Antiferromagnetic Tunnel Junctions for future Gb SOT-MRAM

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Over the past decades, magnetic random-access memory (MRAM) based on electron spin has achieved revolutionary progress. In response to the growing demand for ultra-fast, high-capacity non-volatile memory driven by artificial intelligence, spin-orbit torque MRAM (SOT-MRAM), which employs third-generation write technology, has gained significant attention from both academia and industry. Building upon our self-developed 8-inch manufacturing platform, we have successfully fabricated the world's first 8 Mb SOT-MRAM, which achieves significant breakthroughs in storage capacity and writes speed, and effectively guides the technological roadmap for next-generation MRAM development. However, conventional ferromagnetic (FM)-based MRAM faces bottlenecks in achieving high density and scaled feature sizes due to stray field limitations and the low thermal stability. Consequently, antiferromagnetic spintronics has emerged as a new research topic for overcoming existing barriers. Herein, we demonstrate field-free ultrafast electrical writing in antiferromagnetic random-access memory (ARAM) and report the development of the world's first 128 kb spin-orbit torque antiferromagnetic memory (SOT-ARAM). The device uniquely combines the high-density advantage of zero stray field with ultrafast write capability enabled by high intrinsic precession frequency. This breakthrough offers a critical technological pathway toward next-generation Gb-level memory chips.

References:

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