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Deformability-induced inertial focusing of viscous droplets[1] SOOJUNG HUR, MEHRAN ABOLGHASEMIBIZAKI, Johns Hopkins University —
Deformability-induced lateral migration of soft objects across the streamlines in microchannels provides a robust and continuous way of manipulating droplets and cells inflow. Theoretical analysis has shown that there exists a force away from channel walls in Poiseuille flow that locates deformable particles closer to the channel center than rigid counterparts. As lateral lift forces acting on flowing objects scale with carrier fluids and suspending particles' properties, the deformability can be extrapolated from the positions of objects with known sizes in the channel. Here, behaviors of nearly-neutrally buoyant microscale droplets of various sizes, interfacial tensions, and viscosities were tested to determine droplet's physical attributes and flow conditions, enhancing their lateral migration. Fluorinated oil solutions (μ =1.7mPas and 5mPas) containing droplets (1mPas$<\mu<$1.3Pas) were injected into a microfluidic channel at 8$<$Rc$<$50. The interfacial tensions were varied by adding a controlled amount of a surfactant. The diameter, deformability, and lateral equilibrium position were determined using high-speed microscopy. Through dimensional analysis, we identified critical conditions to inertially-focus deformable droplets in Poiseuille flow. The results suggest that accurate measurements of lateral positions of deformable droplets will provide a means to establish the fundamental understanding required to estimate apparent deformability of flowing objects in high-speed.

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