What's next for MRAM: Industrializing SOT-MRAM

Hong-xi Liu,

Truth Memory Corporation, Beijing China

Abstract

Over the last decade, magnetic random access memory (MRAM) has evolved from a promising idea into a proven, commercial reality. Its combination of non-volatility, nanosecond-level access speed, low power consumption, and seamless CMOS BEOL integration has enabled leading foundries to deliver embedded MRAM (eMRAM) as a practical replacement for eFlash in MCUs and SoCs. As emerging workloads—AI inference, over-the-air updates, and write-intensive edge tasks—demand near-unlimited endurance and tunable retention, MRAM has become central to redefining memory hierarchies. This keynote will chart MRAM's progress to date, focusing on spin-transfer torque MRAM (STT-MRAM), before turning to the next frontier: spin-orbit torque MRAM (SOT-MRAM). By separating the write path from the tunnel barrier, SOT-MRAM leverages spin currents in heavy-metal underlayers to switch bits without degrading the MgO barrier. The result is fundamentally higher endurance, sub-nanosecond switching, and a pathway to SRAM-class performance. Truth Memory Corporation (TMC) is at the forefront of this transition, advancing SOT-MRAM toward manufacturable, mass-producible solutions. This talk will highlight TMC's latest breakthroughs in foundry-compatible BEOL integration, field-free switching, and system-level demonstrations. Finally, it will look ahead to what must change for SOT-MRAM to scale into its next decade: higher spin-efficiency materials, selector-based area scaling, and robust field-free architectures.

Bio Info

Hong-xi Liu received the Ph.D. in Electronics for Informatics from Hokkaido University, Japan, in 2012. He is the Chief Technology Officer of Truth Memory Corporation (TMC) in Beijing, China. He leads the company's SOT-MRAM R&D, focusing on advancing materials, device physics, and manufacturing integration to transition the technology from laboratory prototypes to manufacturable products. Prior TMC, Dr. Liu worked at SPINTEC (CEA-Grenoble), where he focused on hybrid CMOS/MTJ prototype device engineering. He subsequently worked at GlobalFoundries, contributing to the industrialization of embedded STT-MRAM on advanced CMOS nodes. He focused on process integration and yield enhancement, and successfully brought STT-MRAM into high-volume production. He has authored 50+ publications and holds 50+ patents in MRAM technology, gives 10+ invited talks at academic and industrial forums. His career centers on bridging materials innovation, device engineering, and volume manufacturing to deliver robust, scalable non-volatile memory technologies.