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Soap film as a 2D system: Diffusion and flow fields SKANDA VIVEK, ERIC WEEKS, Emory Univ —

We use microrheology to measure the 2D (interfacial) viscosity of soap films. Microrheology uses the diffusivity of tracer particles suspended in the soap film to infer viscosity. Our tracer particles are colloids of diameters d = 0.10 and 0.18 microns. We measure the interfacial viscosity of soap films ranging in thickness from 0.1 to 3 microns. The thickness of these films is measured using the infrared absorbance of the water based soap films. From film thickness, viscosity of the fluid used to make the film and particle diffusivity, we can infer the interfacial viscosity due to the surfactant layers at the film/air interfaces. We find positive constant interfacial viscosities for thin films ($h/d < 5$), within error. For thicker films, we find negative viscosities, indicating 3D effects begin to play a role, as air stresses become less important. The transition from 2D to 3D properties as a function of h/d is sharp at about h/d=6. Additionally, we measure larger length scale flow fields from correlated particle motions and find good agreement with what is expected from the theory of 2D fluids for all our films. In conclusion, single particle diffusion shows a sharp transition away from 2D like behavior as h/d increases, but the long-range flow fields still act as 2D.

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