

## Friction-induced slip-to-roll transition of oleoplaning droplets

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**Abstract:** Understanding droplet-surface interaction is important in numerous industrial applications ranging from spray coating to thermal management. Droplets on state-of-the-art micro/nanotextured lubricant-infused surfaces have been shown to oleoplane akin tires on wet roads. This is attributed to the nearly frictionless ultra-low adhesion and vanishing contact angle hysteresis of droplets on this new class of hemi-solid hemi-liquid surfaces. To date the motion of millimeter size droplets, particularly whether they roll or slide, is not fully understood. To shed light on this topic, we experimentally characterize the internal fluid flow inside moving droplets on textured lubricant-infused surfaces using particle image velocimetry (PIV) to identify the friction-induced transition from sliding to rolling motion. Our preliminary results of the internal fluid motion and velocity profile of tracer particles inside moving droplets show that the viscosity ratio between the droplet and the lubricant oil plays a crucial role in determining the sliding to rolling transition of oleoplaning droplets. The findings of this study inform how friction influences droplet mobility on textured lubricant-infused surfaces. The new knowledge and insights gained from this work have important implications for frictionless droplet transport in microfluidics and lab-on-a-chip devices.

**Key words:** oleoplaning droplets, lubricant-infused surfaces, particle image velocimetry (PIV), slip-to-roll transition

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