DROPLET DYNAMICS ON CONICAL SUBSTRATES

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Droplet motion on conical substrates is a phenomenon observed extensively in nature and has since been adopted in industrial applications. It has been suggested as a mechanism responsible for: dew drops forming on spider webs[1], aiding cacti to remain hydrated in the desert[2] and even repelling water from the legs of the common water strider[3]. This motion has been exploited in the petroleum industry where micron sized droplets of oil can be removed from water using arrays of cones[4]. Surfaces with conical micro-posts have shown promising results in enhancing water repellent surfaces[5.] Despite these promising technologies there has not until very recently been interest in the dynamics of droplet on such surfaces.

We study, both experimentally and theoretically, the dynamics of droplets on conical surfaces. The curvature gradient of the surface induces a pressure gradient that leads to spontaneous propulsion of the droplets. Normally, contact line pinning would prevent or impede this effect. However, by lubricating the substrate the effects of pinning are reduced and the droplet is free to move. We derive the curvature induced force acting on the droplet and balance this with the viscous dissipation occurring in the lubricating wedge. We find that at suitable late times, the droplet's displacement from the apex of the cone, $s \sim t^{1/4}$ and verify this prediction experimentally.

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