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Gravity driven current during sessile drop coalescence on a surface YING ZHANG, SAMUEL OBERDICK, STEPHEN GAROFF, Physics Department, Carnegie Mellon University, SHELLEY ANNA, Chemical Engineering Department and Mechanical Engineering Department, Carnegie Mellon University
— We study the mixing behavior of two sessile drops following coalescence on a flat surface. The surface is composed of silicone elastomer on which the drops exhibit contact angles of about 90 degree. The two drops are of equal volume at coalescence, but different densities and viscosities. Using laser induced fluorescence, we obtain both a top view of the contact line motion and a side view of the cross-sectional flow. During the coalescence stage, the initial healing of the meniscus bridge and damping of capillary waves occur on time scales comparable to the inertio-capillary time. However, the interface between the dyed and undyed components remains sharp, with diffusive mixing occurring at much longer timescales. At intermediate time scales the motion is controlled by a gravity current, which leads to the eventual stratification into two separate horizontal layers within the composite drop. Using lubrication analysis, we characterize the gravity current as a function of the drop sizes, and the density and viscosity differences between the two merging fluids. The numerical solution of the lubrication analysis captures the observed scaling of the time dependent interface movement as a function of fluid and geometric parameters.

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