Unveiling the Underlying Mechanism of Proximity Induced Magnetism in thin-film Heterostructure

Dr Oto-obon Inyang
Durham University, United Kingdom

Proximity induced magnetism (PIM) is an interfacial effect that has been inferred to impact several spin-dependent transport phenomena. However, there is limited understanding of the underlying mechanism of PIM where Pt has been widely chosen for PIM studies due to its large spin-orbit coupling. Here, we used two complementary reflectivity techniques of polarized neutron reflectivity (PNR) and X-ray resonance magnetic reflectivity (XRMR) to shed light on the phenomenology of PIM in Pt at proximity with TM in a Pt/TM/Pt trilayer system [1]. The PNR provides the depth-dependent magnetization of the entire sample while XRMR turned to Pt L3 absorption edge provides the spin-polarized magnetic moment of Pt.

In addition, I will present our recent finding on the alignment of PIM in an antiferromagnetically coupled alloy of transition metal and rare-earth metal (RE) ferrimagnet of RE dominated and TM dominated ferrimagnetic system. This was inspired by an initial investigation on the magnetization reversal behavior of low Gd doped RE-TM alloy of GdCo, GdFe and GdCoFe thin-films [2]. Using X-ray magnetic circular dichroism (XMCD) and XRMR, we demonstrated that PIM follows the TM magnetization direction despite the dominant sublattice or net magnetization [3]. These pieces of information are essential in the design of Spintronic devices and spin-dependent transport experimental analysis.

[1] Inyang, O., Bouchenoire, L., Nicholson, B., Tokaç, M., Rowan-Robinson, R. M., Kinane, C. J., & Hindmarch, A. T. (2019). Threshold interface magnetization required to induce magnetic proximity effect. Physical Review B, 100(17), 174418.

[2] Inyang, O., Rafiq, A., Swindells, C., Ali, S., & Atkinson, D. (2020). The role of low Gd concentrations on magnetisation behaviour in rare-earth: transition metal alloy films. Scientific Reports, 10(1), 1-8.

[3] Swindells, C., Nicholson, B., Inyang, O., Choi, Y., Hase, T., & Atkinson, D. (2020). Proximity-induced magnetism in Pt layered with rare-earth–transition-metal ferrimagnetic alloys. Physical Review Research, 2(3), 033280.

WebEx Meeting
Meeting number (access code): 199 424 1285
Meeting password: jpCeCTs?637

For further information, contact Jeff Lynn: jeffrey.lynn@nist.gov