AS06

Comparative Study of Magnetic and Transport Properties of Epitaxial and Polycrystalline $La_{0.88}Sr_{0.12}MnO_3$ Thin Films

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We report a comparative study of the magneto-electrical properties of epitaxial and polycrystalline thin films of lightly doped manganite $La_{0.88}Sr_{0.12}MnO_3$ (LSMO). The LSMO thin films are deposited on single crystal $LaAlO_3$ (LAO/(100)) and ZrO2 (ZO/(100)) substrates by on axis DC magnetron sputtering from high density target prepared by wet chemical route. Films deposited on LAO (6 and 35 nm thick) as revealed by XRD (θ-2θ scan and rocking curve measurements) are epitaxial and AFM investigations show clean surface morphology. In contrast, films on ZO (20 and 35 nm in thickness) are polycrystalline but highly c-axis oriented with small variation in grain size. DC magnetization measurements show large enhancement in the paramagnetic-ferromagnetic (PM-FM) transition temperature (T_C) of films on LAO. The T_C of 6 and 35 nm thick films are 272 and 282 K respectively that is 100 K higher than that of the polycrystalline bulk target (T_C~175 K). Both, 6 and 35 nm thick films on LAO show sharp I-M transition just around the TC with TIM being 275 and 285 K respectively. The T_{IM} of films on ZO is drastically suppressed as compared to the same for films on LAO. The large enhancement in T_C and hence T_{IM} of LSMO films on LAO has been explained in terms of the compressive strain arising out of the mismatch between the lattice parameters of LAO and LSMO [1,2]. The absence of such strain in LSMO films on ZO accounts for the lower T_C and T_{IM} that are close to that of the plycrystalline bulk. The LSMO/LAO films also show large magneto-resistance only in the vicinity of the T_{IM} and it decreases strongly on lowering and increasing the temperature. In contrast, the LSMO/ ZO films show relatively lower MR that spreads over a temperature range. The electrical transport of all the films, both in the PM as well as the FM regions have been analyzed in the frame work of small polaron hoping in the adiabatic limit and variable range hopping models and the suitability of each model has been discussed.

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AS07

Magnetic Properties of FeRh Nanoparticles and their Nanocomposite

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Magnetic nanoparticles have attracted great interest because of their potential applications in ultrahigh density magnetic recording, highly sensitive magnetic sensor, and advanced nanocomposite permanent magnets [1, 2]. The hard magnetic FePt materials are excellent candidate for future ultrahigh density magnetic recording [3]. However, because of high coercivity resulting from such high magnetic anisotropy, writability becomes a serious issue. To overcome this problem, much effort has been made. The magnetic coupling of FeRh with FePt is one the possible solutions. The magnetic properties of the bulk FeRh exhibits first order phase transition at around 80°C, below which it is antiferromagnetic (AFM) and above which it ferromagnetic (FM) [4].The magnetic coupling of FePt and FeRh at the temperature at which FeRh undergoes the first order transition, one may expect the lower coercivity of FePt. The fabrication of FeRh magnetic nanoparticles are reported elsewhere [5, 6].

Fe43Rh57 nanoparticles were fabricated using solution phase chemical method. These nanoparticles were annealed at 600°C for 6 hours prior to magnetic measurement in order to get the magnetic phase transition. The magnetization versus temperature curve for $Fe_{43}Rh_{57}$ nanoparticles are shown in figure 1. As shown in Fig. 1., in the first heating process the magnetization decreases with increasing temperature up to 120°C and it increases till 180°C then decreases again whereas in the cooling process magnetization shows a small increase then decreases monotonically with decreasing temperature. During second heating process the $Fe_{43}Rh_{57}$ nanoparticles shows magnetic phase transition from AFM to FM phase in the temperature range 120 to 220°C. A large thermal hysteresis width is observed as shown in Fig 1.

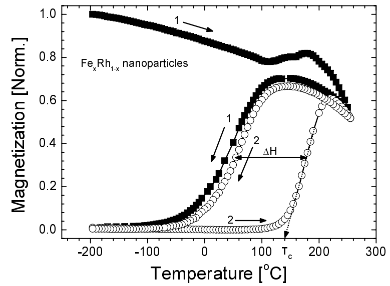

Fig. 1. M-T curve of Fe43Rh57 nanoparticles.

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