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DIRECT MEASUREMENT OF GRAIN BOUNDARY RESISTANCE IN GRANULAR TYPE MAGNETORESISTANCE THIN FILMS

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The spin-polarized tunneling through highly resistive regions at the grain boundaries was proposed as the mechanism responsible for the grain boundary magnetoresistance(MR). The specific propertise of the grain boundaries as a potential barrier depend on several parameters, such as the nature and proportion of second phases, segregation of dopants or impurities, oxygen-deficient zones, shape factor, etc. In this work, the effects of grain boundaries on low-field magnetoresistance (MR) were assessed by preparing a set of polycrystalline $La_{2/3}Sr_{1/3}MnO_3$(LSMO) granular thin films with varying grain sizes and measuring their MR. Also, the difference in the measured MR values was explained with interpretation of grain boundary effects characterized by the complex impedance analysis(CIA). Controlling the different grain sizes was done by varying catalysts and their amount into the LSMO stock solution prepared for spin coating. As the grain sizes increased, MR ratios decreased under the applied field of 120 Oe at room temperature. The difference in the measured MR values was explained by interpreting grain boundary effects characterized using complex impedance analysis (CIA). Results showed that the resistivity of grains(233 ~ 207 Ω) was nearly independent of the grain size(610 ~ 345 Å). On the other hand, resistivity of the grain boundary(530 ~ 1396 Ω) increased with decreasing grain size(610 ~ 345 Å). These revealed that the increase in total resistivity was due to the increase in resistivity of the grain boundary, with the low-field MR of the films dependent on the resistivity of grain boundary. Therefore, it can be concluded that the enhanced MR of polycrystalline LSMO/SiO_2/Si thin films with decreasing grain size is mainly due to an increase in grain boundary regions that can act as potential barrier.

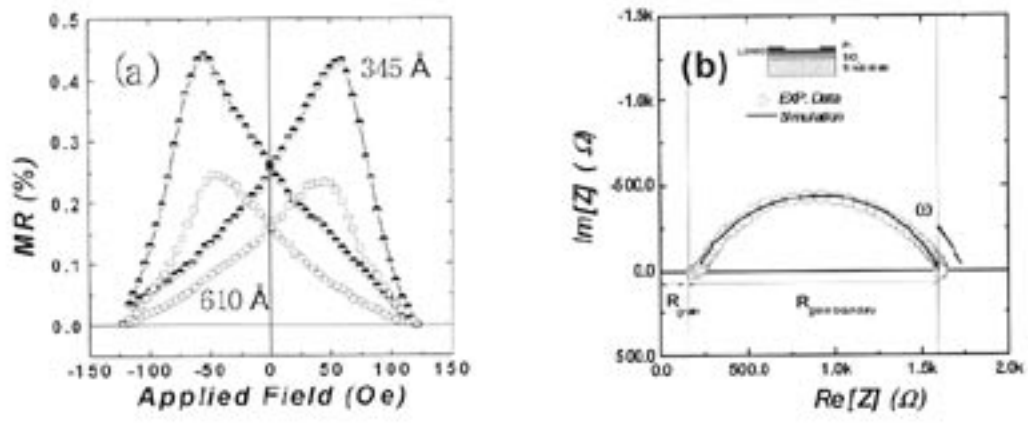

Figure 1. (a) tunnel-type MR ratio for the films having grain size 345 and 610 Å, respectively. (b) AC. impedanc diagram of the LSMO films having grain size 345 Å.

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