Magnetic Field Cooling Effects of MnO-$MoO_{2+\delta}$ Composite Thin Films

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We have investigated magnetic properties of $[MnO]_x[MoO_{2+\delta}]_{1-x}$ ($0.5 \leq x \leq 0.8$) composite films which have been prepared using a magnetron sputtering system enhanced with an inductively coupled rf plasma. X-ray diffraction (XRD) analysis and high-resolution transmission electron microscopy (HRTEM) observation show that these films have a structure that comprises randomly oriented MnO nanocrystallites of about 10 nm diameter.[1] These nanocrystallite films show so-called mixed-magnetic behavior in the temperature dependence of magnetization. Magnetization curves of these films show a hysteresis loop below a critical temperature T_c. After field cooling through T_c, these films exhibit exchange-bias effects, i.e. a loop shift and coercivity (H_C) enhancement. The coercivity H_C and exchange-bias field $|H_E|$ for the film with $x = 0.5$ increase with increasing cooling field H_{FC} and saturate in a high-magnetic-field region, except for $|H_E|$ behavior below $H_{FC} = 10$ kOe. This result is attributable to AF domain wall formation in the MnO nanocrystallite core and the pinning effect of uncompensated magnetic moments on the surface by the AF domain wall.

[1]T. Kida, M. Koyano and K. Higashimine: J. Phys. Soc. Jpn. **73** (2004) 1018.

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