MAR08-2007-004406

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Large angle out of plane steady precession induced by spin-transfer with perpendicular to plane polarizer

DIMITRI HOUSSAMEDDINE, Spintec - CEA/CNRS

The dynamics of a ferromagnetic system is characterized by a conservative precession torque, as well as a non-conservative damping torque. The damping torque is responsible for the realignment of the magnetisation with the equilibrium direction after excitation. Recently it has been shown that the damping torque can be compensated by a spin transfer torque that is due to the interaction between a spin polarized current and the local magnetization. This additional spin transfer torque can lead to auto-oscillations of the magnetization close to constant energy trajectories. The potential exploitation of such large angle auto-oscillations for tuneable microwave devices is currently driving many research efforts. For an in-plane magnetized thin film with uniaxial anisotropy, two types of constant energy trajectories exist which are commonly called in-plane precession (IPP), where the magnetization oscillates around the in-plane energy minimum, and out of plane precession (OPP) where the magnetization oscillates around the out of plane energy maximum [1]. IPP and OPP oscillations differ substantially in their dependence of frequency and amplitude as a function of current and/or applied bias field. In many experiments so far, IPP precessions have been obtained at the threshold current using in-plane magnetized spin valve structures. However, from an applications point of view it will be of interest to excite OPP oscillations since they will lead to a larger output signal than IPP oscillations. Here, we will present experimental evidence of large angle OPP oscillations using a spin torque oscillator that contains a perpendicularly magnetized polarizing layer and an in-plane magnetized analyzing layer in addition to a planar free layer [2]. We will show that OPP oscillations are induced at the threshold current for moderate current densities of 9×10^6 A/cm^2. The experimental current-field state diagram as well as the dependence of the frequency vs. current and applied bias field is in good qualitative agreement with macrospin and micromagnetic simulations. Furthermore, due to the planar analyzer, there exist IPP oscillations which allow a direct comparison of the OPP and IPP precession amplitudes. [1] A. N. Slavin, V. S. Tyberkevich Phys. Rev. B 72, 94428 (2005) [2] Houssameddine et al, Nature Materials 6, 441 (2007)