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Technical Briefs

Marvels of Microelectronic Technology: The 1T-1C Dynamic Random Access Memory, from a Groundbreaking Idea to a Business Benchmark

by Simon Deleonibus, Past Chief Scientist, CEA, LETI

In this issue, we report on one of the flagship Marvels of Microelectronic Technology, which has marked the history of microelectronics in the past 50 years: the 1 Transistor –1 Capacitor Dynamic Random Access Memory (1T1C DRAM). DRAMs have driven and accompanied Moore's Law through Metal Oxide Semiconductor Field Effect Transistor (MOSFET) integrated circuit scaling. They have been and still are a benchmark for the microelectronics industry: they continue to share their leadership with advanced microprocessors, SOCs and nonvolatile memories. DRAM fostered technological progress that was necessary to introduce new materials and revise process integration. In this article, R.H. Dennard, H. Sunami, M. Koyanagi and K. Itoh (Figure 1) accepted to remind us the pioneering times when 1T1C DRAM came out of its cradle.

DRAM Invention and First Developments

The groundbreaking ideas proposed by Robert Dennard, IEEE Fellow, IBM Fellow, to push microelectronics progress thanks to the 1T1C DRAM and MOSFET integrated circuit scaling have already been widely commented and many times awarded. The circumstances giving birth to the idea of MOSFET scaling were reported in the IEEE EDS Newsletter July 2019 issue. In this issue (October 2019), we will report the advent of 1T1C DRAM. Robert Dennard kindly accepted to remind us a few important facts. Some of them were also reported at

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Save the Date!
EDS Governance Meeting Series
7–8 December 2019
San Francisco, California, USA

(CEA-LETI, Editorial Manager), Dr. François Tcheme-Wakam (UGA, Local Arrangement Chair), and Mrs. Dalhila Alouani (IMEP-LAHC, Treasurer) Participants from 21 countries attended the conference: France (30), South Korea (15), Germany (11), Belgium (8), Spain (8), Russia (6), Italy (5), Switzerland (4), India (3), Brazil (2), Canada (2), Japan (2), Mexico (2), Netherlands (2), UK (2), Australia (2), Austria (1), USA (1), Ireland (1), Taiwan (1), Ukraine (1). There were also representatives from 5 major companies: Globalfoundries (2), IBM (1), STMicroelectronics (4), Huawei Technologies (2), and SK Hynix (4).

The best paper award was given to Dr. Gilles Scheen (UCLouvain, Belgium) for his contribution "Post-process porous silicon for 5G applications."

The conference hosted various presentations and posters in six sessions on these topics:

- Advanced transistor architectures
- Advanced materials
- Characterization techniques and reliability assessment techniques
- Novel devices
- III-V semiconductors and memory-oriented materials

Additionally the program hosted keynotes by:

- Nanowire/sheet-FETs for ultra-scaled, high-density logic and memory applications—Anabela Veloso, IMEC
- SOI Technology: From Niche to Mainstream Applications—Ionut Radu, SOITEC
- Effects in Innovative Devices—Marc Gaillardin, CEA-DIF
- Steep-Slope Devices for Ultra-Low-Power Applications—Ru Huang, Peking University

The conference contained as well some satellite events:

- FDSOI RF technology for 5G Workshop
- REMINDER Industrial Workshop on 1T-eDRAM
- IEEE International Nanodevices and Computing Conference *(see separate article)*

~ Mike Schwarz, Editor

ED/AP/MTT/COM/EMC Tomsk Chapter

—by Oleg Stukach

The 14th International Siberian Conference on Control and Communications (SIBCON-2019), organized by the ED/AP/MTT/COM/EMC Tomsk Chapter and Tomsk State University of Control Systems and Radioelectronics (TUSUR), and co-sponsored by National Instruments Rus R&D, was held in Tomsk TUSUR facility "Dom Uchenykh," Russia, on April 18–20, 2019. This biennial conference was formed in 1995 to bring together engineers and scientists to discuss state-of-the-art technologies and devices for control and communications.

This year's topics were: fundamental directions of communication and control theory, robots and automation, computer measurement technologies, sensors and systems, with a focus on the development of microwave electron devices, which are the main field of R&D activities at TUSUR. Nowadays, it is not conceivable to design a new device or rather technological process, or even to study a physical structure without simulation and characterization methods. They have become important tools in semiconductor technology research and development.

The conference had 212 registrants, and 106 selected papers were presented at 12 sessions, including keynote papers. The papers were selected by peer review from 180 papers received. The number of contributions has not increased from year to year but good quality of papers has been achieved. Our sponsor, National Instruments Rus R&D provided the attendees with bags containing promo materials and many technical presentations.

The SIBCON Conference triggered a lot of fruitful discussions and was held in a very friendly atmosphere. Social events were arranged, including a reception, a get together party, the conference banquet, as well as technical and sightseeing tours. Several possibilities for further increase in participation in chapter activities and EDS membership were identified and pursued.

My sincere congratulations must go to the TUSUR Scientific Council staff and personally to Inna Yarimova, who did an excellent job of organizing this successful event. We trust this conference will continue in the future, increasing the number of participants as well as inviting lecturers and growing contributions from other countries. We hope to meet you at the next SIBCON in Kazan in 2021. More data on the SIBCON Conference is available at http://tomsk.chapters.comsoc.org/sibcon/.

About TUSUR (https://tusur.ru/en): Tomsk State University of Control Systems and Radioelectronics is a modern, dynamically developing university, one of the leaders in a system of Russian higher education on electronics included in QS World University Rankings EECA. TUSUR Innovative Complex project provides about 80% scientific and research results in the Tomsk Region.

~ Daniel Tomaszewski, Editor

The National Instruments Session at SIBCON-2019