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Wetting and Dewetting on Superhydrophobic Surfaces with Two-Tier Roughness JONATHAN BOREYKO, CHUAN-HUA CHEN, Duke University, MECHANICAL ENGINEERING AND MATERIALS SCIENCE TEAM —
Many natural superhydrophobic structures, such as the lotus leaf, demonstrate hierarchal two-tier roughness. The hierarchal roughness is empirically known to promote robust superhydrophobicity, but the mechanism is still under debate. Here, we report the wetting and dewetting properties of two-tier roughness as a function of the wettability of the working fluid, where the surface tension of the water/ethanol mixture is tuned by the mixing ratio. On both natural and synthetic two-tier surfaces, externally deposited drops of increasing ethanol concentration exhibit two distinct wetting transitions, first for the impalement of the microscale texture and then for the nanoscale. The impaled drops are subsequently subjected to vibration-induced dewetting [1]. Drops impaling only the micro-scale roughness exhibited a metastable superhydrophobicity, as sufficient vibrational energy can enable a complete dewetting with no residual drops. In contrasct, drops impaling both the micro and nano-scale roughness can not be completely dewetted. Our work suggests that the nanoscale roughness is essential for preventing catastrophic, irreversible wetting of superhydrophobic surfaces.

[1] J.B. Boreyko and C.H. Chen, Phys. Rev. Lett. **103,** 174502 (2009).

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