

Collective spin glass state in nanoscale particles of ferrihydrite

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Ferromagnetic resonance was used to study three types of ferrihydrite nanoparticles: nanoparticles formed as a result of the cultivation of microorganisms *Klebsiella oxytoca*; chemically ferrihydrite nanoparticles; chemically prepared ferrihydrite nanoparticles doped with Cu. It is established from the ferromagnetic resonance data that the frequency-field dependence (in the temperature range $T_P < T < T^*$) is described by the expression: $2\pi\nu/\gamma = H_R + H_{(T=0)}^A \cdot (1 - T/T^*)$, where γ is the gyromagnetic ratio, H_R is the resonance field. The induced anisotropy H^A is due to the spin-glass state of the near-surface regions. T_P temperature characterizes the energy of the interparticle interaction of nanoparticles.

Keywords: nanoparticles, ferrihydrite, magnetic anisotropy, magnetic resonance.

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