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Instabilities of Evaporating Droplets on Immiscible Liquid Substrates W.D. RISTENPART, C. DOMINGUES, H.A. STONE, Division of Engineering and Applied Sciences, Harvard University — We report a new class of convective instabilities observed in thin (lens-shaped) droplets of volatile liquids floating on a thick layer of an immiscible liquid. Two types of behavior are observed: internal axisymmetric fingering and one-dimensional spreading. For sufficiently low substrate viscosities ($\nu < 100$ cSt), a hole quickly develops near the center of the volatile liquid lens ($\nu \sim 1$ cSt). The hole rapidly forms fingers which grow radially outward into the remainder of the droplet. This instability is axisymmetric, but in some cases the droplet also spreads rapidly in one dimension, yielding aspect ratios > 50. The one-dimensional spreading is observed at all substrate viscosities tested (up to 1000 cSt), with or without internal fingering; any holes that do form (at lower viscosities) are stretched into a long groove that extends the entire length of the droplet. Both instabilities are frequently observed concurrently, giving rise to "fishbone" structures with complicated dynamics. In this presentation we survey the observations and analyze the results in terms of evaporation-induced convection in the context of lubrication theory.

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