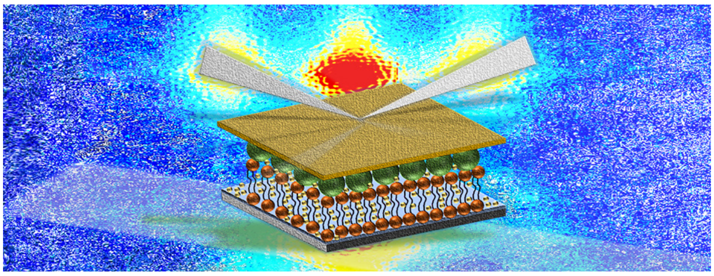

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Investigation on the presence of magnetic skyrmions in SrIrO3/SrRuO3 bilayer Interface on SrTiO3

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Topological magnetic textures, known as magnetic skyrmions, hold significant promise for applications as nanoscale information components in logic and memory devices. These quasiparticles, characterized by their swirling spin configurations, exhibit unique advantages due to their stability, diminutive size, and the low current densities required for manipulation [1]. In transition metal oxides, electronic correlations between 4d and 5d oxides in bilayer forms induce strong spin-orbit coupling (SOC), facilitating the formation of magnetic skyrmions on the surface of $SrRuO_3$ (SRO). Stacks of $SrRuO_3/SrIrO_3$ (SIO) epitaxial layers integrate essential elements such as the Dzyaloshinskii-Moriya interaction (DMI), large perpendicular magnetic anisotropy (PMA), and spin-orbit torques (SOT) to stabilize magnetic skyrmions and enable their efficient current-driven motion. Bilayers of SRO/SIO are grown on TiO_2 terminated $SrTiO_3$ (STO) (001) substrates, where the growth of SRO is achieved via High Oxygen Pressure Sputtering (HOPS) and SIO via Molecular Beam Epitaxy (MBE). Precise control of film thickness is crucial to maintain the intrinsic properties of both materials and observe magnetic skyrmions. Therefore, we systematically vary the thickness of both the layers to optimize their magnetic properties, magnetoresistance and the Hall effect that includes ordinary Hall effect (OHE), anomalous Hall effect (AHE), and Topological Hall effect (THE). Given the challenges associated with directly observing skyrmions directly at the nano-meter scale in the real space, we employ the topological Hall effect as an indirect method to characterize magnetic skyrmions in ferromagnetic thin films[2]. For detailed interfacial and surface studies of the thin films, Polarized Neutron Reflectometry (PNR) and Grazing Incidence Small Angle Neutron Scattering (GISANS) will be performed. The expected results will test the hypothesis of the presence of ordered magnetic skyrmions and their contribution to the topological Hall effect in the bilayer oxide thin film, potentially advancing our understanding of skyrmion dynamics and their application in spintronics devices.

[1] N. Nagaosa et. al. Nat. Nanotechnol. 8, 899-911, (2013).
[2] Xu Niu et. al. J. Phys.: Condens. Matter 34, 244001, (2022).

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