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Capillary wave instability driven air film rupture during drop impact on smooth surfaces.[1] LIGE ZHANG, TEJASWI SOORI, ARIF ROKONI, YING SUN, Drexel University — The stability of the interstitial air film underneath a droplet plays an important role in drop contact dynamics upon impacting a smooth surface. A stable air film leads to droplet bouncing whereas an unstable air film results in droplet contacting the surface and consequent spreading or splashing depending on the impact velocity. Apart from the previously reported film and kink contact modes, here we present the theoretical and experimental evidence for a dimple failure mode of air film driven by a capillary wave instability, for a liquid droplet impacting onto an atomically smooth, lubricated surface. The dimple failure occurs beyond the inertial-capillary time scale and the contact is initiated when the dimple inverts at the central of the droplet. The effects of drop impact velocity and viscosity on the dimple failure mode are explored. While low viscosity droplets exhibit bouncing, dimple failure, and kink failure with increasing impact velocity, the dimple failure mode is absent in higher viscosity droplets due to viscous damping of the capillary wave.

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