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Transistors on show

Technology breakthroughs at the 2022 IEEE International Electron Devices Meeting, where transistors remain centre stage, 75 years after their invention.

The first transistor — a point-contact transistor — was developed at Bell Labs in December 1947. This would be followed by the bipolar junction transistor, the integrated circuit, the metal–oxide–semiconductor field-effect transistor, the microprocessor and the numerous other developments that have led us to the electronics of today. Its form may change, but the transistor remains at the heart of all of this.

The IEEE International Electron Devices Meeting (IEDM) began in 1955, just 8 years after the invention of the transistor. The event returns this month in San Francisco for its 68th edition with the 75th anniversary of the transistor as part of its theme. In 2018, 2019, 2020 and 2021, we highlighted some of the breakthroughs reported at the meeting. This year, we return to IEDM and offer our highlights of the 2022 event.

We open with an interview with Srabanti Chowdhury and Jungwoo Joh, publicity chairs of IEDM 2022. Reflecting on the trends at this year's meeting, they highlight the increasing prominence of work from industry on two-dimensional systems for advanced logic. They also emphasize the continuing importance of research on memory technology, as well as a growing focus on thermal management in high-performance devices.

Two-dimensional systems are the focus of our first highlighted article, where Iuliana Radu and colleagues at the Taiwan Semiconductor Manufacturing Company (TSMC) report gate-all-around nanosheet field-effect transistors based on monolayer molybdenum disulfide. As Zhihong Chen of Purdue University explains in a News & Views article about the work, the TSMC team address some of the key process-related questions that surround such devices and take a valuable step forward in the development of technology based on two-dimensional semiconductors.

For our second highlight, we focus on memory technology, where T. Y. Lee and colleagues at Samsung Electronics report the creation of an energy-efficient magnetoresistive random-access memory (MRAM) technology. As Atsufumi Hirohata of the University of York discusses in a News & Views article on the work, the memory is fabricated with 28 nm embedded MRAM technology and offers a write energy of 25 pJ per bit. Notably, the Samsung team also show that the approach can be scaled down to 14 nm fin field-effect transistor technology.

Thermal management is the focus of our third highlighted article. Here Srabanti Chowdhury and colleagues at various academic institutes in the United States and the United Kingdom show that a diamond coating on high-electron-mobility transistors can provide an effective approach to dissipate heat in high-power electronics applications. The result is covered in a News & Views article by Jae-Hyun Ryou and Sukwon Choi at the University of Houston and the Pennsylvania State University.

Elsewhere, we highlight work on three-tier complementary metal–oxide–semiconductor (CMOS) imaging sensors and work on the integration of heterojunction bipolar transistors in CMOS technology. We highlight advances in fibreless neural probes for optogenetics and developments in vertically integrated acoustic filters. Finally, we return again to transistors, and highlight a computational analysis that identifies materials that could be used to create barrier-free contacts for two-dimensional p-type field-effect transistors.

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