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Vibration-induced Wenzel to Cassie Transition on a Superhydrophobic Surface JONATHAN BOREYKO, CHUAN-HUA CHEN, Duke University — A drop on a roughened superhydrophobic surface will exhibit either the Cassie state, where the drop sits on the air-filled textures, or the Wenzel state, where the drop wets the cavities of the textures. The superhydrophobic Cassie state is the preferred state with a small contact angle hysteresis and high drop mobility. Although superhydrophobic surfaces can be designed to make the Cassie state energetically more favorable, drops often end up trapped in a metastable Wenzel state and an energy barrier has to be crossed for reversal to the desired Cassie state. We show that mechanical vibration can be used to cross this energy barrier without resorting to liquid-vapor phase change. A complete Wenzel to Cassie dewetting transition is accomplished by vibrating a metastable Wenzel drop on a superhydrophobic lotus leaf. A water drop in a metastable Wenzel state is obtained by exploiting the differential evaporation rate of water and ethanol. The dewetting transition requires minimum external forcing when the vibration is in resonance with the drop. The vibration-induced Wenzel to Cassie transition is a plausible mechanism used by water-repellant plants to maintain superhydrophobicity, and is applicable to a variety of engineering systems requiring sustained superhydrophobicity.

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