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Impact on a breath figure

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A breath figure describes the droplet pattern formed when a vapor condenses onto a surface. First, nanometric droplets of spherical cap shape are created by heterogeneous nucleation. When vapor is constantly provided (supersaturated atmosphere, cold enough surface…), this breath figure evolves with time, the average droplets radii increase. This evolution has been actively studied in the last decades, motivated by understanding nucleation effects [Beysens et al., 2006], thin film vapor deposition, development of anti-dew surfaces and dew recovery system [Lee et al., 2012 et Garimella et al., 2017].

We present here the effect of a mechanical impact on a solid substrate supporting a breath figure. A falling spherical metallic ball impacts the top of the plate, the droplets being on its bottom part. We changed the drop height of the projectile and we observed at different locations the evolution of the breath figure with time. We compared the droplets size distributions before and after impact using the droplet number reduction (%DNR). We show that, for a given mean radius of the droplets, when the acceleration of the substrate exceeds a threshold, the final number of droplets starts to decrease and keeps on decreasing as acceleration is increased. We interpret this result knowing that droplets vibrate, their contact line unpin above a threshold in acceleration [Noblin et al., 2004], presenting oscillations of their radius. This makes them contacting and coalescing with neighbours giving birth eventually to liquids networks. The impact accelerates the natural aging of a breath figure. This could provide a new solution to increase the efficiency of dew recovery processes [L. Betti, C. Cohen, and X. Noblin, Phys. Rev. Fluids 8, 013601 (2023)].

For a better understanding, we then focused on the coalescence dynamics between two water droplets partially wetting under vibrations. e show that several behaviours can then be expressed as function of the contact line speed and the substrate wetting properties. Vibrations thus appear to be a good way to control the dynamics of drop coalescence.

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