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Dynamics of Wetting on a PAMPS-PAAM Hydrogel Substrate

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Gels are materials which have been attracting continued interest as they are intriguing state of matter in fundamental sciences and they also have various technological potentials in many applications [1]. The understanding and control of interfacial properties of gels is of crucial importanc, e.g., adhesion, friction, and wetting [2, 3]. Of those problems about the interfacial properties of gels, here we are focusing on the wetting problem on gel surfaces.

In this work, we studied the wetting and diffusing processes of water droplets on hydrogel (Poly (2-acrylamido-2-methyl-propane-sulfonic acid -co- acrylamide (PAMPS-PAAM)) substrates. Compared to general solid materials on which wetting problems have been extensively studied, gels have two specific features which can affect the dynamics of the contact line of liquid, i.e., gels are very soft and swells drastically with liquid. For the precise analysis of the behavior of contact line with the existence of the deformation of substrate and diffusion of liquid, it is required to measure both the profiles of the droplet and of the substrate simultaneously. Using a grid projection method, we have established a new experimental method for measuring these two profiles simultaneously and dynamically.

Figure 1 shows the setup for the profile measurement. In the grid projection method, the profiles are measured by tracing the distortion of grid lines between before and after the placement of the droplet. The original grid plate was located far from the observation system. Using two optical lenses, the mirror image of the grid is projected inside the gel substrate, which is set just below the droplet. The grid image was measured by a CCD camera which was located above the droplet.

The original profile can be obtained by tracing path of light which passes through each grid line. With geometrical optics, the original profile is reconstructed from the shift of each grid between the before and after placement of droplet as is shown in fig. 2. We have found that the behavior of the contact line is strongly coupled with the local deformation of the gel surface close to the contact line. The contact line is pinned at the initial stage. As water diffuses into the gel, the apparent contact angle of the droplet and the substrate slope come close to each other. At the moment where these two angles correspond (i.e. when liquid and substrate free surfaces have the same slope), the contact line starts to recede. In this conference, we will report the details of our experimental data and propose a possible mechanism for the present phenomena.

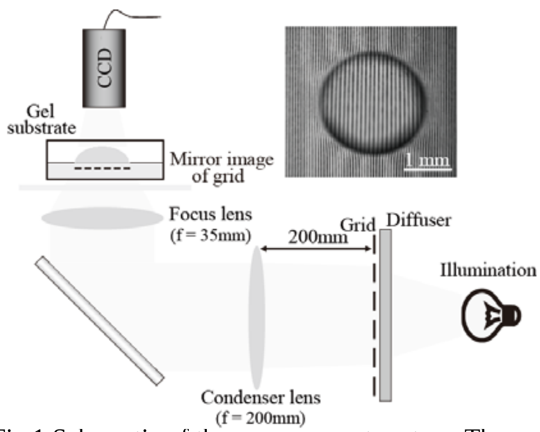

Fig.1 Schematic of the measurement system. The profiles of droplet and substrate are measured simultaneously using a grid projection method.

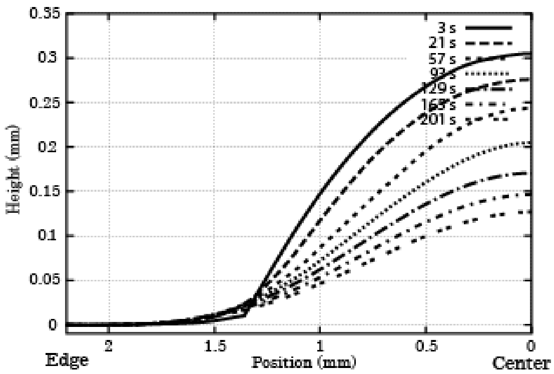

Fig.2 Cross sections of the profiles of the droplet and substrate in different time-steps. Substrate is a PAMPS-PAAM gel

Références

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