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Lateral adhesion of droplets measured with the scanning drop friction force instrument

The understanding of wetting phenomena plays a crucial role in many daily processes. For example, dirt repelling surfaces can be achieved by a hydrophobic coating. Typically, the wetting properties of such a coating are characterized by measurements of the advancing and receding contact angles by sessile drop goniometry [1]. This method provides only information on selected points and local imperfections may remain hidden.
Recently, Hinduja et al, reported on a fast and easy method to analyse friction forces of drops on surfaces [2]. The method was called scanning drop friction force instrument (sDoFFI) and allows to image wetting properties on cm2 large areas within a few minutes. A drop adheres to an elastic glass capillary while the sample underneath is moved with a constant speed to imitate sliding of the drop. The deflection of the elastic glass capillary provides information about the friction force between the drop and the surface.
Often drops do not adhere strongly to the elastic glass capillary. Then the drop detaches from the capillary while scanning. In order to improve drop adhesion to the elastic glass capillary, I glued metal rings to it. Shaping the metal rings forces the drop to shape as well. In particular, shaping the drop into different width allows to verify the Furmidge equation [3]

F=k ·γ·w·(cos(θ_rec)-cos(θ_adv)).

Where F is the friction force of the drop, k is a geometrical factor, γ is the liquid surface tension, w the width of the drop at the three-phase contact line and θ_rec and θ_adv are the receding and advancing contact angles, respectively. I will present initial measurements of the friction force of drops in dependence of drop shape. Furthermore, I will present sDoFFI measurements of real samples that we tested.

[1] Huhtamäki, Tommi, et al. "Surface-wetting characterization using contact-angle measurements." Nature protocols 13.7 (2018): 1521-1538.
[2] Hinduja, Chirag, et al. "Scanning drop friction force microscopy." Langmuir 38.48 (2022): 14635-14643.
[3] Furmidge, C. G. L. "Studies at phase interfaces. I. The sliding of liquid drops on solid surfaces and a theory for spray retention." Journal of colloid science 17.4 (1962): 309-324.

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