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

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The understanding of wetting phenomena plays a crucial role in many daily processes. For example, dirt repelling glasses 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]. However, this method provides only information on the selected areas corresponding to the observed moving contact line. In sessile drop goniometry this area is typically a few mm^2. Thus local variation of wetting properties of cm2 samples remaining hidden in case the contact line does not cover this area. Therefore, in order to obtain a representative information of the surface of interest a method where the contact line is scanned over cm^2 area is of interest.

Recently, Hinduja et al, reported on a scanning drop friction force instrument (sDoFFI) to analyse friction forces of drops on surfaces [2]. This method allows to image wetting properties on cm^2 large areas within a few minutes. A drop is fixated to an elastic glass capillary which acts as a spring with spring constant κ. The sample underneath the drop is moved with a constant speed u leading to sliding of the drop at a defined trajectory along surfaces. The deflection of the capillary, d, provides information about the friction force between the drop and the surface, F_meas= κ·d. Forces arising from CAH are given by the Furmidge equation [3], where the drop's sliding force F_CAH corresponds to

F_CAH=k ·γ·w·(cos(θ_rec)-cos(θ_adv))

Where k is a geometrical factor, γ is the liquid surface tension, w the width of the drop and θ_rec and θ_adv are the receding and advancing contact angles, respectively. For small u we assume F_meas= F_CAH. The parameters γ, w, θ_rec and θ_adv are known or can be measured optically. Thus the geometrical factor k can be calculated. We realize different geometries of the drop by glueing metal rings to the elastic glass capillary. Shaping the metal rings forces the drop to shape. We discuss experiments where we shape the drop into different width and discuss dependence of the geometrical factor k.

[1] Huhtamäki, Tommi, et al. "Surface-wetting characterization using contact-angle measurements." Nature Protocols (2018): 1521-1538.

[2] Hinduja, Chirag, et al. "Scanning drop friction force microscopy." Langmuir (2022): 14635-14643

[3] Collet,P, et al. "Dynamics of the Contact Line: Contac Angle Hysteresis."Phys. Rev. Lett., 79 (1997) 3704.

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