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Dispersion of a suspension plug in oscillatory pressure-driven flow
FRANCIS CUI, AMANDA HOWARD, MARTIN MAXEY, ANUBHAV TRIPATHI, Brown University — We investigate the dispersion of suspension plugs in a micro-capillary as they are sheared in periodic pressure-driven flows. To study this novel configuration, a new experimental method was implemented to observe the shear-induced evolution of semi-infinite suspension plugs consisting of non-colloidal spherical particles (90-μm mean diameter) at dilute and high concentrations for various values of applied strain. In this cyclic shearing flow, irreversible particle migration arises from numerous unpredictable hydrodynamic interactions between particles and walls. Although the periodic velocity profiles do not lead to any significant increase in plug length, significant streamwise particle migration was observed near the walls of the capillary, becoming more pronounced with increasing strain amplitude γ_0. This experimental outcome agrees with the results of numerical simulation, which produces analogous behavior for a suspension sheared between parallel walls. Calculating dimensionless particle diffusivities D_z for various γ_0 allows us to determine a cutoff point demarcating regimes of reversibility and irreversibility.

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