MAR17-2016-000404

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Spin-Orbit Torques and Magnetoresistance in 5d and 4d Metal Systems

PIETRO GAMBARDELLA, ETH Zurich

Heterostructures composed of ferromagnetic (FM) and heavy metal (HM) layers have been studied for decades due to their application as perpendicular magnetic recording media. Only recently, however, experiments and theory have evidenced a wide range of magnetotransport phenomena that have little or no counterpart in single FM layers. The absorption and reflection of spin currents induced by spin-orbit coupling in FM/HM bilayers are responsible for the generation of spin-orbit torques (SOT) as well as for unusual magnetoresistive phenomena. The origin of such spin currents is still widely debated. In this talk we will compare the SOT in 5d and 4d metal systems, namely in Co/Pt and Co/Pd bilayers, showing how the reduced bulk spin Hall effect of Pd allows for the detection of interface-related field-like and damping-like SOT, highlighting diverse effects contributing to the total spin current. Further, we will present a comparative study of the spin-orbit torques and magnetoresistance in the linear and nonlinear (current-dependent) regimes. The magnetoresistance of Co/HM bilayers (HM = Ta, W, Pt) is phenomenologically similar to the spin Hall magnetoresistance (SMR) of YIG/Pt, but has a much larger anisotropy, of the order of 0.5 %, which increases with the atomic number of the HM. Additionally, we find a novel magnetoresistance term that is directly proportional to the current and to the transverse component of the magnetization. This so-called unidirectional magnetoresistance changes sign upon inversion of either current or magnetization and correlates with the amplitude of the damping-like SOT.