Wetting on soft gels

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How a liquid wets the surface of a solid substrate has been long studied, and is still attracting researchers from different subjects because of the fundamental physics behind and its wide industrial applications. Many experiments were performed to gain insight into both the statics and the dynamics of wetting in such systems. However, a throughout knowledge of wetting is still missing because of experimental limitations and mathematical intricacies. In particular, precise control on both the surface and mechanical properties of substrates has challenged scientists for decades, and appropriate optical methods that allow the visualization of the surface deformation both in the vicinity and far from the contact line are required. A complete study of the surface deformation induced by resting droplets from both experimental side and theoretical side under different parameters is in demand, and how the geometry of the system can affect the spreading dynamics remains to be resolved. Here we report the results of a study of both the statics and the dynamics of wetting. First, we develop a quantitative Schlieren optics enabling us to directly observe the surface deformation after the deposition of a water droplet in real time. We measure the out-of-plane deformation outside the droplet as a function of droplet size, gel thickness and elasticity. We identify a submicrometer-deep dimple, on the dry side of the droplet, which extends over a few mm away from the contact line. Second, we characterize the receding dynamics and we show that the dynamic contact angle, hence dissipation, depends in a non-trivial fashion on the thickness of the sample. We rationalize our experiments, with an analytical model accounting for the linear elastic response of the gel bulk as well as its surface tension. We find excellent agreement with experiments.

Références