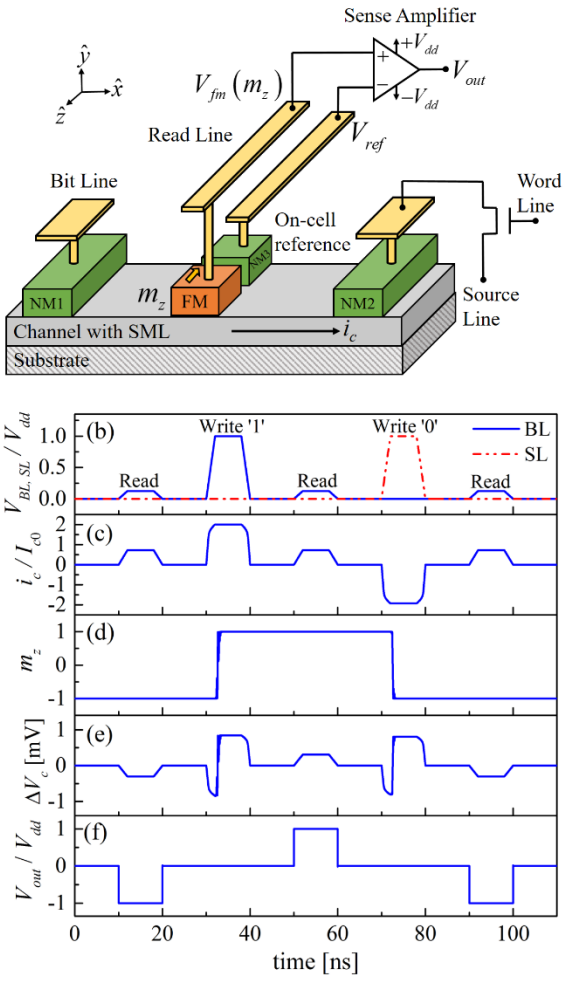
Novel Spin-Orbit Torque Driven MRAM without MTJ

Magnetoresistive random access memory (MRAM) is one of the emerging memory technologies due to fast read / write, high endurance, and low power consumption. State-of-the-art MRAM designs use either spin-transfer torque (STT) or spin-orbit torque (SOT) to write information. However, both utilize magnetic tunnel junctions (MTJ) to read information.



Researchers at Purdue University have proposed that the MTJ and associated synthetic anti-ferromagnetic layer in SOT driven MRAM can be replaced by a single storage ferromagnet (FM) contact which can read information directly through the recently demonstrated phenomenon of current-induced spin voltage whose sign depends on the magnetization direction of the FM. This is expected to simplify the fabrication steps and improve reliability compared to existing MTJ based designs.

It should be possible to implement this proposal within the established interconnection and control scheme of STT MRAM, since read and write currents share the same path. The proposal also offers on-cell reference voltage generation without any external circuitry, which is believed to improve performance in a large array by enabling simple and efficient self-referencing. The read signal in the proposed design is lower than state-of-the-art MTJ based designs, but the noise is also expected to be lower in this metallic structure.

The research was performed by Shehrin Sayed (email: ssayed@purdue.edu), working for Supriyo Datta, the Thomas Duncan Distinguished Professor of Electrical and Computer Engineering. The proposal has been accepted for publication in IEEE Electron Device Letters (DOI: 10.1109/LED.2017.2761318) and available online. The research was supported by FAME, one of six centers of STARnet, a Semiconductor Research Corporation program sponsored by MARCO and DARPA.