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An anisotropic continuum model for flow, aggregation and microstructure evolution in magnetorheological fluids MURAT OCALAN, GARETH MCKINLEY, Massachusetts Institute of Technology — The complexities associated with the transport of magnetorheological (MR) fluids under non-uniform magnetic and flow fields pose unresolved problems for generating accurate computational models. The evolutions of the electromagnetic and rheological properties of MR fluids are strong functions of the suspension microstructure; however, the geometrical features that lead to the field non-uniformities are often of a much larger length scale. To address these commonly occurring flow problems, we develop an anisotropic continuum model for MR fluids in which the electromagnetic stress is incorporated into the constitutive model for the viscoplastic stress generated in the bulk fluid by considering the generation and distortion of suspension microstructure under flow. The new model is incorporated into both a single-phase and a two-phase continuum description of the suspension. The aggregation dynamics and the evolution of MR fluid microstructure are observed in unique ferromagnetic microfluidic channels that replicate flow conditions of practical interest. The predictions of the newly developed models are verified with the experimental observations of microstructure evolution and macroscopic measurements of fluid rheology.

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