Viscoelasticity based droplet migration and sorting. SHAMIK
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Indian Institute of Technology, Madras — We experimentally elucidate the cross-
stream migration behavior of viscoelastic Polydimethylsiloxane (PDMS) droplets in
the non-inertial Poiseuille flow of constant viscosity aqueous viscoelastic solution
of Polyvinylpyrrolidone (PVP) in straight rectangular microchannels. We investi-
gate the complex interaction among deformability induced non-inertial lift force,
viscoelastic lift force due to matrix viscoelasticity, and viscoelastic lift force due to
droplet viscoelasticity and propose a new droplet migration regime. We vary the
drop-to-medium viscosity ratio (k) by varying the PVP concentration and demon-
strate center-ward droplet migration for k $<$18.52 and $>$3.72 respectively, while
droplets stay near the wall for 3.72$\leq$ k $\leq$18.52, contrary to Chan and Leal's pre-
diction with second-order fluids. We observe that for k = 12, Newtonian castor oil
(viscosity 650 mPa-s, relaxation time = 0) droplets migrate to center while PDMS
(average viscosity 666 mPa-s, relaxation time = 0.001) droplets stay near the wall.
Finally, we demonstrate viscoelasticity based sorting of castor and PDMS droplets.

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