Abstract Submitted
for the SES11 Meeting of
The American Physical Society

Magnetization Dynamics in Magnetic Nanoparticle Chains SUVOJIT GHOSH, ISHWAR PURI, Department of Engineering Science and Mechanics, Virginia Tech — Magnetic nanoparticles (MNPs) exhibit superparamagnetism when the energy changes due to thermal fluctuations ($\sim k_B T$) are comparable to or larger than the anisotropy potential barrier KV. Thermal fluctuations produce frequent magnetization reversals in such a situation causing the net MNP magnetization to approach zero. If thermal oscillations are relatively small, the odds of magnetization reversal diminish significantly implying that an MNP is permanently magnetized. In this study we explore the influence of the magnetostatic coupling of moments in neighboring MNPs in an idealized two-particle system. The anisotropic nature of such coupling adds to the magnetocrystalline anisotropy to augment the potential barrier for magnetization reversal. A two particle system of MNPs therefore has a more stable magnetization than an isolated particle. This is analyzed by a scaling analysis of the interaction energies concerned. Numerical simulations of mangetization dynamics of MNPs using a stochastic form of the Landau-Lifshitz-Gilbert equation confirm the hypothesis. The phenomena is explored to determine a range of radii within which an MNP exhibits superparamagnetism in isolation while forming permanently magnetized chains upon self-assembly.

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Date submitted: 29 Aug 2011 Electronic form version 1.4