

Magnetoresistance and surface properties with deposition condition for the La-Sr-Mn-O thin films

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Polycrystalline La-Sr-Mn-O(LSMO) thin films were deposited on Si (100) substrate by the RF magnetron sputtering. The deposition condition of the LSMO thin films was 0, 20, 40, 60 and 80 % partial oxygen pressures of the buffer gas. The deposition RF power and the substrate temperature have 2.46 W/cm^2 and room temperature. All deposited films were annealed at $800 \text{ }^\circ\text{C}$ for 3 hour in ambient. The crystalline structure, the chemical composition, surface characters and the magnetic properties of the LSMO films were studied using a x-ray diffraction, an oxygen back-scattering spectroscopy, a x-ray photoemission spectroscopy, an atomic force microscopy, a scanning electron microscopy and a vibrating sample magnetometer. The crystalline structure of the all LSMO thin films was found to be a perovskite cubic structure with the lattice parameter $a_0 = 3.862 \pm 0.001 \text{ \AA}$ at room temperature. The lattice parameter of the LSMO films has no significant change as oxygen partial pressure increased, whereas the root mean square roughness (R_{rms}) and particle size decreased. Figure 1 show the AFM image of the LSMO film with $P_{\text{O}_2} = 60 \text{ \%}$. The chemical composition of the LSMO film with $P_{\text{O}_2} = 60 \text{ \%}$ was determined to be $\text{La}_{0.60}\text{Sr}_{0.32}\text{MnO}_{3.2}$ with the XPS spectrum analysis. In this case of the tunnelling low-field MR has a maximum value of 0.68 % under the applied field of 500 Oe at room temperature as shown in Fig.2. The enhancement of the low-field MR ratio is caused by the improvement of morphologies, the growth of uniform and smaller grains according to the increased partial oxygen pressure in LSMO films. The correlation between the grain size and the tunnelling magnetoresistance at room temperature can be explained that the grain boundary regions can play the role of a potential barrier.

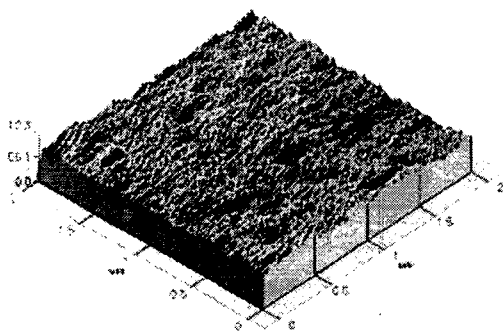


Fig.1. The AFM image of the LSMO film with $P_{\text{O}_2} = 60 \text{ \%}$ at room temperature.

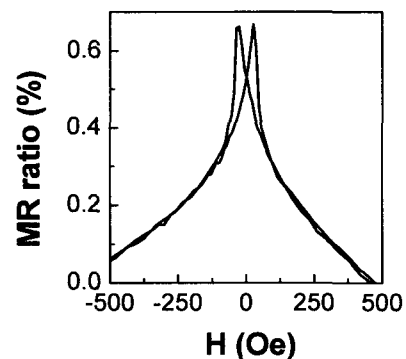


Fig.2. The tunnelling magnetoresistance of the LSMO film with $P_{\text{O}_2} = 60 \text{ \%}$ under the applied field of 500 Oe at room temperature.