DEWETTING OF POLYSTYRENE THIN FILMS ON TERRACED SUBSTRATES: INTERACTION OF A CONTACT LINE WITH NANOMETRIC STEPS

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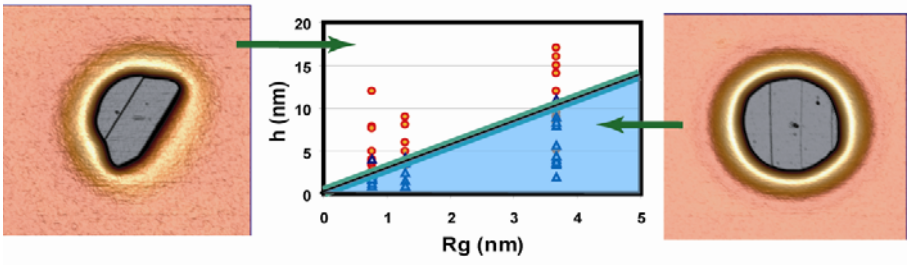
The laws governing the spreading of liquids on surfaces are well understood at the macroscopic scale but little is known when scaling down to nanometer scale. In particular, the structure of the liquid in the very close vicinity of the contact line remains largely unknown. We used steps on alumina and graphite surfaces to probe, at nanometer scale, the structure of the contact line. The interaction of the contact line with the steps is observed during the dewetting of polystyrene films on these surfaces. We observe that, for steps heights larger than a critical value, the hole is asymmetric: the contact line is blocked by downwards steps whereas it passes through upwards steps with no interaction. This behavior is explained by simple macroscopic considerations based on the equilibrium contact angle. For steps smaller than this critical value, the contact line is insensitive to the steps: the hole grows symmetrically as on a homogeneous surface. Statistics with various polystyrene over a large number of steps on alumina show that the critical step height is about 3 times the radius of gyration of the polymer. This indicates that the "macroscopic" description remains valid down to dimensions of the order of the diameter of one single molecular chain. We also evidenced a regime of temporary pinning close to the critical height with well-defined pinning times as a function of steps heights. The same experiment on alumina shows a drastically different relationship between critical step height and the radius of gyration of the polymer. This demonstrates the sensitivity of the method to probe the solid-liquid interaction at nanometer scale.



Statistics on the anchoring condition of a contact line on nanometric steps as a function of the polymer radius of gyration with AFM images of the two distinct situations (pinning on downward steps on the left image and non-pinning on the right one).

Reference :
Pinning of a contact line on nanometric steps during the dewetting of a terraced substrate
T. Ondarçuhu, A. Piednoir *NanoLett* **5** (2005) 1744-1750.

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