Study on the lateral migration of a ferrofluid droplet in a plane Poiseuille flow under uniform magnetic fields

MD. RIFAT HASSAN, CHENG WANG, Department of Mechanical and Aerospace Engineering, Missouri University of Science and Technology — Droplet dispersion in another immiscible fluid is important in a variety of technological processes that involve liquid-liquid extraction where phase separation is crucial to the purification of the product. In this study, we investigate the lateral migration of a ferrofluid droplet in a plane Poiseuille flow under uniform magnetic fields by means of a numerical simulation, which uses a level set method to track the droplet interface between the two phases. Focusing on low droplet Reynolds number (i.e., $Re_d \leq 0.05$), the results indicate that the magnetic field plays a pivotal role in the motion trajectory of the droplet and the final equilibrium position in the channel. When the magnetic field acts in a direction parallel to the flow direction (i.e., $\alpha = 0^\circ$), the dropletsettles closer to the bottom wall with increasing magnetic field strength, while at $\alpha = 45^\circ$ the droplet settles closer to the center. Also, variation of initial droplet sizes results in different equilibrium positions along the channel. Furthermore, at $\alpha = 90^\circ$ the droplet finds its equilibrium position at the channel center irrespective of different magnetic field strengths and droplet sizes.

Mdl. Rifat Hassan
Dept of Mech and Aerospace Eng, Missouri Univ of Science and Technology

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