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Fresnel Lorentz Microscopy Imaging of Domains in Fe3O4 Nanoparticle Arrays S. A. MAJETICH, E. R. EVARTS, C. HOGG, Physics Department, Carnegie Mellon University, K. YAMAMOTO, T. HIRAYAMA, Japan Fine Ceramics Center — Fresnel Lorentz microscopy was used to study the magnetic domain structures of self-assembled nanoparticle arrays as a function of temperature, from 24 to 605 $^\circ$C. 11 nm diameter Fe3O4 nanoparticles with an edge-to-edge spacing of 2.5 nm form magnetic domains through magnetostatic interactions alone. At room temperature stripe domains were evident in monolayer arrays. The average domain size in monolayer regions is larger than that in bilayers. Mean field theories predict a reduced stabilization energy for bilayers, relative to that for monolayers. The domain wall positions were fairly stable up to 500 $^\circ$C, though the contrast in the walls diminished, indicating reduced magnetic order. Above 500 $^\circ$C there were large temperature-dependent changes. The walls surrounding the smaller domains disappeared at lower temperatures than those of the larger domains. Some magnetic contrast was visible up to 575 $^\circ$C, close to the Curie temperature of Fe3O4 (585 $^\circ$C). Transmission electron microscopy after cooling showed that the particle shape and position in the ordered arrays had been preserved during the high temperature imaging experiments.

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