Driving Droplets on Liquid Repellent Surfaces via Light-Driven Marangoni Propulsion

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Manipulation of liquid droplet on liquid repellent surfaces has allured considerable interest for their promising applications in drug delivery, micromotor, and microfluidics device. To control motions of droplet, recently, various sources of propulsion force have been introduced, such as electrostatic charge, magnetic attraction, and thermocapillary convection. Here, we propose a new strategy to manipulate droplet motion, driven by controlled Marangoni flow along the surface tension gradient. To realize the surface tension gradient via temperature gradient on the surface of droplet, the droplets incorporating photothermal polypyrrole nanoparticles (PPy NPs) are introduced. Therefore, near infrared (NIR) irradiation is a trigger to heat the PPy NPs dispersion. In this method, the droplet is heated from the inside, not from the substrate. By using the NIR laser, irradiation position can be precisely controlled, which allows localized heating of the droplet and altering the direction of thermocapillary convection. In addition, we found the effect of composition gradient of the mixture droplet on the Marangoni flow in addition to the thermocapillary convection by temperature gradient.