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**A Three Terminal Approach to Spin-Torque Written MRAM Cells**

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Magnetic random access memory (MRAM) is a potentially superior alternative to silicon-based memories due to a combination of properties including non-volatility, fast read/write times, and low power consumption. Future MRAM technologies have been considered which use the spin transfer effect as a mechanism for bit element writing. Here, a spin polarized current passing through a ferromagnetic element is used to reverse its moment via an exchange of angular momentum, as opposed to the magnetic fields from remote write lines used in more conventional toggle MRAM [1]. However, the large current densities required for spin transfer reversal create significant barrier wearout issues in the magnetic tunnel junctions (MTJs) used as bit elements. One possible solution is to develop a nanopillar structure where a third electrode can be made to any point within a thin-film multilayer stack, substantially enhancing the versatility of the device by providing the means of applying independent electrical biases to two separate parts of the device. Using experimental results and micromagnetic simulations, I will discuss a joint magnetic spin valve/tunnel junction structure sharing a common free layer nanomagnet contacted by this third electrode [2]. A spatially nonuniform spin-polarized current flowing into the free layer via the low-resistance spin valve path can reverse the magnetic orientation of the free layer as a consequence of the spin torque effect, by nucleating a reversal domain at the spin injection site that propagates across the free layer. The free layer magnetic state can then be read out separately via the higher-resistance magnetic tunnel junction. This three-terminal structure provides a strategy for developing high performance spin-torque MRAM cells which avoids the need to apply a large voltage across a MTJ during the writing step, thereby enhancing device reliability, while retaining the benefits of a high-impedance MTJ for read-out.

[1] Slaughter J.M., Dave R.W., DeHerrera M., Durlam M., Engel B.N., Janesky J., Rizzo N.D., Tehrani S., Fundamentals of MRAM technology, *Journal of Superconductivity: Incorporating Novel Magnetism* 15, 19 (2002).
[2] Braganca P.M., Katine J.A., Emley N.C., Mauri D., Childress J.R., Rice P.M., Delenia E., Ralph D.C., Buhrman R.A., *IEEE Trans. Nanotechnol.*, In press (2008).