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Interface Engineering and Emergent Magnetism in Oxide Heterostructures

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Complex oxide interfaces have mesmerized the scientific community in the last decade due to the possibility of creating tunable novel multifunctionalities, which are possible owing to the strong interaction among charge, spin, orbital and structural degrees of freedom. Artificial interfacial modifications, which include defects, formal polarization, structural symmetry breaking and interlayer interaction, have led to novel properties in various complex oxide heterostructures. These emergent phenomena not only serve as a platform for investigating strong electronic correlations in low-dimensional systems, but also provide potentials for exploring next-generation electronic devices with high functionality. In particular, emergent magnetism at the oxide interfaces has profound application in future development of spintronic memory. In this talk, I will review our effort in exploring interface magnetism in various different systems. I will then focus on an heterostructure based on CaMnO_3/CaIrO_3 superlattices which is found to possess interface ferrimagnetism by charge transfer, perpendicular magnetic anisotropy up to room temperature, as well as Topological Hall Effect (THE) indicating the presence of magnetic Skyrmion. Emergence of Skyrmions in such symmetric, antiferromagnet/paramagnet superlattice is the first of its kind, and its stabilization is explained by an “interfacial roughness model”. The abrupt suppression of THE by large current allows measurement of threshold current density of ~10^8 A/m^2 and Skyrmion drift velocities. This system provides a novel route in stabilizing the Skyrmion phase in oxide heterostructure.

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