

Ultrafast Energy-Efficient Spin-Torque Magnetic Random Access Memories

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Primary CNF Tools Used: ASML stepper, Veeco Icon AFM, JEOL JBX-6300FS, AJA sputter

Abstract:

Spin-orbit torques [1-5] have been a hot topic in the research and technology communities due to their great promise for magnetic memories, oscillators and logic of post-Moore era. Here we demonstrate ultrafast energy-efficient magnetic random access memories (MRAMs) [6,7] fabricated at the Cornell NanoScale Science and Technology Facility.

Summary of Research:

We fabricated the spin-torque MRAM devices shown in Figure 1(a). The magnetic multilayer samples are patterned into three-terminal MRAM devices with a three-step procedure. First, we defined the spin Hall channel using DUV lithography (ASML stepper) and ion beam etching and measured the channel size by atomic force microscopy (Veeco Icon). We then defined the elliptical magnetic tunnel junction nanopillars with different aspect ratios and micron-size “via” pillars (as vertical connector between the bottom channel to top contact) onto the spin Hall channel with e-beam lithography (JEOL JBX-6300FS) and ion beam etching, and isolated the pillars with 80 nm thick SiO₂ deposited by an e-beam evaporator. Finally, contacts of Ti/Pt were deposited on the top of the magnetic tunnel junction pillars and “via” pillars for electrical measurements by combining the DUV lithography (ASML stepper), AJA sputtering, and liftoff processes.

Figure 1(b) shows ultrafast, reliable, and efficient current switching of our spin-torque MRAMs.

References:

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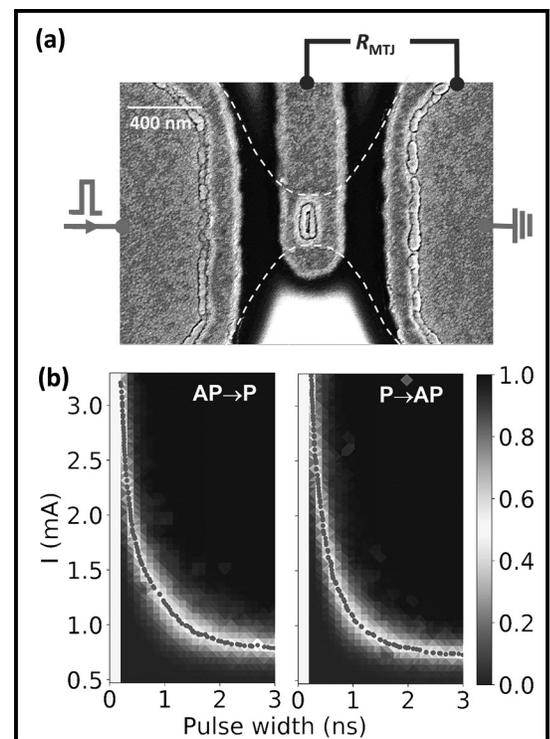


Figure 1: (a) Top-view scanning electron microscopy image of a spin-torque MRAM device; (b) Current-induced switching of the MRAMs. (See pages vi-vii for full color version.)

