Characterization of Slippery Rough Surfaces: Drop Bouncing, Evaporation, and Self-Cleaning

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Purpose of research
- A droplet on a rough hydrophobic surface can be in one of two states: the Cassie State or the Wenzel State.
- Cassie State – droplet rests on a combination of air and the tops of micropillars
- Wenzel State- droplet sits between micropillars
- With conventional rough hydrophobic surfaces, a droplet is mobile in the Cassie State, but trapped in the Wenzel State.
- Slippery rough surface (SRS) contains hierarchical micropillars with lubricant-infused nanotextures and allows droplet mobility in both the Cassie State and the Wenzel State.
- Useful for applications where the Wenzel State is difficult to be avoided, such as condensation heat transfer and fog harvesting.
- Goals: characterizing the surface and understanding droplets in the Slippery (mobile) Wenzel State

Methods and Materials

Evaporation Profiles
- Observe contact angle as a droplet evaporates on SRS
  - Micropillar height ~ 5µm, 10 µm, 20 µm
  - Micropillar width/spacing ~ 20 µm, 50 µm
  - Lubricant viscosity ~ Krytox 100, Krytox 101, and Krytox 102

Evaporation Rate (R) = 1 + \((w+h)^2\)

where R = roughness, w = pillar width, h = pillar height, L = spacing between pillars

Self-Cleaning
- Range of outcomes
- Wenzel State droplet can clean tops of pillars and between pillars
- Increased droplet height
- Greater droplet width on SRS than superhydrophobic surface

Drop Bounce Tests
- Increased drop height → increased drop width
- Greater droplet width on SRS than superhydrophobic surface

Future Work
- Evaporation Profiles
  - Variation in SRS micropillar height/width/spacing
  - New types of liquid droplets
  - Comparison of maximum and minimum contact angle to advancing and receding angle
- Self-Cleaning
  - New pre-dispersion method
  - Hydrophobic contaminants
  - Particle equal to pillar spacing
- Drop Bouncing
  - Explore correlation between SRS dimensions and bouncing drop properties
  - Comparison of SRS to superhydrophobic surface

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