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# A Lattice Gas Approach to the Structure and Dynamics of Electrorheological Fluids

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Electrorheological fluids consist of a colloidal suspension of dielectric particles in a continuous fluid of smaller dielectric constant. Molecular dynamics (MD) simulations of these fluids in an applied electric fields have recently been shown to produce percolated, columnar structures. No systematic attempt has been made so far to simultaneously include the effects of temperature (thermal disordering) and the viscous drag due to the continuous fluid. We propose a dipolar lattice gas model for electrorheological fluids and study the resulting structures and dynamics. We attempt to incorporate the effect of the viscosity of the continuous medium by a dynamic ansatz that determines the range over which individual particles can jump in a single simulation event. The temperature is simulated by assigning a probability of jumping to higher energy states in accordance with the Boltzman distribution. We study the equilibrium phases of the system as a function of temperature and find interesting new results.

We find that the structures are very similar to what is observed experimentally and in earlier MD simulations. Our new results from finite temperature simulations suggest that there is a gradual phase transformation from a liquid like phase at low electric field and high temperature to a solid like phase at high electric field and low temperature. The simplicity obtained by going to a lattice version will allow us to carry out these simulations even in three dimensions, where little is known about these systems.

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