Asymmetric modification of the magnetic proximity effect in Pt/Co/Pt trilayers

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Interfacial spin-orbit coupling in the ferromagnet-nonmagnet (FM/NM) systems promotes remarkable spin-related phenomena and interactions such as interfacial spin Hall effect, interfacial Dzyaloshinskii–Moriya interaction (iDMI), Rashba effect and spin–orbit torque (SOT). All these effects simultaneously provide the electrical manipulation of the magnetization to control magnetization switching by current-driven domain wall motion. A static magnetic moment in the adjacent NM can be induced by the FM in certain FM/NM systems (e.g. Fe/Pd, Fe/Pt). The phenomenon of a nominally paramagnetic material getting spin-polarized in presence of an adjacent FM or ferrimagnetic material by the exchange interaction, is known as magnetic proximity effect (MPE). Furthermore, broken spatial inversion symmetry at the FM-NM interface can attribute to non-equivalent spin-transport properties (e.g. SOT, iDMI) in NM/FM/NM systems. The magnetic proximity effect in top and bottom Pt layers induced by Co in Ta/Pt/Co/Pt multilayers has been studied by interface sensitive, element specific x-ray resonant magnetic reflectivity. The asymmetry ratio for circularly polarized x-rays of left and right helicity has been measured at the Pt L3 absorption edge (11567 eV) with an in-plane magnetic field (±158 mT) to verify its magnetic origin. The proximity-induced magnetic moment in the bottom Pt layer decreases with the thickness of the Ta buffer layer. Grazing incidence x-ray diffraction has been carried out to show that the Ta buffer layer induces the growth of Pt(011) rather than Pt(111) which in turn reduces the induced moment. A detailed density functional theory study shows that an adjacent Co layer induces more magnetic moment in Pt(111) than in Pt(011). The manipulation of the magnetism in Pt by the insertion of a Ta buffer layer provides a new way of controlling the MPE which is of huge importance in spin-transport experiments across similar kind of interfaces.