SKKU-PNU Quantum Matter Seminar Series

Oxide electronics utilizing spin-orbit coupling

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ZOOM Webinar https://pusan.zoom.us/j/84514331691?pwd=MW9xaGpoUHNHS0o2VEYzZ1Z4QTlpdz09

Abstract A strong spin-orbit coupling (SOC) inherent to 5*d* electron systems recently emerged as a new paradigm for oxide electronics. For example, we investigated novel physics of spin-orbital Mott insulators [1] and possible topological insulators [2] by tuning the electronic phases through superlattice technique. In this talk, we suggest that 5*d* Ir oxides are promising class of spintronic materials by focusing on two topics: magnetic skyrmion and spin current.

Magnetic skyrmion is a topological spin texture, which is promising for low-power electronics since it can be driven by tiny current. We have studied transport properties of $SrRuO_3$-$SrIrO_3$ bilayers to observe an anomaly in the Hall resistivity in addition to anomalous Hall effect (AHE); this is attributed to topological Hall effect (THE) [3]. The results suggest that magnetic skyrmions of 10–20 nm are generated by the combination of broken inversion symmetry at the interface and strong SOC of $SrIrO_3$. Even more surprising is that we can control both AHE and THE by electric field in the $SrRuO_3$-$SrIrO_3$ bilayers [4]. The results established that strong SOC of nonmagnetic $SrIrO_3$ is essential in electrical tuning of these Hall effects.

Spin-current is a flow of spin angular momentum without any charge current; low-power electronics is expected based on spin current. A charge current can be converted into a spin current and vice versa, known as the spin Hall effect (SHE) and the inverse spin Hall effect (ISHE). We demonstrated a large ISHE of IrO_2, one of the simplest 5*d* oxides [5]. Very recently we also evidenced a large SHE of IrO_2 through spin-orbit torque generation [6]. The results indicate that Ir oxides are promising class of spintronic materials in terms of spin current.

References:

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