Substrate effect to low-field transport properties of La-Pb-Mn-O granular-type thin films

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The low-field magnetoresistance of perovskite manganite thin films has been extensively investigated since these materials are promising candidates for applications of magnetoresistive elements. Also, the discovery that grain boundary and interface might be important factors of low-field magnetoresistance has stimulated the renewed interest in polycrystalline samples.

In this study, the low-field transport properties of polycrystalline and c-axis-oriented $La_{0.7}Pb_{0.3}MnO_3$ (LPMO) thin films were characterized. The LPMO films were synthesized using soft-chemical deposition method. Polycrystalline thin films were fabricated on SiO_2 /Si(100) substrate and SiO_2 /Si substrate with yttria-stabilized zirconia (YSZ) buffer layer, while c-axis-oriented thin film was grown on $LaAlO_3$ (001)(LAO) single crystal substrate. YSZ buffer layer, which acts as a barrier against inter-diffusion, decreases the amount of dead layer generated from interface and helps produce higher quality films. The microstructures and the surface morphologies of the films were examined by scanning electron microscopy and atomic force microscopy. The grain size of the polycrystalline film is much smaller than that of the LPMO/LAO film which has a coherent grain structure. Low-field tunnel-type MR measurement was performed under the applied field of 500 Oe by a standard four-probe method at room temperature. The MR ratio for LPMO/SiO_2/Si film and the film with YSZ buffer layer was 0.52 and 0.7 %, respectively. On the other hand, the MR ratio of the LPMO/LAO film was less than 0.4 %. MR peaks of low field magnetoresistance hysteresis were observed near the coercive field. The difference of the above MR values can be explained by the result that the polycrystalline film had denser boundaries than the c-axis oriented film, i.e., the polycrystalline film gave more effective potential barrier regions than the c-axis oriented film

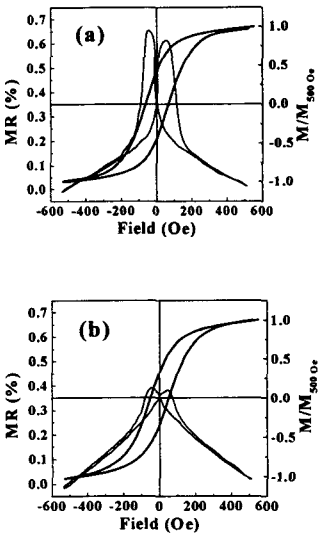

Figure 1. The tunnel-type MR & M-H hysteresis loop(normalized to the 500 Oe value) of LPMO/YSZ/SiO2/Si (a) and LPMO /LAO (b) at room temperature.