Title:	Emergent phenomena at the conducting interface of insulating oxides with strong spin-orbit coupling
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Keywords:	Insulating oxides Strong spin-orbit coupling Integration density
Issue Date:	28-Jul-2021
Publisher:	IISERM
Abstract:	Semiconductors have been the keystone of the field of electronics for decades. The development of high quality growth techniques and our theoretical understanding enabled the realization of a pool of devices such as transistors etc. and revolu- tionised the way of human living. However, with the evolution of mankind, there is always a demand of materials with larger integration density and enhanced prop- erties. The urge of attaining new functionalities in modern electronic devices led to the manipulation of spin degree of freedom of an electron along with its charge and gave rise to an altogether new field of ”spintronics”. Recently, among different classes of materials, ”oxides”, possessing an astounding variety of properties have emerged as potential candidates for spintronics applications. Oxides, particularly, transition metal oxides (TMOs) are a hunting ground to study many fascinating physical properties due to the interplay between their spin, lattice, and orbital de- grees of freedom and the presence of strong electron correlations. The benefit of using TMOs over semiconductors for spintronic applications is that many emergent phenomena can be integrated on a single platform due to the electron correlations present and the materials exhibit a full spectrum of electronic, optical, and mag- netic behavior: insulating, semiconducting, metallic, superconducting, ferroelectric, pyroelectric, piezoelectric, ferromagnetic, multiferroic, nonlinear optical effects and so on. All these properties and particularly their integrability in oxides make them the materials of choice for future generation electronic devices. It has been realized that momentum dependent splitting of spin-bands in an electronic system, the ”Rashba effect”, plays a key role in spintronic devices and the essential condition to realize the Rashba effect is strong spin-orbit coupling. In this dissertation work, we have tried to explore and study perovskite oxide, KTaO 3 (KTO) and fabricate its heterostructure with Mott-insulator LaVO 3 (LVO). The aim of choosing KTO is its strong spin-orbit coupling in addition to the simple cubic structure and other properties like high dielectric constant etc. which makes it suitable for future generation spintronic devices. The heterostructure LVO-KTO prepared in this work is found to exhibit emergent phenomena like interfacial con- ductivity, planar Hall effect and anomalous magnetoresistance due to Rashba spin- band splitting. This makes LVO-KTO a potential candidate for channel material of a spin-transistor. In addition to this, the heterointerface is found to have linear dispersion relation at the crossing point of Rashba spin-bands which is similar to the Dirac cone formation in topological systems and hence the system is a playground to explore topological phases in oxides which may unravel many mysteries of science. Other than, the LVO-KTO heterostructure, this thesis also focuses on the applica- tion of KTO in optoelectronic and storage devices and discusses its photo-response and nano-electrical domain writing using atomic force microscopy tip.
URI:	http://hdl.handle.net/123456789/3737
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