Viscosity-Ratio-Dependent Shear-Driven Drainage of Liquid-Infused Surfaces

Ying Liu

Liquid-infused surfaces display great advantages such as omniphobicity, anti-icing, anti-fouling and self-cleaning. They can also reduce the drag of an object moving through an immiscible fluid since there is slip along the fluid-fluid interface. However, the trapped liquids are susceptible to the shear of the external flow which will drain the lubricants from the surfaces and hinder their practical use. In this study, we investigate the shear-driven failure of liquid-infused surfaces under a broad range of ratios of the viscosity of the external fluid to that of the lubricant. The effect of viscosity ratio on the steady-state lubricant retention is characterized experimentally and analyzed analytically. The model offers a possible way to estimate the shear-driven failure of surfaces filled with different lubricants and even air-infused superhydrophobic surfaces in the limit where the external fluid is much more viscous than the infused liquid.