Strategies for Smart and Slippery Surfaces

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The problem of contact line pinning on surfaces is pervasive and contributes to problems from ring stains to ice formation. Here, I discuss five strategies for modifying the solid-liquid interface to remove pinning and increase the ability of surfaces to shed droplets. I described three biomimetic strategies, i) reducing the liquid-solid interfacial area inspired by the Lotus effect, ii) converting the liquid-solid contact to a solid-solid contact by the formation of a liquid marble inspired by how galling aphids remove honeydew, and iii) converting the liquid-solid interface to a liquid-lubricant contact by the use of an lubricant impregnated surface inspired by the *Nepenthe*s Pitcher plant. I then explain two further strategies, iv) converting the liquid-solid contact to a liquid-vapor contact by using the Leidenfrost effect, and v) converting the contact to a liquid-liquid-like solid contact using covalent attachment of a liquid-like coating. Using these approaches, I explain how surfaces can be designed and structured to have smart functionality whilst retaining the mobility of contact lines and droplets and how their wetting and dewetting properties can be re-programmed using electric fields. I exemplify these ideas with experiments showing constant contact angle droplet evaporation [1,2], droplet positioning and control using meniscus forces from Cheerios-type effects [3], energy invariant transport of liquids by boundary reconfiguration [4], and by driving the rotation of solid components in a Leidenfrost heat engine [5].

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References
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