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Measurement of strong Marangoni flow near a contact line of a water droplet on hydrophobic surfaces JOONSIK PARK, KENNETH S. BREUER, Brown University — Strong Marangoni flow from a water droplet on unheated substrate has been theoretically predicted but not been quantitatively measured. Using two different experimental techniques, multi-layer flood illumination and Total Internal Reflection Fluorescence Microscopy (TIRFM), we report Marangoni flows with large ($O(100\ \mu\text{m/s})$) velocity near a contact line of a water droplet on hydrophobic substrates. The flow is measured by tracking the motion of nanoparticles with respect to the contact line, using statistical particle tracking velocimetry combined with sub-pixel edge detection algorithm. Under multi-layer flood illumination, the recirculating convective flow is identified within 5 μm vertically from the substrate. From the TIRFM measurement, the changes in the bulk-averaged velocity ($O(100\ \mu\text{m/s})$) and the shear rate ($O(100\ \text{s}^{-1})$) as the distance from the contact line are identified within 550 nm vertically from the substrate, and compared to the characteristic shear rate and speed from Marangoni effect, respectively. Surprisingly, both Flood and TIRFM measurements indicate high slip velocities extending as far as 33 μm from the contact line. One possible explanation is that the high slip velocity is due to the accumulation of nanobubbles near the contact line which were formed at the deposition of a droplet.

Joonsik Park
Brown University

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