Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Stochastic Resonance Driven by Spin Torque in Nanoscale Magnetic Tunnel Junctions XIAO CHENG, University of California Irvine, JORDAN KATINE, Hitachi Global Storage Techonologies, GRAHAM ROWLANDS, JIAN ZHU, CARL BOONE, ILYA KRIVOROTOV, University of California Irvine —

Application of a microwave current to a nanoscale magnetic tunnel junction (MTJ) gives rise to a rectified voltage, V_r, generated by magnetization oscillations driven by spin transfer torque. We study the effect of direct current bias on these dynamics in nanoscale MTJs with superparamagnetic free layers. For certain combinations of the direct current and external magnetic field, we observe large (nearly three orders of magnitude) enhancement of V_r compared to V_r at zero direct current. For a 2-GHz alternating current of 0.04 mA rms amplitude, the rectified voltage reaches 55 mV. The large magnitude of the rectified voltage indicates that large-amplitude magnetization precession is excited by weak ac spin transfer torque in the presence of the direct current bias. The large enhancement of V_r takes place only above a threshold temperature, which points to a stochastic character of the observed large-amplitude dynamics. The dependence of V_r on temperature and current reveals that this new type of large-amplitude high-frequency dynamics is non-adiabatic stochastic resonance of magnetization excited by spin transfer torque. This new type of magnetic resonance may find use in sensitive microwave signal detectors and magnetic field sensors of nanoscale dimensions.

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Date submitted: 20 Nov 2009

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