Watching Nanodroplets Jump

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The manipulation of liquids at nanoscale dimensions is a central goal of the emergent nanofluidics field. Naturally, such efforts extend to nanodroplets, ubiquitous objects whose controlled generation and manipulation is crucial to a number of technologically important endeavors, such as jet printing with droplets of ever smaller dimensions.

Here, we employ time-resolved electron microscopy to elucidate a process that generates monodisperse nanodroplets in free space and accelerates them to high velocities. We flash-melt a thin metal nanostructure with a laser pulse to directly observe how the nascent nanodroplet contracts into a sphere and jumps off its substrate. The ensemble averaged trajectories reveal dewetting velocities of up to 80 m/s, with the droplet jumping in under 10 ns. At the same time, we observe significant variations in the trajectories of individual droplets, which points to nanoscale heterogeneity of friction at the liquid-solid interface.

Our experimental approach opens up new avenues for studying the fast morphological dynamics of nanodroplets through direct observation. Moreover, it provides an opportunity to study the nanoscale dynamics of the contact line and investigate liquid friction on its inherent length scale.