Title:	Modeling for Improved Performance of Ultra-Fast Nonvolatile Toggle Spin Torque MRAM Bit-Cell
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Abstract:	In the recent past, exploiting nonvolatile memory devices to facilitate in-memory computation benchmarks has demonstrated a considerable capability to address the von-Neumann drawbacks. This process resulted in a tremendous effort towards spintronics memory development. Due to the voltage-controlled magnetic anisotropy (VCMA) effect, the toggle magnetoresistive random-access memory (MRAM) exhibits faster switching and lower power consumption than spin-transfer torque (STT) MRAM. We assessed read/write access time, magnetized time and anisotropic field for crystalline perpendicular magnetic tunnel junctions (CPMTJ) with detailed material study and device parameters in this work. These junctions are affected by the VCMA effect. Various VCMA parameters, including the VCMA coefficient, the time constant and antiparallel (AP) resistance on the saturated magnetization, are measured via the memory cell's SPICE modeling. The Rashba spin–orbit interaction (SOI) and spin-valve model are developed by MATLAB scripting for evaluating a Rashba and Hamiltonian vector field. The toggle spin torque (TST) in the TST-MRAM cell is generated due to the interconnection between STT and spin–orbit torque (SOT) mechanisms. The TST-MRAM cell's benefits are energy efficiency, large TMR ratio and superfast read and write operation. This work's novel part is that the Hamiltonian field can control the net magnetization factor by the Rashba SOI effect. We end this paper with the performance enhancement techniques of MRAM cells due to VCMA and Rashba SOI effect.
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