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STT-MRAM: Past History, Current Status and Future Perspectives

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Dr. Yiming Huai serves as VP of Technology and Foundry Partnership at Avalanche Technology, a front runner to commercialize STT MRAM technology. He leads Avalanche STT MRAM product development and manufacturing in collaboration with top-tier foundries and also plays a key role in business development.

Dr. Huai is a pioneer on STT MRAM and was the first to demonstrate spin transfer switching in magnetic tunnel junctions. Dr. Huai received his BS degree in theoretical physics from Shanghai University of Science and Technology and his M.S. and Ph.D. in Physics from the University of Montreal. He worked as a Staff Scientist at the Lawrence Livermore National Laboratory and as a Post-Doctoral Fellow at the National Research Council in Ottawa, Canada. From 1996 to 2001, Dr. Huai served as Sr. Director of Thin Film Manufacturing at Read-Rite Corporation (now Western Digital), where he led the development and volume production of industry leading GMR heads for hard disk drives. In 2002, Dr. Huai cofounded Grandis, Inc., a pioneer in STT MRAM technology and served as CTO, VP of Engineering and board member. While at Grandis, Dr. Huai successfully raised more than \$25M in private and government (DARPA STT MRAM and NIST) funding and led STT MRAM joint development with leading semiconductor companies (Renesas and Hynix). Grandis was acquired by Samsung in 2011. He has published more than 150 papers in scientific journals, and holds more than 160 U.S. patents. He has given more than 60 invited talks on STT-MRAM technology and has served as Conference Chairman and Organizer for major international magnetic and semiconductor conferences and workshops. Dr. Huai was an Editorial Board member of Spin Journal. In 1996, Dr. Huai received the prestigious R&D 100 Award for his innovative work on Ultra-High Density Magnetic Sensors.

Spin transfer torque magnetic RAM (STT-MRAM) is the most promising new nonvolatile memory technology owing to its superior performance of unlimited endurance ($>10^{16}$) and fast switching speed (<10 ns). While Standalone STT-MRAM products are rapidly entering market with increasing varieties of applications, embedded STT MRAM products are on the cusp of mass production with larger market impact. This tutorial will provide an introduction to STT-MRAM from past STT-MRAM development history, including spin transfer torque switching and magnetic tunnel junction basics, to current STT-MRAM product development status with recent landscape in semiconductor industry, to STT-MRAM applications, markets and future perspectives.