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Interfacial Effects on Droplet Dynamics in Poiseuille Flow JONATHAN SCHWALBE, KENDRA ERK, National Institute of Standards and Technology, JEFFREY MARTIN, Unilever, PETIA VLAHOVSKA, Brown University, STEVEN HUDSON, National Institute of Standards and Technology — Interfacial rheology governs many properties of emulsions, and here we report theory and experiments that account for and measure surface viscous and elastic forces. For the theoretical portion, Stokes flow is assumed in bulk phases and a jump in hydrodynamic stress at the interface is balanced by Marangoni and surface viscous forces according to the Boussinesq-Scriven constitutive law. Our model employs linear equation of state for the surfactant. Our analysis predicts slip, cross-stream migration and droplet-circulation velocities for a spherical drop in plane Poiseuille flow. These results and the corresponding interfacial parameters are separable: e.g., cross- stream migration occurs only if surfactant is present; slip velocity depends on viscosity contrast and dilatational Boussinesq number, but not shear Boussinesq number. Drop dynamics in plan Poiseuille flow are measured experimentally using microfluidics, particle velocimetry, and shape analysis. Several types of surfactant-stabilized aqueous drops in oil are examined and the interfacial properties depend on interfacial composition.

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