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Size Distribution and Anisotropy of Self-assembled MnAs Nanoparticles in GaAs ROBERT DIPIETRO, HANNAH JOHNSON, STEVE BENNETT, TOM NUMMY, LAURA LEWIS, DON HEIMAN, Northeastern University — The size distribution and anisotropy of composite films of MnAs nanoparticles in a GaAs matrix have been determined by *thermomagnetic* measurement and subsequently confirmed by electron microscopy studies. The composite was fabricated from a homogeneous $Ga_{0.9}Mn_{0.1}As$ film grown by MBE and annealed at 520-570 $^\circ$ C to produce superparamagnetic particles of diameter 10-50 nm. Magnetization measurements show a peak in the temperature-dependent zero field cooling (ZFC) moment, m_{ZFC}(T), near the system blocking temperature T_B. The distribution in T_B was first obtained from $f(T_B) \propto$ d/dT [T$\cdot m_{ZFC}$(T)], derived assuming that the moment of a particle below its blocking temperature is zero and varies as 1/T above the blocking temperature. The distribution in particle diameter f(D) was obtained using the usual relation between blocking temperature and particle volume, $K_{eff}V/k_BT_B$=25, where K_{eff} is the effective MnAs anisotropy constant. A value for the anisotropy constant was obtained by comparing the thermomagnetic f(D) with the size distribution obtained visually from SEM micrographs, where <D>=12 nm and width ΔD=7nm for a 50-nm-thick film. The visual and thermomagnetic size distribution functions are found to be nearly identical using K_{eff}=160,000 erg/cm^3.
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