Study of PDMS and 8CB prewetting films by Sarfus

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The prewetting films of a methyl-terminated PDMS droplet and 8 CB liquid crystal are characterized by SARFUS. Thin layers of 0.7 and 3.3 nm are measured on both systems, respectively.

Prewetting films play a crucial role in many wetting and evaporation phenomena. For example, it is well-known that molecule organization of a liquid in contact with a solid substrate in a molecular film thickness can lead to drastic modifications of the surface wetting properties. To date the main techniques used for wetting studies at the molecular scale are ellipsometry, AFM and X-reflectivity. We present hereafter two examples of images obtained by the Sarfus technique on samples perfectly characterized by other ways (at different space scales).

The Sarfus technique advantages are those of optical microscopy in particular to provide in real time a direct film visualization. But Sarfus gives in addition an access to nanometric thin films visualisation and measurement (0.7 nm in the case of PDMS spreading). This technique is the complementary tool of AFM and ellipsometry in the wetting behaviour study. AFM allows a quantitative thickness measurement of ultrathin films but its use is delicate for the film edge localization (range scan lower than one micron). It is often difficult to follow fast kinetic and quite impossible to look at behaviours on the micron scale. Ellipsometry provides quantitative thickness measurements but is limited by its weak lateral resolution (~ 50x50 µm²). The studied films must be millimetre-wide. It is also difficult to follow fast kinetic phenomena. These two methods need a surface scan that slow down the data acquisition.

Spreading of a PDMS layer

A methyl-terminated PDMS droplet is deposited on an hydrophobic Surf. Raw Sarfus image recorded 10 minutes after the deposition is shown hereafter (image 1). Three stairs are present at the drop border whom each step height is 0.7 nm (in accordance with ellipsometric measurement). This value corresponds to the molecule thickness lying on the surface.

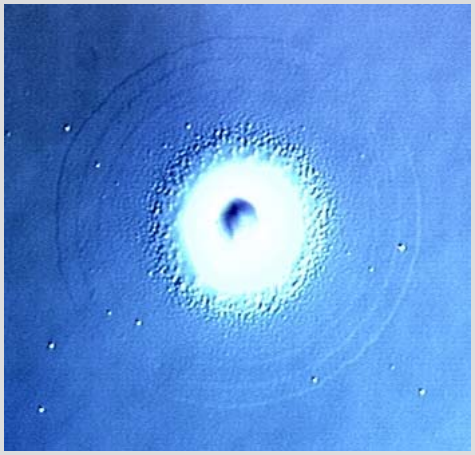

Image 1: PDMS droplet on an hydrophobic surf.

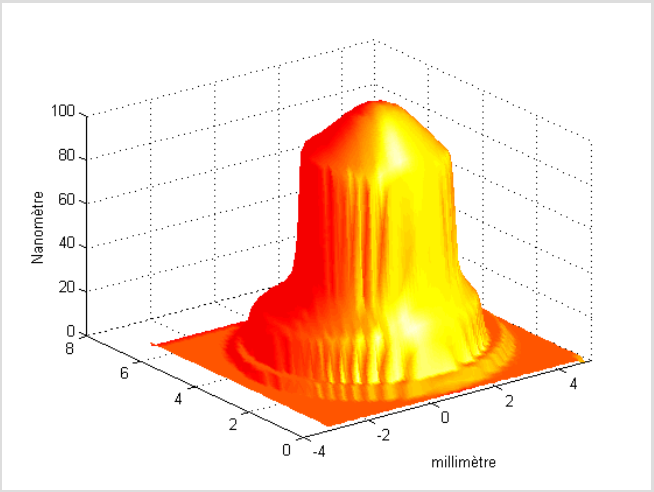

Image 2: Ellipsometry image of a 8CB drop. Lateral dimensions: 7 mm x 7 mm.

Spreading of a 8CB layer

A 8CB liquid crystal (4-n-octyl-4-cyanobiphenyl) droplet deposited on a standard surf (at 25°C) does not wet the surface from a macroscopically point of view but a molecular film spreads out. The thickness of this layer is 3.3nm and corresponds to the 8CB smectite periodicity (also characterized by ellipsometry, AFM and X-reflectivity).
At a temperature close to the smectic/nematic transition, the spontaneous spreading of the droplet is observed. It leads to the formation of additional steps with a thickness multiple (from 1 to 4) of the smectic period. Image 2 corresponds to a ellipsometric measurement of the 8CB droplet at 30°C (~ 4000 measurements ie. ~15 min.). A thin layer (3,3 nm) and a shoulder are observed. Ellipsometry does not allow characterizing the nature of the shoulder that is observed by the Sarfus technique (image 3).

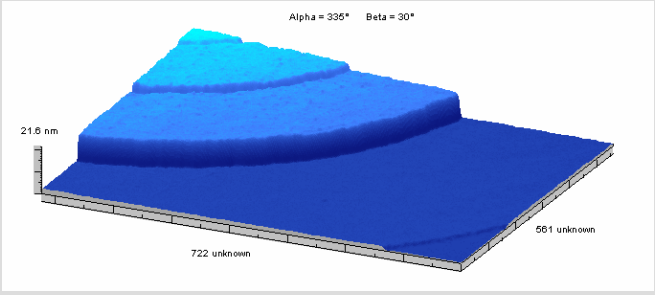

Image 3: 3D Sarfus image of a 8CB drop on a standard surf. Lateral dimensions: 370 µm x 370 µm

Contribution of Sarfus

- Ultra-thin films (< 1nm) visualization and measurement.
- small (100µm²) to large (2mm²) lateral scale analysis.
- ultra fast visualisation and measurement