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Hysteretic rheological response of a highly viscous drop in linear flows with rotation YUAN-NAN YOUNG, Dept. of Mathematical Sciences, NJIT, JERZY BLAWZDZIEWICZ, Dept. of Mechanical Engineering, Yale University, VITTORIO CHRISTINI, Dept. of Biomedical Engineering, UC Irvine — High-viscosity drops in flows with a small vorticity magnitude are known to possess two stable stationary shapes. One corresponds to nearly spherical drops stabilized primarily by rotation, and the other to elongated drops stabilized primarily by cpaillary forces. In this work we explore interesting quasi-static dynamics of high-viscosity drops in a linear flow with small rotation. For sufficiently high drop viscosity and an appropriate range of the vorticity component in the linear flow, the quasi-static drop states are found to be hysteretic. We explore in details such hysteretic drop dynamics using both small deformation equations and direct numerical simulations of the drop dynamics. Due to the multiplicity of the two steady drop states, we find novel chaotic drop dynamics in a linear flow with (temporal) sinusoidal variation in the vorticity. Based on these results we also suggest how to control size distribution of viscous drops in emulsion by forcing the emulsion in certain fashions.

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