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Current-driven Magnetisation Reversal in CoFeTaB/Pt Probed By X-ray Magnetic Reflectivity

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ABSTRACT
Electrical control of magnetisation offers a promising alternative to conventional external magnetic fields for manipulating magnetic materials. This work investigates the current driven magnetisation reversal in CoFeTaB/Pt taking advantage of the magnetisation direction and the polarisation dependence of the X-ray scattering cross-section [1]. A current is applied perpendicular to the scattering plane to induce magnetisation reorientation within the plane [2]. Hysteresis curves are measured during the current cycle using both positive circular (pc) and negative circular (nc) polarisation at Fe-L3 resonance. The asymmetry ratios ((Rpc-Rnc)/(Rpc+Rnc)) derived from the X-ray magnetic reflectivity (XRMR) measured during the current cycle indicate transitions between two magnetic states. The XRMR measurements are performed in these magnetic states with circular polarisation as a function of angle. The asymmetry ratios in this case show slight variations in both magnetic states. The measurements with linear polarisation (sensitive to the out of scattering plane components of magnetisation) show significant asymmetries, suggesting a substantial perpendicular magnetisation component in the current-driven states and hence, incomplete magnetisation switching with applied current [3]. The optical modelling suggests that the magnetisation switching occurs primarily in the region close to the interface. Therefore, the interfacial magnetisation is probed by proximity-induced magnetism in the Pt layer. The XRMR measurements at Pt L3 edge during a current cycle reveal a hysteresis curve with sharp transitions between two magnetic states. The measurements on field driven hysteresis curves show that the Pt moments are aligned transverse to the bulk CoFeTaB magnetisation. The application of electric current results in the reorientation of this transverse magnetisation only, resulting in the incomplete magnetisation switching of the film.
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