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Effects of surfactants on the deformation of microfluidic drops[1]
MARIA LUISA CORDERO, Departamento de Fisica, FCFM, Universidad de Chile, CAMILO ULLOA, De — A microfluidic analog of the four-roll-mill experiment is used to study the deformation and breakup of microfluidic drops. The behavior of water drops flowing in mineral oil is quantified as a function of the capillary number, Ca, which is based on the oil viscosity, drop radius, flow shear rate and equilibrium interfacial tension, both in the presence and absence of surfactants. In the absence of surfactants the deformation of the drops increases linearly with Ca. If surfactants are added to the carrier oil then, for the same value of Ca, drops deform less if the flow velocity is larger. Moreover, for a given drop size in the presence of surfactants, drops begin to split at a threshold shear rate but stop breaking if the shear rate is increased beyond a second threshold. These observations are explained by a decrease in the surfactant concentration at the surface of the drop due to advection of surfactant molecules by the oil flow. This increases the interfacial tension, thus making the drop less deformable for higher flow velocities. We use the deformation of the drops to infer the mean interfacial tension and from this we quantify the surface concentration of surfactants at the drop interface.

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