Abstract

Perovskite oxides (ABO 3) possessing a broad spectrum of properties such as ferroelectricity, ferromagnetism, charge ordering, etc. have been gaining an unrivalled position in the field of spintronics. Several theoretical and experimental studies have uncovered emergent phenomena emerging at their interfaces like superconductivity, Quantum Hall effect, Subhnikov de Hass oscillations, magnetoreistance, magnetism, planar Hall effect etc. The formation of high mobility two dimensional electron gas (2DEG) at the interface of two perovskite oxides has revolutionized the field of oxide electronics. But the origin of this interface conductivity has been a matter of intensive studies. The main aim of the thesis is to investigate the mechanism of 2DEG formation at oxide interface and to explore its interface properties. To realize such phenomena at oxide interface, the foremost requirement is to use atomically flat single terminated surface of the substrates with proper termination. In this thesis, we first present a chemical free non-corrosive technique to achieve the single terminated surface of the oxide single crystals using de-ionized water followed by annealing. To study the mechanism for interface conductivity, we have grown LaVO 3 (LVO) thin films on TiO 2 terminated SrTiO 3 (STO) single crystals with orientation (001) employing Pulsed Laser Deposition system. A comparison of our results on LVO/STO interface with well studied interface of LaAlO 3 (LAO) and STO indicates that the film stoichiometry might be an important key to generate conducting states at the interface of Perovskite oxides. Another part of the thesis focuses on the exploration of such oxides and their heterostructures for technological point of view. For opto-electronic device applications, we studied the effect of simultaneous application of light and electrostatic gating on LVO-STO heterointerface. We demonstrate the giant conductivity tuning under the illumination of light in presence of electrostatic gating in LVO-STO interface originating even in the absence of detectable oxygen vacancies. Our experimental results indicate that the oxygen vacancies migration is not the prime mechanism for this effect as reported for the LAO/STO interface. Rather it is a complex interplay between band filling, electric field at the interface, strong electron interaction due to mottness of LVO and modification of conducting channel width. We also present the localized nano-electrical domains writing using atomic force microscopy tip on the surface of different kinds of (bulk, surface and interface) conducting oxide material namely, SrTiO 3 . We observed though the presence of charge carriers in the sample is mandatory for charge writing but its capacity is independent of the charge carrier density. Writing capacity and stability depends on the mobility of the conduction electrons in the sample. Through a control experiment, we have demonstrated that introducing the defects (oxygen vacancies) increases the stability of the written pattern. Our results provide a guidance to achieve higher performance in oxide based nano-electrical memory devices.