Nonequilibrium Dynamics and Magnetoviscosity of Moderately Concentrated Magnetic Liquids: A dynamic Mean-field Study

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A mean-field Fokker-Planck equation approach to the dynamics of ferrofluids in the presence of a magnetic field and velocity gradients is proposed that incorporates magnetic dipole-dipole interactions of the colloidal particles. The model allows to study the combined effect of a magnetic field and dipolar interactions on the viscosity of the ferrofluid. It is found that dipolar interactions lead to additional non-Newtonian contributions to the stress tensor, which modify the behavior of the non-interacting system. The predictions of the present model are in qualitative agreement with experimental results, such as the enhancement as well as the different anisotropy of the magnetoviscous effect and the dependence on the symmetric velocity gradient.

Key words: Magnetohydrodynamics and Electrohydrodynamics; Magnetic Liquids; Rotational Flow and Vorticity; Suspensions, Dispersions, pastes, slurries, colloids; Kinetic Theory.
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