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Numerical Investigation of Enhanced Mixing in a Microchannel Using Ferrofluid Using The Lattice Boltzmann Method ANINDYA DE, ISHWAR PURI, Virginia Polytechnic Institute and State University, ENGG. SCIENCE & MECH. TEAM — Ferrofluids are colloidal suspensions of magnetic nanoparticles in carrier liquids which can be readily maneuvered from a distance using magnetic fields. When functionalized with different antibodies or medicinal compounds the ferrofluid nanoparticles can be used for various purposes, e.g., to detect bacteria or as a carrier of chemotherapeutic agents for targeted drug delivery. Localized magnetic nanoparticle agglomerates can also be remotely moved to create perturbations within a microchannel flow, thereby resulting in better mixing of various fluids. We have numerically investigated ferrofluid agglomeration and its influence on enhancing local mixing in microchannels by using the lattice Boltzmann method. Employing this method, we solve for the one-particle probability distribution function f which denotes the probability density of finding a particle at time t, at the location $\mathbf{x}$, moving with velocity $\mathbf{v}$ when a force $\mathbf{F}$ is acting on it. (A Chapman-Enskog expansion recreates the continuum relation and the Navier-Stokes equation for weakly compressible flows.) We have simulated ferrofluid agglomeration near a magnetic dipole for flow through a rectangular microchannel. When a number of such magnets are placed across the channel and activated in sequence, they locally perturb the fluid flow to produce better mixing in two initially unmixed fluids.

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