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Measuring interfacial magnetic configurations with Polarized Neutron Reflectometry

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Polarized neutron reflectivity (PNR) is ideally suited for imaging both vertical structural and magnetic variations in the complex magnetic multilayers [1]. During the talk will be described particularly how this technique allows obtaining the magnetic depth-profile of exchange-coupled bilayer. For instance, Gd40Fe60/ Tb12Fe88 is a model system to study exchange-bias phenomena origin in anti-ferromagnetically coupled AF/FM system, like FeF2/Fe. In these systems, unusual properties are observed such as a transition from positive to negative exchange bias field HE as the cooling field Hcf is swept from small to large positive value [2]. Combining complementary techniques that are macroscopic magnetization measurements and PNR, we have demonstrated that the above properties, e.g. the cooling field dependence of HE, come from an interfacial domain wall (iDW) frozen in the TbFe as the sample is cooled down under a field [3, 4]. Moreover, PNR measurements have recently revealed that the frozen iDW is metastable and that the exchange bias training effect in TbFe/GdFe results from the thermally assisted relaxation of the iDW, with field cycling [4, 5]. Overall, PNR studies concerning the TbFe/GdFe have brought strong insights into the exchange bias mechanisms in exchange coupled hard/soft systems with in-plane anisotropy. However we have demonstrated as well that this powerful technique can be applied to systems with perpendicular magnetic anisotropy (PMA). Although, in that case, the perpendicular moments are parallel to the scattering vector and do not give rise to scattering via the neutron selection rules, we have used a unconventional geometry to obtain a depth-dependent magnetic profile of a PMA exchange-coupled system. Specifically, we have characterized antiferromagnetically-coupled, TbFeCo/[Co/Pd] multilayers [6].

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