QA05

Surface analysis of thickness-dependent $La_{0.75}Sr_{0.25}MnO_3$ Epitaxial films on $SrTiO_3$ Substrate

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Over the past years, doped-manganite perovskites, RxA1-xMnO3(R = rare earth elements and A = alkaline earth elements) have been extensively investigated because of their novel magnetotransport properties, such as colossal magnetoresistance (CMR).In the CMR materials, the magnetic transition at Curie temperature, T_c, is accompanied by a metal-insulator (M-I) transition of electron transport. Recent experiments [1] observed that the dead layer of $La_{0.67}Sr_{0.33}MnO_3$ films grown on $LaAlO_3$ and $NdGaO_3$ is around 5 nm and 3 nm, respectively. So far, the origin of the dead layer is still argumentative and indefinite. In this work, we propose an approach to discriminate the characteristics of $La_{0.75}Sr_{0.25}MnO_3$ (LSMO) films grown on $SrTiO_3$ (STO) varying thickness from 5 to 30 nm.

The LSMO films were grown on Nb-doped STO (001) single crystal substrate using rf-magnetron sputtering with a base pressure lower than $7x10^{-7}$ torr. Structural analysis was done by x-ray diffraction (XRD). The surface morphologiesof the films were investigated by AFM in ultra-high vacuum system. The magnetic properties of samples were measured using a superconducting quantum interference device (SQUID) magnetometer, where the field was applied in parallel to the film plane.

The XRD confirms the epitaxial growth of c-axis-oriented LSMO filmswith a slight lattice mismatch to the STO substrate. The surface topography of a 30 nm thick LSMO film reveals that the root mean square roughness (R_{rms}) and the maximum peak to valley roughness (R_{p-v}) are 0.216nm and 0.64nm, respectively. The Curie temperature (T_C) of LSMO films decreased as decreasing the LSMO thickness, which would be related to the strain induced from lattice mismatch between the substrate and LSMO films. The XPS analysis displays the ratio of Mn^{4+} increased as decreasing the LSMO thickness. The results reveal that the presence of a dead layer of electric conduction adjacent to the interface as decreasing LSMO thickness, which the metallic ferromagnetic metallic phase is formed as isolated domains in insulative matrix and the conduction path would be blocked. The temperature-dependent resistivity of the LSMO films also confirmed the results.

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QA06

Magneto-transport Properties of $La_{0.7}Sr_{0.3}MnO_3$(t = 10 ~ 50 nm)/ZnO on *p*-Si(100)

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Recently, manganite-based *p-n* or *p-i-n* junctions have attracted much attention because these junctions show diode-like behavior and magnetic tunability, which is promising for applications in spintronics [1]. Especially, p-n junction composed of *p*-type $La_{0.7}Sr_{0.3}MnO_3$(*LSMO*) and *n*-type ZnO could be predicted to have the magnetic-electrical and the magneto-optical functionalities because LSMO is one of half-metals with high Curie-temperature, and ZnO is a promising material for short wavelength low-power consuming light-emitting and laser diodes with large direct wide band gap (3.37 eV) and large exciton binding energy (60 meV). In addition, the *p-n* junction between LSMO and ZnO contains a thin depletion layer at the junction due to high carrier concentrations on LSMO and ZnO layers. Hence, the carrier concentration in the system can be modulated by applying the external electric field or light across the junction. In this report, we fabricated the p-n junctions composed of polycrystalline LSMO with different thickness and polycrystalline ZnO on *p*-Si(100). The choice of polycrystalline LSMO is based on the following fact that the lattice mismatch between LSMO (a = 3.870 Å) and ZnO ($a = b$ = 3.25 Å) and (c = 5.206 Å) is extremely large, which suppresses the magnetic transition to very low temperature [2]. The p-n junctions are prepared by reactive rf-magnetron sputtering using a so-called "Soft" LSMO target and ZnO. The thickness of LSMO is varied from 10 nm to 50 nm, while that of ZnO is kept at 100 nm. The electrods (100 nm) are deposited onto films. The crystal structure and composition of all these films was determined by x-ray diffraction using an x-ray diffractometer with Cu Ka radiation, and Rutherford back-scattering spectroscopy. The current-to-voltage curves and the magnetoresistance measurements are performed by both two- and four-point probe method, respectively. Carrier concentration in these films was determined by van der Pauw method at different temperature. Carrier concentration in ZnO and LSMO films were estimated to be ~1.23x1019 and 1.831020 cm-3, respectively. I-V curves demonstrate clearly the rectifying behaviors.

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