

FIG. 1. On a superhydrophobic surface, water condensate spontaneously jump upon drop coalescence. In the capillary-inertial regime, smaller drops jump higher: coalescing drops are 200 and 270 μm in diameter in (a), and 80 and 90 μm in (b) (enhanced online) [URL: <http://dx.doi.org/10.1063/1.3483222.1>].

Self-propelled jumping drops on superhydrophobic surfaces

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We report a self-propelled jumping phenomenon for coalescing drops on superhydrophobic surfaces. The spontaneous motion is powered by surface energy released upon coalescence.^{1,2}

On a horizontal, chilled superhydrophobic surface with an apparent contact angle close to 180° , coalescing drops of water condensate spontaneously jump out of plane, against gravity. In the capillary-inertial regime, the velocity scales as $v \propto \sqrt{\sigma/\rho r}$, where σ is the surface tension, ρ is the density, and r is the drop radius before coalescence. Therefore, smaller drops jump with a higher velocity (Fig. 1), as long as the drop diameter is above 100 μm where viscous effects are not dominating.²

On a heated Leidenfrost surface with liquid drops floating on a vapor layer which resembles superhydrophobicity, the mechanism of the out-of-plane directionality was re-

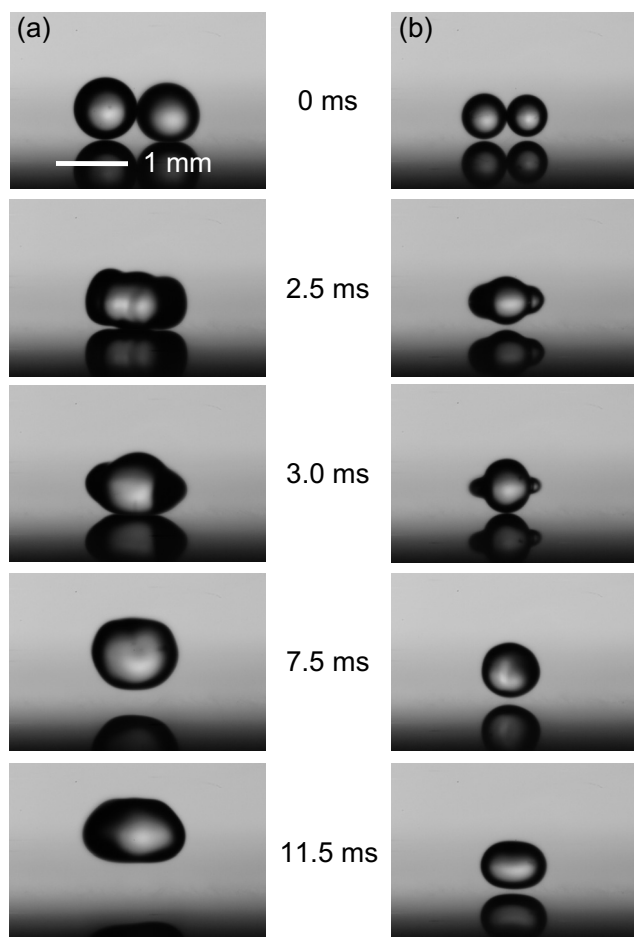


FIG. 2. On a Leidenfrost surface, coalescing water drops spontaneously jump when the liquid bridge impacts the substrate (a). This mechanism is confirmed in (b) where coalescence away from the substrate does not lead to jumping.

vealed by releasing two drops from opposing synchronized gates to induce coalescence. The jumping motion resulted from the evolving liquid bridge of the coalescing drops impinging against the substrate [Fig. 2(a)]; the liquid bridge initiated well above the surface because of the high contact angle of the drops. As a confirmation of the impingement mechanism, when bouncing drops coalesced away from the substrate, no appreciable jumping occurred [Fig. 2(b)].

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