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State Diagram of Orthogonal Spin-Transfer Spin-Valve Devices
LI YE, GEORG WOLF, DANIELE PINNA, ANDREW KENT, Department of Physics, New York University, New York, NY 10003, USA — Orthogonal spin transfer (OST) devices that incorporate an out-of-plane magnetized polarizing layer with an in-plane collinear spin valve are expected to exhibit ultrafast magnetization switching as well as large amplitude precessional modes. The current and field dependence of the switching thresholds are also distinct from the collinear spin-valves because of the combined effect from in-plane reference layer (RL) and polarizing layer (PL). Here we present an experimental investigation of complete current-field state diagrams, demonstrating reversal between parallel (P) and anti-parallel (AP) states and dynamic states of the free layer in both OST pseudo spin valve and spin valve devices, where in the latter a synthetic anti-ferromagnetic layer (SAF) is used as reference layer. Switching from AP (P) to P (AP) states is observed at both positive and negative current with a different field dependence of the critical current, reflecting spin polarization asymmetry between AP and P states and different RL and PL spin torque efficiencies. High frequency noise spectra have also been acquired providing evidence of out-of-plane precessional modes, where an intermediate resistance is seen in quasistatic measurements. Modeling of this orthogonal spin transfer system is also discussed.

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