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Effects of fluid–particle interactions on the structure formation in magnetic fluids

Authors: Andreas M. Menzel[1]; Henning Reinken[1]

[1] *Otto-von-Guericke-Universität Magdeburg, Germany*

Applying a sufficiently strong external magnetic field to a magnetorheological fluid induces the formation of chain-like particle aggregates. This structure formation leads to complex magnetorheological behavior. It can further be utilized in the production of anisotropic magnetic elastomers [1]. Structured particle aggregates form in the presence of an external magnetic field while the carrier medium is still fluid. They are locked into the material during crosslinking when generating the elastomer, and they affect the overall material behavior.

We numerically investigate the role of explicit fluid–particle and hydrodynamic interactions on the aggregation process of magnetically soft particles. The particles are assumed to be of micrometer size or larger, so that thermal fluctuations can be neglected. We utilize the simulation method of fluid particle dynamics [2] and extend it to magnetizable systems. Both fluid flows and magnetization are spatially resolved, allowing us to describe the aggregation process until the particles are in virtual contact. Our simulations show that hydrodynamic interactions can affect and support the process of structure formation [3].

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