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CFD Simulation of the Magnetophoretic Separation in a Microchannel

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Abstract: The CFD simulation of the separation of labeled biospecies from a native fluid flowing through a planar microchannel, mediated by a magnetic field is presented in this study. The fluid flow, coupled with Eulerian advection?convection concentration equation, is utilized to model the transport of the magnetic biospecies. A moderate-gradient magnetic field caused accumulation of the magnetic labeled species in the vicinity of the higher magnetic field region. The re-distribution of the magnetically labeled species in the region close to the highest magnetic field zone presents a scheme for the focusing or collection of these species from the heterogeneous samples under the simulation conditions. The magnetic?fluidic interactions and interplay between the magnetophoretic mass transfer and molecular diffusion for different throughputs are analyzed. The study found out that the axial magnetic forces, created from a dipole-like magnetic field, is playing a major role in the vortex formation, and this complements the downward vertical force in confining the particles to a small region near the point with the highest magnetic strength. Also, the study predicts that the generated viscous shear stress levels in the interior region of the channel provide a safe transport mechanism for the biological cells in the solution.