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Magnetic Force Microscopy of Ferromagnetic MnAs Nanoparticles in GaAs. BEN CHAPRUT, RADHIKA BARUA, LAURA LEWIS, DON HEIMAN, Northeastern University — The switching behavior and anisotropy of ferromagnetic MnAs nanoparticles in GaAs was investigated with variable-temperature magnetic force microscopy. Nanoparticles of MnAs were synthesized by annealing thin layers of GaMnAs, with Mn/Ga=0.1. Annealing at 640 C resulted in thin disc-shaped MnAs particles with diameters ∼100 nm embedded in GaAs. Magnetization measurements at room temperature show that the samples are ferromagnetic and exhibit hysteresis with a coercive field ∼0.1 T. In MFM images at room temperature, the majority of the nanoparticles have a single-domain magnetic dipole moment which can be oriented in one direction after applying a magnetic field ∼0.1 T. The dipole orientation can be reversed after applying a field in the opposite direction. After raising the temperature above the Curie point, Tc=337 K, the sample becomes demagnetized at room temperature, with equal numbers of particles aligned in opposite directions. A sharp phase transition, from the ferromagnetic hexagonal phase to the paramagnetic orthorhombic phase, was found at 340 C, nearly coincident with the Curie temperature. This transition occurs ∼30 C higher than in thin MnAs films and is attributed to tensile strain on the nanoparticles from the surrounding GaAs.

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