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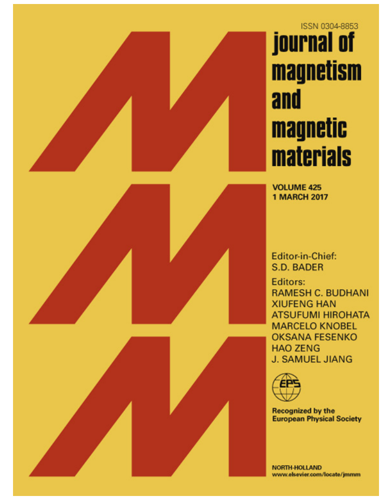

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Scaling the effect of the dipolar interactions on the ZFC/FC curves of random nanoparticle assemblies

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Abstract

Zero field cooling (ZFC) and *field cooling* (FC) protocols are commonly used to investigate the properties of magnetic nanoparticle systems. For non-interacting conditions the particle properties are fairly well correlated with the shape of the ZFC/FC curves. However, that is not the case when significant dipolar interparticle interactions (DII) are present, what frequently occurs in experimental samples (e.g. aggregates in biological systems; or the dried powder often used for the ZFC/FC measurements). The purpose of this work is to show how the influence of the DII on the ZFC/FC curves, computed by the volume sample concentration c, can be described in a general way if scaled by the dimensionless parameter $c_0 = 2K/M_S^2$; where K and M_S are the anisotropy and saturation magnetization constants of the particles, respectively. This scaling parameter, which is straightforwardly derived from the energy equation governing the system, has an analogous meaning to the normalization of the external magnetic field H by the anisotropy field of the particles $H_A = 2K/M_S$. We use a Monte Carlo technique to illustrate how apparently different T_B *vs.* c curves of various particles types (where T_B is the *blocking temperature*), follow the same trend if scaling c/c_0.

Keywords: Magnetic nanoparticles, ZFC/FC curves, Dipolar interactions, Monte Carlo simulations

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