

## [젊은진공기술과학자상 후보 1 : 표면 및 계면 분과]

# Effects of three-dimensional strain on the magnetic and the transport properties of epitaxial CMR bilayered films

박상윤, 홍범수, 조광환, 이영백, V. G. Prokhorov\*

한양대학교 물리학과 & 양자 광기능 물성 연구센터, \*Institute of Metal Physics, Ukraine

In this study, we present that the Curie temperature can be controlled by the lattice strain, which plays a crucial role in determining the magnetic and the magneto-transport properties of epitaxial hole-doped perovskite manganite films.  $\text{La}_{0.9}\text{Ca}_{0.1}\text{MnO}_3/\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$  (LCMO/LCMO) and  $\text{La}_{0.8}\text{Sr}_{0.2}\text{MnO}_3/\text{La}_{0.8}\text{Ca}_{0.2}\text{MnO}_3$  (LSMO/LCMO) epitaxial bilayered (BL) films were successfully grown on  $\text{LaAlO}_3(100)$  substrates by rf-magnetron sputtering from powder-type targets. According to the magnetic and the electronic phase diagrams, bulk  $\text{La}_{0.8}\text{Sr}_{0.2}\text{MnO}_3$  exhibits the ferromagnetic metallic phase at low temperatures, while bulk  $\text{La}_{0.9}\text{Ca}_{0.1}\text{MnO}_3$  shows the ferromagnetic insulator phase. The high-resolution electron microscopy and the x-ray diffraction results reveal that both LCMO/LCMO and LSMO/LCMO films are in compressive in-plane strain and tensile out-of-plane strain. In order to investigate the effect of 3-dimensional strain on the magnetic and the transport properties, SQUID and resistance measurements were carried out. It was found that the Curie temperatures of LCMO/LCMO and LSMO/LCMO BL films shift to higher temperatures with respect to  $\text{La}_{0.9}\text{Ca}_{0.1}\text{MnO}_3/\text{LaAlO}_3$  and  $\text{La}_{0.8}\text{Sr}_{0.2}\text{MnO}_3/\text{LaAlO}_3$  films, respectively. It was also observed that the metal-insulator phase transition in the LCMO/LCMO film occurs near the Curie temperature, while there is no metal-insulator transition in  $\text{La}_{0.9}\text{Ca}_{0.1}\text{MnO}_3/\text{LaAlO}_3$  film. According to Millis model, the shift of Curie temperature indicates that the strain in LCMO/LCMO and LSMO/LCMO BL films plays an important role for the symmetry-breaking Jahn-Teller distortion. On the other hand, the contribution from Jahn-Teller distortion to the ferromagnetic ordering is reduced with increasing the lattice mismatch between substrate and film.