Inertial Liquid-Liquid Dewetting

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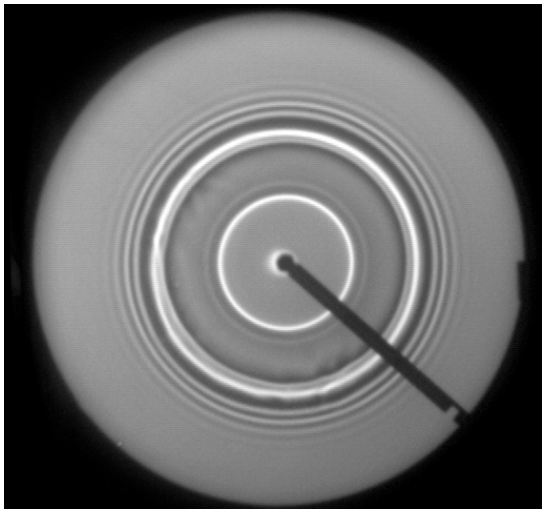
A liquid film deposited on a nonwettable substrate tends to dewet. Previous studies concern the case of a solid substrate, in viscous regime, where viscous forces at the contact line counterbalance surface tension. For lower viscosity liquids, inertial regime has been explored where surface tension converts to inertia and lead to faster dewetting. Here we study the case of such fast dewetting (up to 1 m/s) of water films (*A*) but deposited on highly hydrophobic liquid substrates (*B*), nonmiscible and denser which are ideal support free of defects. The film (thickness e) becomes unstable below a certain thickness e_c, and dewets by nucleation and growth of a "dry" patch of radius R(t) surrounded by a rim collecting the water. We measure the dewetting speed as function of thickness e (using fast imaging) and compare it to the Culick law for the bursting of soap films: we find a similar behavior ($V \sim e^{-1/2}$) with different numerical coefficients that we discuss. We also study the wave pattern generated by the advancing rim, as for boats traveling faster than the minimum phase speed for capillary-gravity waves. In our case waves can also be induced from the front of the rim where the liquid bath is coated by the water film, and from the back of the rim where the liquid substrate is "dry". We observe two hydraulic shocks (gravity waves behind the rim, and capillary waves ahead) when rim speed is higher than wave speed on each of its sides (see figure).



Figur:. Dewetting visualized by refraction (diameter: 20 cm). Waves ahead and behind the rim (large bright annulus).

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