

Course Organizer: Dirk Wouters, RWTH-Aachen University, Germany.

Memories form an increasingly important part of any electronic system, complying with the ever-growing demand for large size data handling and storage. In order to optimize both system performance and cost, a combination of three different memory types is conventionally used: SRAM for on-chip ultra-fast (cash) memory, DRAM for fast access working memory, and non-volatile Flash for (slow but) low cost storage memory. While SRAM is based on conventional CMOS technology, both DRAM and Flash have evolved to very specific technologies and are mainly implemented on separate chips.

Future system operation, however, may be in jeopardy as all these three conventional memories are facing important roadblocks towards further technology scaling. Solutions that are currently pursued surpass conventional scaling engineering and material improvements, and increasingly rely on new integration paradigms as 3D memory.

In parallel, new emerging memory concepts based on resistive switching (RRAM, PCM and STT-MRAM) are intensively investigated as possible replacing candidates. Particular of interest, however, seems their potential as a new class of memory, called storage class memory. Indeed, from a system perspective there is a huge gap in access time between DRAM and Flash, and system performance could be considerably improved by a so-called storage class memory technology that combines non-volatility with an intermediate speed.(and cost), like the recently announced 3D Xpoint™ memory.

This short course will discuss in detail the status and evolution of both DRAM and Flash memory technologies as well of the major emerging new memories (ReRAM, PCM and STT-MRAM). On the other hand, it will give a system-based view on the requirement for memories that drives their future technology roadmap as well as possible applications.

Dirk Wouters

Dirk Wouters received the Master and Ph.D. degree in Electrical Engineering in 1982 and 1989, both from the University of Leuven in Belgium. From 1989 till 1990, he was a post-doctoral researcher in the LSI Research and Development Laboratory of Mitsubishi Electric Corporation in Itami, Japan, working on SOI technology for fabricating 3-D devices. From 1992 he worked at imec, Leuven, Belgium, as Principal Scientist in the Memory Device Design Group of the CMOS Process Technology Unit, investigating device and integration technology of different emerging memories including Ferroelectric RAM, Phase-Change Memories, and resistive switching RRAM. From 2011-2015 he was also Professor at ESAT-INSYS department of the KULeuven teaching in the Nanoscience and Nanotechnology Master Program. In 2014 he joined the Institute of Electronic Materials (IWE2) of the University of Aachen (RWTH), focusing on research of metaloxide based RRAM:

Dirk has (co)authored more than 100 papers published in international journals and presented at international conferences, and is member of MRS and IEEE.

He has been in the organizing committee of MRS (1999, 2000, 2001, 2008) and E-MRS (1992, 2004) Symposia of ISIF (2000), of ICMTD (2007, now , and of IEDM (Member of the IEEE Subcommittee SSN (Solid State & Nanoelectronic Devices) 2006 and 2007, and Chair Subcommittee Memory Technology 2008).