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Metal-insulator Transition in Low Dimensional $La_{0.75}Sr_{0.25}VO_3$ Thin Films

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We report on the metal-insulator transition that occurs as a function of film thickness in ultrathin $La_{0.75}Sr_{0.25}VO_3$ films. The metal-insulator transition displays a critical thickness of 5 unit cell. Above the critical thickness, metallic films exhibit a temperature driven metal-insulator transition with weak localization behavior. With decreasing film thickness, oxygen octahedron rotation in the films increases, causing enhanced electron-electron correlation. The electron-electron correlations in ultrathin films induce the transition from metal to insulator in addition to Anderson localization.

Keywords: Metal-insulator transition, LSVO, Thin film

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Metal-insulator Transition in $(Sr_{0.75}, La_{0.25})TiO_3$ Ultra-thin Films

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The $(Sr_{0.75}, La_{0.25})TiO_3$ (SLTO) ultra-thin films with various thicknesses have been grown on Ti-O terminated $SrTiO_3$(100) substrate using Laser-Molecular Beam Epitaxy (Laser MBE). By monitoring the in-situ specular spot intensity oscillation of reflection high energy electron diffraction (RHEED), we controlled the layer-by-layer film growth. The film structure and topography were verified by atomic force microscopy (AFM) and high resolution thin film x-ray diffraction by the synchrotron x-ray radiation. We have also investigated the electronic band structure using x-ray absorption spectroscopy (XAS). The ultra thin SLTO film exhibits thickness driven metal-insulator transition around 8 unit cell thickness when the film thickness progressively reduced to 2 unit cell. The SLTO thin films with an insulating character showed band splitting in Ti L_3-L_2 edge XAS spectrum which is attributed to Ti 3d band splitting. This narrow d band splitting could drive the metal-insulator transition along with Anderson Localization. In optical conductivity, we have found the spectral weight transfer from coherent part to incoherent part when the film thickness was reduced. This result indicates the possibility of enhanced electron correlation in ultra thin films.

Keywords: SLTO, Metal-insulator transition, Thin film