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Influence of interparticle interactions on the blocking temperature and high frequency permeability of Fe_3O_4 nanoparticle systems MD EHSAN SADAT, DAVID B. MAST, DONGLU SHI, University of Cincinnati, SERGEY L. BUD'KO, Ames Laboratory, Iowa State University — In Néel's model of superparamagnetism, magnetization and relaxation dynamics depend on the magnetic anisotropy constant of the non-interacting, individual nanoparticles (NPs). However, NP interactions modify these dynamics in real systems. To investigate the influence of magnetic interactions on NP anisotropy, we compare the results from measurements of the blocking temperature of Fe_3O_4 NP systems with very different average interparticle separations, one with uniformly dispersed NPs and the other with the NPs tightly confined in a polystyrene matrix. The blocking temperature for the confined NPs (263K) was substantially higher than for the uniformly dispersed NPs (131K), which we attribute to stronger dipolar interactions. The relaxation times are determined from peaks in the imaginary part of the complex permeability versus frequency from 10 MHz - 3 GHz. For uniformly dispersed Fe_3O_4 NP (in hydrocarbon carrier), the Néel relaxation and the gyromagnetic resonance were observed at 41 MHz and 1.2 GHz, respectively, which corresponds to an anisotropy constant of $\sim$ 15 KJ/m3 compared to 12 kJ/m3 predicted by Néel's relaxation model for 10 nm diameter Fe_3O_4 NPs. Details of this correlation between the blocking temperature and high frequency permeability will be discussed.

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