Observation of antiparallel Ru-Ir spins in $SrRuO_3$-$SrIrO_3$ heterointerface

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Intriguing phenomena in spintronic devices have been arising in heterostructures of ferromagnets and non-magnetic materials with strong spin-orbit coupling (SOC) [1-3]. In addition to the metallic systems, heterostructures composed of epitaxially grown oxides can provide a new point of view in understanding the interface physics and designing more efficient systems. One of such oxides is the perovskite-based heterostructure composed of ferromagnetic $SrRuO_3$ and non-magnetic $SrIrO_3$, where strong SOC in $SrIrO_3$ induces interface-driven topological Hall effect associated with magnetic skyrmions [4].

Here we investigate magnetic proximity effect in $SrIrO_3$ neighboring $SrRuO_3$ by x-ray magnetic circular dichroism (XMCD) at SPring-8 BL39XU. We prepared the epitaxial superlattice of $SrRuO_3$ (5 unit cells) and $SrIrO_3$ (3 unit cells) on a $SrTiO_3$ substrate by pulsed laser deposition method [Fig. 1(a)]. XMCD signals at the Ir L_3 and L_2 edges are observed at 25 K [Fig. 1(b)]. The induced magnetization is as small as 0.02 μ_B/Ir, which is antiparallel to the magnetization of $SrRuO_3$. By applying the sum rules, we clarified that the orbital component in the Ir magnetic moment is 0.01 μ_B/Ir. This large proportion of the orbital magnetic moment is in contrast with the conventional metallic systems such as Pt/Co. These results and theoretical calculation suggest that SOC in $SrIrO_3$ plays an important role in the proximity induced magnetization.

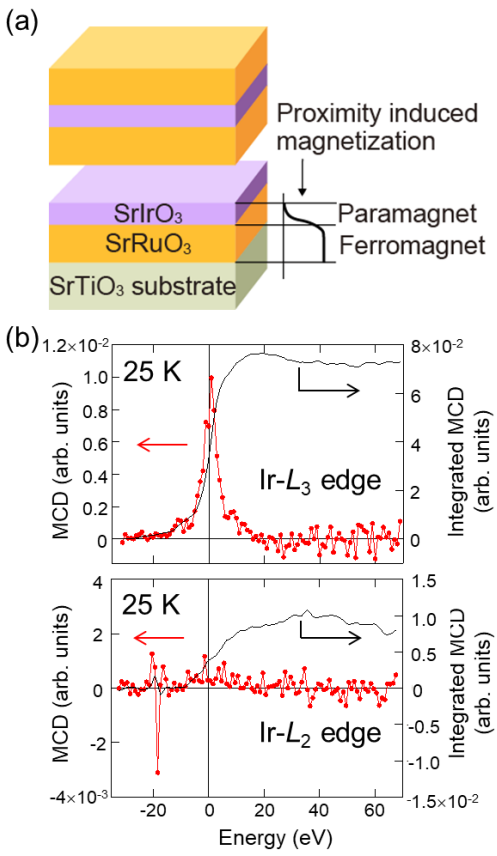

Fig. 1: (a) Schematic of proximity induced Ir-magnetization in $SrRuO_3$/$SrIrO_3$ superlattice. (b) XMCD signals at the Ir-L_3 edge (top) and Ir-L_2 edge (bottom) at 25 K.

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