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Lateral migration of an electrophoretic particle in Newtonian and viscoelastic pressure driven flows AKASH CHOUDHARY, Indian Institute of Technology Madras, DI LI, Clemson University, South Carolina, RENGANATHAN T, Indian Institute of Technology Madras, XIANGCHUN XUAN, Clemson University, South Carolina, PUSHPAVANAM S, Indian Institute of Technology Madras —
In recent years there has been a growing interest towards incorporation of electrokinetics to inertial and viscoelastic focusing techniques to achieve higher throughput and external control over the focusing positions. This is performed by applying a DC electric field parallel to the flow. In this work, we investigate the effects of electrokinetics on the particle migration in pressure-driven flows of Newtonian and viscoelastic fluids through experiments and theoretical analysis. Using Lorentz reciprocal theorem in conjunction with perturbation expansion (in Reynolds or Deborah number), we derive analytical expressions which describe the lateral migration at the leading order. We find that that the direction of migration in inertial-Newtonian flow and inertialess-viscoelastic flow is towards the regions of high shear, provided the electrokinetic motion is in the direction of the imposed Poiseuille flow. The trajectories obtained from the theoretical analysis, in agreement with experiments, demonstrate that the interaction of electrokinetic and rheological effects can result in an enhancement in migration by an order of magnitude. Furthermore, it is revealed that the magnitude of the background shear and particle zeta potential primarily governs the migration.

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