National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Study of Rashba Spin-orbit Coupling in Oxide Heterostructures
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Venue	: Google Meet (https://meet.google.com/kti-ktiw-rhk)
Date and Time	: 09 Jul 2024 (11:00 A.M)
Abstract	: Spintronic devices hold the promise of being resilient, energy-efficient, and non-volatile compared to conventional electronic devices. One of the fundamental aims of spintronics is to develop efficient methods for controlling electrons&rsquo spin degrees of freedom. Interestingly, the Rashba spin-orbit (RSO) effect, which arises due to the interplay of intrinsic spin-orbit coupling and broken structural inversion symmetry offers an efficient route for such control. In this respect, transition metal-based oxide heterostructures have emerged as the front-runner due to strong intrinsic spin-orbit coupling, higher spin-flip length, and ease of breaking the structural inversion symmetry. However, most of these systems are ill-suited for device applications due to the emergence of magnetism at the interface. In this thesis, we employ functional theory (DFT) based first-principles calculations to study a polar-nonpolar sandwich heterostructure made of $LaAlO_3$ (LAO)/$SrTiO_3$ (STO) and the polar-polar heterostructure made of $LaAlO_3$/$KTaO_3$ (KTO) and demonstrated that these structures are nonmagnetic while hosting the RSO effect prominently. Surprisingly, we have found a strong inter-orbital coupling between t_{2g} and e_g orbitals, which contributes to the RSO effect, in the LAO/STO heterostructure. Furthermore, we find that the strength of the cubic Rashba splitting in this system surpasses the linear Rashba splitting. On the other hand, we have found evidence of both cubic and linear Rashba interactions in the LAO/KTO heterostructure, and the linear RSO coupling strength found in this system is the highest among the non-magnetic oxide heterostructures. Moreover, a potential photocurrent transition path has been discovered in this heterostructure, making it an excellent platform to study the circularly polarized photogalvanic effect.