Viola also envisioned how these transistors have eluded extinction despite their larger feature sizes and process complexities and how they have evolved in modern technologies. Some interesting games and interactions with audiences were organized by Ms. Viola during the lecture.

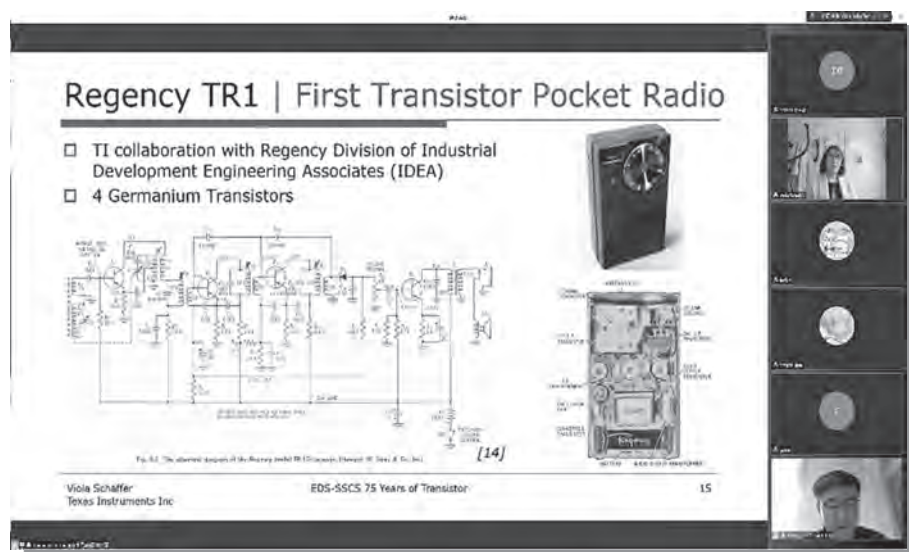
This event attracted many attendances with more than 70 PhD students and master students, 6 faculties, and post-doctors.

## ED Taipei Chapter—The 2023 International Symposium on VLSI Technology, Systems and Applications (VLSI-TSA)

—by Steve Chung

The Symposium VLSI-TSA was held in a hybrid mode on 17–20 April 2023 in Hsinchu, Taiwan. In celebrating its 40th anniversary, both VLSI-TSA and VLSI-DAT were merged starting from this year. As travel restrictions have been gradually eased up, the Symposium received an enthusiastic response with almost 1,000 registered participants. Hsinchu City has a reputation known as "Taiwan's Silicon Valley," with clusters of world-class semiconductor companies. Therefore, the conference attracts many industrial participants around the world who would like to take advantage of combining this in-person meeting with their business trips in Taiwan.

Since its inception in 1983, the VLSI TSA Symposium has been the premier VLSI conference in the region, which provides an excellent platform for semiconductor experts in talent cultivation, international interaction, and technology exchange. The event promises to be rich in content. This year, there were three half-day tutorials, three-day technical presentations of contributed papers, and nine special sessions consisting of prominent invited talks. The 3 tutorials included BEOL semiconductor devices, AI fundamentals and practices, and data-converter design for emerging applications. During the three-day technical presentations, a total of 6 keynotes kicked off each day which included building a quantum computer (John Martinis,



ED-SSC Nanjing, Invited Transistor 75th Anniversary Talk by Ms. Viola Schaffer at Southeast University.



(Left) 2023 VLSI-TSA opening keynote (John Martinis, UCSB); (Right) Luncheon talk (Brian Sung, Cadence).

UCSB), industry scale reuse in the chiplet era (R. Munoz, Intel), disruptive approaches towards energy efficient VLSI technologies (O. Faynot, CEA-Leti), generative-AI: how it changes our lives (Y-C. Wang, nVidia), neuromorphic computing with computation-in-memory (K. Takeuchi, Univ. of Tokyo), and VLSI design and test view of computer security (S-L. Lu, Warner Pacific Univ.).

Nine special session were held including technology-related ones: "High power devices," "Advanced packaging technologies," "Novel channel logic and 3D- stacked transistors" "Dielectric stacking and interface engineering," design-related sessions: "Compute-in-memory: from architecture to devices," "Security and encryption, Advanced process-induced design challenges and solutions," and joint sessions: "Sensors—devices circuit and applications in automotive/drone" and "Heterogeneous integration."

The Symposium also featured a luncheon keynote with Brian Sung (Cadence) on "The revolution of AI in intelligent system design." A poster session was also arranged to encourage more interaction among participants.

After the end of the 4-day event, recorded online videos were also available from 23 April to 23 May for registered participants to watch. The next VLSI-TSA will be scheduled (tentatively), 22-25 April 2024 at the same venue. The paper submission due date is 31 October 2023. The attendees from industry may take this opportunity to visit the Hsinchu Science Park business units, whereas the attendees from academia may visit major universities/research institutes in Taiwan.

~Tuo-Hung Hou, Editor

## ED Delhi Section Chapter

—by Harsupreet Kaur and Manoj Saxena

The EDS Delhi Chapter initiated "Webinar Series by Leading IEEE Electron Device Luminaries" as part of the

Celebration of 75 Years of Invention of Transistor. The webinars were jointly organized with the DBT Star College Status Program of Deen Dayal Upadhyaya College (University of Delhi) and The National Academy of Sciences India—Delhi Chapter. On 25 January 2023, a virtual talk on "Physical Modeling and Numerical Analysis Driven by the Evolution of Semiconductor Technology" was delivered by Professor Massimo Rudan, Professor Emeritus and IEEE Life Fellow, Adjunct Professor, Department of Electrical, Electronic, and Information Engineering "Guglielmo Marconi", Alma Mater Studiorum – Università di Bologna.

On 27 January 2023, a talk on "Symmetric Lateral Bipolar Transistor on SOI—a Shockley Transistor without Kirk Effect " was delivered by Professor Tak H. Ning, IBM Fellow (Retired). On 8 February 2023, another talk on "Controlled-polarity transistors: higher density and better control" was delivered by Professor Giovanni De Micheli, EPF Lausanne, Switzerland. On 15 February 2023, a lecture on "75 Years of the Transistor, some Brazilian Contributions and 50 years' experience in the Field" was delivered by Professor Jacobus Swart, Universidade Estadual de Campinas, Brazil. On 22 February 2023, a lecture on "Transistor discovery and Microelectronics evolution" was delivered by Professor Giorgio Baccarani, IEEE Life Fellow, Professor Emeritus, University of Bologna, Italy. On 29 March 2023, a lecture on "Quantum Switching in Y-shaped Nanodevices" was delivered by Professor V. Mitin, University at Buffalo, USA. These talks saw a huge participation and were attended by 200+ attendees from 23 different countries i.e., Bangladesh, Belgium, Canada, China, Colombia, Germany, Greece, India, Ireland, Israel, Italy, Mexico, Nepal, Nigeria, Pakistan, Sudan, Switzerland, Taiwan, United Kingdom, United States and Venezuela.

Maharaja Agrasen College, University of Delhi in association with the ED Chapter of Delhi successfully organized





*Faculty members and participants during the workshop “Basics of Electronic Design: Step-by-step designing and building DC Power Supplies.”*

on 30 January 2023, a Hands-on Workshop on “Basics of Electronic Design: Step-by-step designing and building DC Power Supplies.” The workshop was aimed to establish an effective platform for the students to gain a real-time experience and an in-depth training of practical aspects of designing stable and robust power supplies.

On 30 January 2023, a one-day national seminar “On Recent Advancements in Semiconductor Devices and Materials (RASDM-2023)” was organized by the Department of Applied Physics, Delhi Technological University (DTU), Delhi in association with the Chapter. The aim of this seminar was to create an opportunity for students, faculty members and participants from other institutions to gain knowledge in the domain of semiconductor devices and their applications. The inaugural talk was delivered by Prof. Ram Gopal Rao, former director, IIT Delhi and Padam Shree awardee. Other renowned experts such as Prof. Kedar Singh, School of Physical Sciences, JNU, Prof. Abhinav Kranti, Department of Electrical Engineering, IIT Indore, India, Prof. Zishan Husain Khan, Jamia Milia, Islamia University and Prof. Govind Gupta, Senior Principal Scientist, CSIR -NPL, Delhi, India also delivered enlightening talks during the seminar which were attended by over 95 participants.

The Chapter also organized two technical lectures under the “Women in EDS” Lecture Series. On 11 January 2023, D.H. Triyoso, TEL Technology Center, America, delivered a talk on “Teaching an old dog (ALD  $\text{HfO}_2$ ) some new tricks.” On 16 February 2023, a technical talk on “The need from Wide Bandgap Technology for sustaining clean and afford-

able energy” was delivered by Prof. Srabanti Chowdhury, Stanford University. 109 attendees from Bangladesh, Belgium, China, Colombia, Germany, India, Italy, Nepal, Nigeria, Pakistan, Philippines, United Kingdom and United States attended the talks.

Department of Electronic Science, University of Delhi South Campus and the ED Delhi Chapter jointly organized two Distinguished Lectures. The first one, on “5G Electronics Systems” by Prof. Ajit Panda, National Inst. of Science & Technology (NIST), was held on 3 February 2023. The second one, on “Predictive Analytics in Machine Learning” was delivered on 13 March 2023 by Dr. Rajiv Joshi, IBMT. J. Watson Research Center. Both events were held at the University of Delhi South Campus. Over 50 participants attended each of those very insightful presentations.

### **ED IIITDM-Kancheepuram Student Branch Chapter**

—by Kumar Prasannajit Pradhan

The Chapter in association with the Department of Electronics and Communication Engineering, Indian Institute of Information Technology Design and Manufacturing (IIITDM) Kancheepuram organized a distinguished lecture on the topic “Atomic Orbital Overlap Engineering for 3D-2D Contacts & Record High-Performance 2D Transistors” by Prof. Mayank Shrivastava, Department of Electronic Systems Engineering (DESE), Indian Institute of Science (IISc) Bangalore.



Post-DL photo session with Prof. Mayank Shrivastava on 22 February 2023 in presence of Prof. K P Pradhan, Faculty Advisor of the Chapter and Chapter Chair Mr. Rameez Raja Shaik.

## ED NIT Silchar Student Branch Chapter

—by Dr. T. R. Lenka

The Chapter in association with IEEE Nanotechnology Council Chapter and Department of Electronics and Communication Engineering, National Institute of Tech-

nology Silchar organized an International Conference on Micro/Nanoelectronics Devices, Circuits and Systems (MNDCS-2023) (Hybrid Mode) on 29–31 January 2023. There were eleven distinguished lecture talks delivered by selected distinguished lecturers, five invited talks and forty-one oral presentations.



Participants of MNDCS-2023; Dr. P. Pattanayak, Prof. R. H. Laskar (HOD ECE), Dr. T. R. Lenka (SBC Advisor), Prof. Ganannath Dash (DL), Prof. Anil Kottantharayil (DL), Prof. Ajit Kumar Panda (DL), Prof. F. A. Talukdar (Branch Counselor), Prof. Manoj Saxena (DL), Mr. Rabin Paul (SBC Vice-Chair), Dr. Koushik Guha (Vice Chair NTC), Ms. Samadrita Das (SBC Chair), and EDS SBC Members.



## ED Kanpur Chapter – Uttar Pradesh Section

—by Shubham Sahay

The Chapter organized two distinguished lecture talks. Dr. Fernando Guarín, Distinguished Member of Technical Staff, GlobalFoundries, East Fishkill, NY, delivered the talk on “Leveraging semiconductor technology for the benefit of society.” The second speaker was Prof. Santosh K. Kurinec, Fellow IEEE, Rochester Institute of Technology, Rochester, NY. She delivered a talk on “Emergence of Ferroelectric Memory: Prospects & Challenges.”

The Chapter in association with the IEEE Madhya Pradesh Section EDS Chapter organized the Workshop on Devices and Circuits (WDC 2023) which spanned over 4 days with more than 50 eminent speakers and nearly 75 technical talks from both academia and industries. The aim of the Workshop was to boost the knowledge, initiate collaboration and expose the members to diverse research areas including semiconductor material growth, device fabrication, digital, analog, and mixed-signal circuit design, RF circuit design, physics of semiconductors, compact modeling, SPICE and TCAD simulations, IC fabrication, atomistic simulations, RF and sub-THz measurements, optoelectronic and flexible electronics, non-invasive sensing techniques, MEMS and biosensors, neuromorphic computing and hardware security. The workshop was attended by more than 100 IEEE members.

## ED Nepal Chapter – Uttar Pradesh Section

—by Bhadra Pokharel

The 10th International Conference on the Frontiers of Plasma Physics and Technology (FPPT-10) was organized jointly by the ED Nepal Chapter, Tribhuvan University, Kirtipur, Kathmandu University, Dhulikhel, Nepal, and many national and international Scientific Organizations. The Conference was held in Kathmandu on 13–17 March 2023. It was attended by 101 participants from 21 different countries out of which 60 were the local participants with 11 IEEE members (from Nepal). The first day of the program was held at Hotel Mystic Mountain, Nagarkot. It was inaugurated by Dean of Science and Technology, Prof. Binil Aryal by lighting Panas (a traditional lamp). In his address, Prof. Aryal expressed the importance of plasma technology and its impact on our society. He also pointed out the importance of astrophysical plasma to understand the beginning phase of the universe. Prof. Tara Desai, Chair and Director of FPPT-10, highlighted the objectives of the Conference. Altogether, 44 talks and 35 posters were presented during 13 Scientific Sessions and 1 poster session. The research papers concerned various fields of plasma physics: laser plasma interaction, tokamaks and other magnetic confinement fusion devices, theory (from astrophysics to laboratory plasma), heavy ion beams in fundamental material study and inertial

### IEEE-EDS WORKSHOP ON DEVICES AND CIRCUITS – 2023 RADISSON HOTEL KHAJURAHO, M.P.



Participants of the workshop WDC 2023.





*Participants of 10th International Conference on the Frontiers of Plasma Physics and Technology.*

confinement fusion, nano-science and related topics, plasma jets and applications, wires explosions studies and applications, plasma surface interaction, sheath physics, etc. The poster session encouraged young researchers by providing them with a platform to present their work. In order to motivate young researchers towards the poster session two “Best Poster Awards” and one best oral presentation were provided.

### **ED Heritage Institute of Technology-Kolkata Student Branch Chapter**

—by Soumya Biswas and Atanu Kundu

The Chapter jointly with the IEEE EDS Center of Excellence and Department of E.C.E. Heritage Institute of Technology organized on 15 February 2023 a Distinguished

Lecture by Prof. Durga Misra, Professor and Chair of the E.C.E. Department of New Jersey Institute of Technology, Newark, USA. The lecture topic was “75th Year of Transistors: Dielectrics responsible for the Transistor’s Scaling.” Prof. Misra gave an insight into his work and observations over the years in the field of transistors and dielectrics. He talked about the use of different gate dielectrics and their reliability, discussing the evolution of dielectric science in nanoelectronics that enabled the effective scaling of transistors. The audience included professionals, students, and professors from different institutes. The lecture was followed by the questionnaire session. The talk

was attended by 147 participants, among whom 11 were members of IEEE EDS.

The Chapter organized on 23 February 2023 a workshop on the application of PID controllers. The speakers of the workshop discussed the basics of circuit design required for building the PID controller. The application of these concepts in a ball balancing model that was built to balance a ball at a set point was demonstrated. The components, algorithm and the working principle of the model were elaborately presented by the student volunteers of the Institute. The event was attended by 186 students from all departments of the Institute.

In addition, the Chapter organized on 29–31 March 2023 a 3-day event “Student Paper Competition 2023.” Students submitted their review/research articles on application of robotics in healthcare. A total of 19 papers were accepted



*Distinguished Lecture program on “75th Year of Transistors: Dielectrics responsible for the Transistor’s Scaling,” by Prof. Durga Misra, NJIT.*



Group of participants of "Student Paper Competition 2023" grand final held on 31 March 2023.

through review. The papers were presented in front of a panel of judges in 6 sessions spread out over two days. 5 finalists presented their works on the third day at the grand final. Three papers were selected and awarded cash prizes. The final event was attended by 52 students and 11 faculty members.

### ED Calcutta University of Technology Student Branch Chapter

—by Koyel Mukherjee and Soumya Pandit

A Distinguished Lecture talk was organized by EDS Calcutta University Student Branch Chapter in the institute

of Radio Physics and Electronics. The speaker, Dr. Amlan Chakrabarti is a distinguished speaker of ACM. The topic of the lecture was "Quantum Computing: Harnessing Power of Atomic States for Accelerated and Secure Computing". The speaker explained in detail the principle of quantum computing as well as the present scope of application in this area. Total number of participants was 54 including students from both undergraduate and post-graduate levels, with both science and technology backgrounds. Also, a significant number of participants were research scholars.

~Soumya Pandit, Editor



Group of participants of the lecture on Quantum Computing.

# EDS MEETINGS CALENDAR



THE COMPLETE EDS CALENDAR CAN BE FOUND AT OUR WEB SITE:  
[HTTP://EDS.IEEE.ORG](http://eds.ieee.org). PLEASE VISIT.

<b><u>2023 IEEE Latin American Electron Devices Conference (LAEDC)</u></b>	3 Jul – 5 Jul 2023	Puebla, Colombia
<b><u>2023 30th International Workshop on Active-Matrix Flatpanel Displays and Devices (AM-FPD)</u></b>	4 Jul – 7 Jul 2023	Kyoto, Japan
<b><u>2023 IEEE 36th International Vacuum Nanoelectronics Conference (IVNC)</u></b>	10 Jul -14 Jul 2023	Cambridge, MA
<b><u>2023 IEEE International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA)</u></b>	23 Jul – 26 Jul 2023	Pulau Pinang, Malaysia
<b><u>2023 IEEE International Flexible Electronics Technology Conference (IFETC)</u></b>	13 Aug – 16 Aug 2023	San Jose, CA
<b><u>2023 16th UK-Europe-China Workshop on Millimetre Waves and Terahertz Technologies (UCMMT)</u></b>	31 Aug – 3 Sept 2023	Guangzhou, China
<b><u>2023 IEEE XXVIII International Seminar/Workshop on Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED)</u></b>	11 Sept – 13 Sept 2023	Tbilisi, Georgia
<b><u>IEEE 49th European Solid State Circuits Conference (ESSCIRC) &amp; IEEE 53rd European Solid-State Device Research Conference (ESSDERC)</u></b>	11 Sept – 14 Sept 2023	Lisbon, Portugal



<b><u>2023 IEEE International Conference on Quantum Computing and Engineering (QCE)</u></b>	17 Sept – 22 Sept 2023	Bellevue, WA
<b><u>2023 18th European Microwave Integrated Circuits Conference (EuMIC)</u></b>	18 Sept – 19 Sept 2023	Berlin, Germany
<b><u>2023 International Conference on Simulation of Semiconductor Processes and Devices (SISPAD)</u></b>	26 Sept – 29 Sept 2023	Kobe, Japan
<b><u>2023 45th Annual EOS/ESD Symposium (EOS/ESD)</u></b>	1 Oct – 6 Oct 2023	Riverside, CA
<b><u>2023 IEEE International Integrated Reliability Workshop (IIRW)</u></b>	8 Oct – 12 Oct 2023	South Lake Tahoe, CA
<b><u>2023 International Semiconductor Conference (CAS)</u></b>	11 Oct – 13 Oct 2023	Sinaia, Romania
<b><u>2023 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS)</u></b>	14 Oct – 18 Oct 2023	Monterey, CA
<b><u>2023 IEEE 33rd International Conference on Microelectronics (MIEL)</u></b>	16 Oct – 18 Oct 2023	Nis, Serbia
<b><u>2023 IEEE/ACM International Conference on Computer Aided Design (ICCAD)</u></b>	28 Oct – 2 Nov 2023	San Francisco, CA
<b><u>2023 Middle East and North Africa Solar Conference (MENA-SC)</u></b>	15 Nov – 18 Nov 2023	Dubai, United Arab Emirates
<b><u>2023 IEEE 10th Workshop on Wide Bandgap Power Devices &amp; Applications (WiPDA)</u></b>	4 Dec – 6 Dec 2023	Charlotte, NC
<b><u>2023 International Electron Devices Meeting (IEDM)</u></b>	9 Dec – 13 Dec 2023	San Francisco, CA
<b><u>2023 IEEE 54th Semiconductor Interface Specialists Conference (SISC)</u></b>	13 Dec – 16 Dec 2023	San Diego, CA



Call for Contributed Articles and Papers for the Feature Topic of “Large-Area and Flexible Electronics” in IEEE Electron Devices Magazine (ED-M), Vol. 2, No. 1 (March 2024).

The IEEE Electron Devices Magazine invites manuscript submissions within the scope of Large Area Electronics and Flexible Electronics. The IEEE Electron Devices Magazine focuses on the publication of peer-reviewed tutorial and survey papers related to the wider field of electron devices and its application. The purpose of this special issue is to document the latest frontiers in fundamental research and technological development in the fields of large-area electronics and flexible electronics devices.

The primary focus is on large-area and flexible device technologies, and application areas of interest include but are not limited to:

- Displays, active and passive matrix backplanes, backlights
- Sensors, Actuators
- Photovoltaics, energy harvesting, batteries
- Antennas, RFID
- Lighting
- Wearable devices

Along with focusing on device design, fabrication processes, and performance; additional aspects interesting to discuss include: modeling, materials, packaging/metallization, system-level integration, and additive manufacturing.

Submission instructions:

Manuscripts up to 8 pages should be submitted in a double column format using an IEEE style file. Please visit the following link to download the templates:

[IEEE Article Templates - IEEE Author Center Journals](#)

Additional information IEEE Electron Devices Magazine can be found at:

[IEEE Electron Devices Magazine - IEEE Electron Devices Society](#)

All submissions will be reviewed in accordance with the normal procedures of Electron Devices Magazine.

Submissions of open columns (1 page) will also be considered.

Space in each ED-M issue is limited. Therefore, papers passing the peer review successfully may be ranked and be accepted for publication in the order of ranking.

Submission deadline: September 15, 2023

Publication date: March 2024

Guest Editors:

Sean Garner, Corning (garnersm@corning.com)

Luisa Petti, Free University of Bolzano-Bozen (luisa.petti@unibz.it)



## **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.