Anisotropic wetting behavior on polymeric textured surfaces

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On anisotropic textured surfaces, the droplet has not a circular geometry. Indeed, anisotropic texture affects the spreading of the droplet. This phenomenon can not be explained by the classical laws of the wetting and it is not well controlled. In this study, anisotropic spreading of the droplet is quantified on anisotropic textured surfaces with various chemistries. Then, the influence of the chemistry, the geometry and the wetting state on droplet spreading is investigated to a better understanding and a better control of this spreading phenomenon.

Keywords: Wetting, Textured Surface, 3D goniometer

1. Introduction

The topography-wetting link has been highlighted by Wenzel and Cassie-Baxter's equations. However, these classical models do not allow to understand the wetting behavior on complex textures. These models cannot totally explain the anisotropic wetting behavior of a droplet on an anisotropic surface[1]. In this study, this behavior is experimentally investigated with a special goniometer. Then, contact angles measured are interpreted in function of the material, the texture, the wetting state.

2. Experiments

To study the spreading anisotropy of the droplets various anisotropic polymeric surfaces have been studied.

2.1. Surfaces studied

Several polymeric surfaces are studied (PA6.6, ABS, PDMS…). Theses surfaces presents anisotropic textures (Figure 1a) obtained by direct femtosecond laser texturing, injection molding and bio-inspired replication.

2.2. Experimental wetting setup

A homemade goniometer is used to measure contact angle. This goniometer can measure contact angle in each direction by rotation of the surface. The classical side view is completed by a top view of the droplet (Figure 1b). This goniometer can also be tilted to measure sliding angle and study the dynamic behavior.

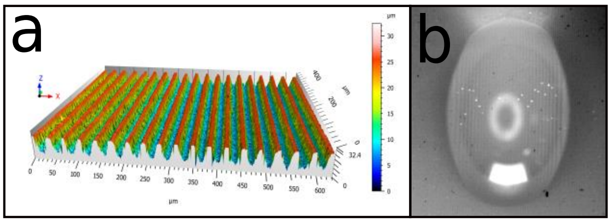

Figure 1: (a)ABS anisotropic stripes obtained by injection molding. (b)Anisotropic spreading of water droplet on the surface.

2.3. Results

Contact angle is measured in function of rotation angle (Figure 2). The contact angle evolves cyclically during rotation. The number of these cycles is equal to the number of symmetry axis of the texture. On ABS anisotropic stripes, 2 cycles are observable for 2 symmetry axes, with a maximum contact angle of 128° and a minimum contact angle of 86°. So, the contact angle evolves by more than 40° depending on the directionality of the texture.

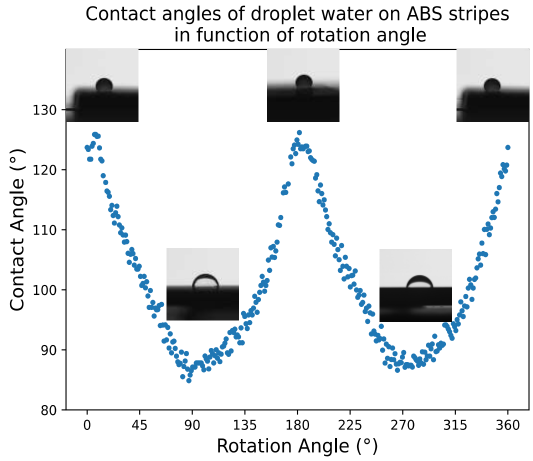

Figure 2: Contact angle of water droplet in function of rotation angle on ABS anisotropic stripes.

3. Discussion

Classically droplet base line has circular geometry to minimize energy. However, on anisotropic surfaces, the droplet reaches an anisotropic state. This phenomenon depends on the number of textures under the droplet and tends to disappear as the number of textures increases[2]. In addition, this phenomenon also depends on the state of wetting of the droplet and is much more pronounced with a Wenzel-type wetting.

Anisotropic wetting behavior is investigated on textured surfaces in function of the texture geometry, the chemistry, and the wetting state identified by Extrand model[3]. Thus, this study, support by an improved goniometer, allow a better understanding of anisotropic spreading phenomenon.

4. References

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