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Title:	OPTO-ELECTRICAL PROPERTIES OF THE 2DEG AT THE CONDUCTING INTERFACE OF EuO-KTaO3
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Abstract:	Oxides are an exciting class of materials with a wide range of fascinating electrical, magnetic and optical properties, promising for constructing multifunctional devices. Till date, silicon is the basis of conventional electronic and photovoltaic applications. Recently the interfaces and surfaces of oxide heterostructures have been gaining interest in scientific communities due to a rich variety of emergent phenomena that include the realization of high mobility two- dimensional electron gas, superconductivity, magnetism, ferroelectricity, quantum Hall effect, etc. Recent advances in creating complex oxide heterostructure, interfaces formed between two different transition metal oxides, have heralded a new era of materials and physics research, enabling a uniquely diverse set of coexisting physical properties to be combined with an ever- increasing degree of experimental control. The heterostructure of oxides can be tuned by various external stimuli but the most effective stimuli are the back gating and light irradiation, where we can even change the state of a system from insulating to conducting. Strontium titanate (STO) is one of workhouses in the emerging technologies based on complex oxide interfaces and hetero-structures. STO has been the centre of attention among various oxides for more than half a century. In this thesis, we focus on a rather new member of the perovskite oxide family, KTaO 3 (KTO), which has properties similar to STO but in addition to them, has an order of magnitude higher spin-orbit coupling strength than that of STO. Recently, an unusual 2D superconductivity was found at interfaces between KTO (111) single-crystal substrates and other oxide films including LaAlO 3 , EuO, YAlO 3 , and TiO X . In the first part of the thesis, we have focussed on the optimization and standardization of the pulsed laser deposition (PLD) system. Thin film growth using PLD hinges on various parameters that decide the composition, structure, quality, and finally the physical properties of the films, interfaces, and superlattices. Here, it is demonstrated that how the growth conditions inside the chamber during the growth can be judged from the outside by combining in-situ and ex-situ techniques. Further, the highly spin-polarized ferromagnetic semiconductor, EuO has been examined as a potential candidate for spintronics and optoelectronic applications and is chosen as a depositing material on KTO substrate. We optimized the EuO-KTO interface and then studied its opto-electrical properties at different temperatures. We have shown how the photoconductivity changes with temperature, carrier density, and wavelength of light. In another part, we found up to 3 order changes in conductivity at room temperature when we simultaneously applied the light and electric field. Our results may provide a guideline to achieve higher performance in oxide-based memory devices and optical switches. Finally, we will also present the high field (60 T) magneto-transport data at the EuO-KTO interface. High amplitude quantum Shubnikov de Hass (SdH) oscillations are observed at different tilt angles at low temperatures as 0.7 K. Apart from detailed observation of the electronic properties of the KTO-2DEG, this study demonstrates a possible route of studying quantum transport in 2DEG based on 5d-oxides.
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