MAR16-2015-000934

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Engineering a spin-orbital magnetic insulator by tailoring iridate-based superlattices

JOBU MATSUNO, RIKEN Center for Emergent Matter Science

In $5d$ Ir oxides with an interplay of spin-orbit coupling and electron correlations, we have tailored a spin-orbital magnetic insulator out of a semimetal $SrIrO_3$ by tuning the structure through superlattices $[(SrIrO_3)_m, SrTiO_3]$ ($m = 1$, 2, 3, 4, and ∞) grown on $SrTiO_3(001)$ substrates. We observed the systematic decrease of the magnetic ordering temperature and the resistivity as a function of m. The transition from the semimetal to the insulator is found to be closely linked to the appearance of magnetism at $m \simeq 3$. Long range magnetic ordering was realized even in the $m = 1$ single layer superlattice, implying that the design and realization of novel electronic phases is feasible at the level of a single atomic layer in complex Ir oxides. We also report the fabrication of (111)-oriented superlattice structures with alternating $2m$-layers ($m = 1$, 2, and 3) of $Ca_{0.5}Sr_{0.5}IrO_3$ perovskite and two layers of $SrTiO_3$ perovskite on $SrTiO_3(111)$ substrates. In the case of $m = 1$ bilayer films, the Ir sublattice is a buckled honeycomb, where a topological state may be anticipated. The ground states of the superlattice films were found to be magnetic insulators, which may suggest the importance of electron correlations in Ir perovskites in addition to the much discussed topological effects.