Water and Ethanol Droplet Wetting Transition during Evaporation on Omniphobic Surfaces

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Objective

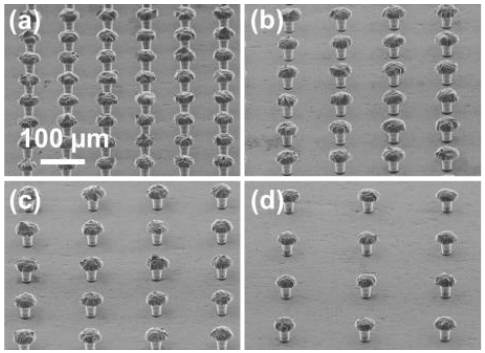
Understanding of the effect of surface roughness on wetting transitions for low–surface-tension organic liquids evaporating on omniphobic surfaces.

Approach

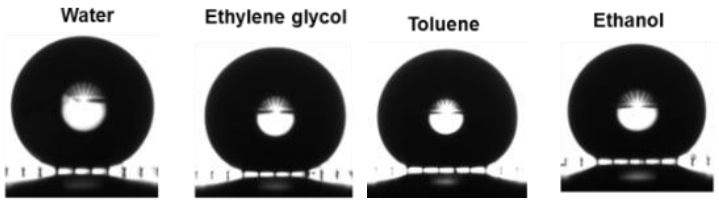
- Fabricate mushroom-structured omniphobic surfaces on copper substrates.
- Investigate the effects of surface topography on water and ethanol droplet evaporation on omniphobic surfaces.
- Develop an interfacial energy-based analysis to predict the Cassie-to-Wenzel wetting transition observed in the experiments..

Publication

X. Chen, J. A. Weibel, and S. V. Garimella, Sci. Rep., 5, 17110, 2015.



SEM images of the mushroom-structured copper surfaces, denoted as (a) OM-90, (b) OM-120, (c) OM-150, and (d) OM-180, based on the mushroom center-to-center spacing.

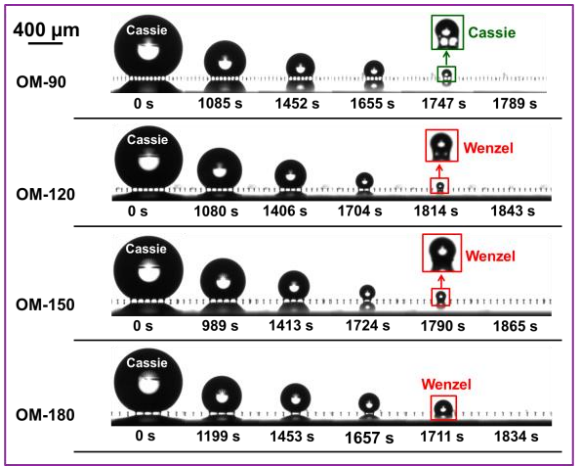


Surface OM-180

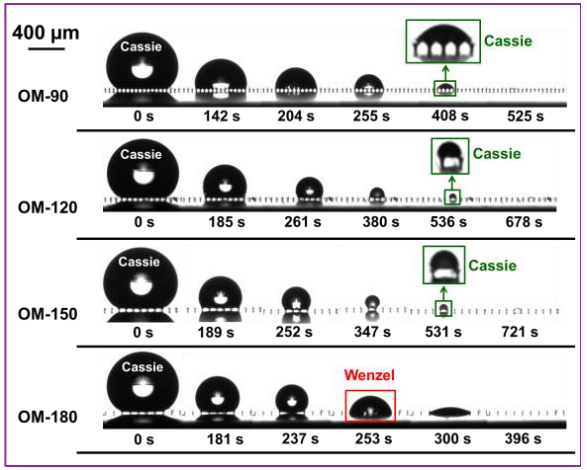
Impact

- Ethanol droplets not only have shorter evaporation lifetimes, but also inhibit the Cassie-to-Wenzel wetting transition for certain geometries at the late stages of evaporation.
- Exploiting the unique suppression of the wetting transition during ethanol droplet evaporation on omniphobic surfaces may offer a novel avenue in biosensing that allows for concentrating target molecules contained in the droplets onto the sensing area with minimal loss.

Water droplet evaporation:



Ethanol droplet evaporation:



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