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Effect of Polymer Confinement on the Film Drainage Behavior– An RICM Study SURAJ BORKAR, ARUN RAMCHANDRAN, University of Toronto — We consider the dynamic effects of confinement of macromolecular liquids on the film drainage process between a drop and a flat surface. Under confinement of the order of few molecular length scales, layering and adsorption of long chains of polymers can cause entropic repulsion due to a reduced configurational freedom. This repulsive force can prevent film rupture and lead to the formation of an equilibrium film. In the current work, experiments were conducted with deformable droplets settling under gravity in a suspending liquid for Bond numbers of $O(10^{-4})$. The film drainage was studied using a microinterferometric technique namely, Reflection Interference Contrast Microscopy (RICM) for two different systems: a) silicone oil drops in paraffin oil, b) glycerol drops in silicone oil. The RICM analysis for obtaining the film drainage profiles, was done using a combination of simple cosine theory and ray tracing algorithm. For the silicone oil-paraffin oil system, the film drainage behavior observed was as expected from simulations based on thin film drainage equations. On the other hand, glycerol drops of radii smaller than 130 μm, resulted in the formation of an equilibrium film of silicone oil with an approximate thickness of 10 nm. The origin of this repulsive force is attributed to the presence of an immobilized layer of adsorbed polymer chains. Film drainage observed in glycerol drops of radii larger than 130 μm, was found to destabilize in a non-axisymmetric mode. The rapid growth of this asymmetric instability can lead to stresses (O(100 Pa)) higher than the yield stress of the adsorbed polymer layer.

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