Solid surface geometry dependence of advancing contact angle

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Wetting dynamics of a sessile droplet on large geometric surface was investigated by using the pseudo two-dimensional droplet. Thanks to new processing technologies for solid surfaces, making functional solid surfaces, such as lotus leaves and rose petals, have recently been actively studied. Both surfaces have fractal structures and super hydrophobicity, but have totally different contact angle hysteresis. To understand wetting dynamics on such kind of complex surfaces and make a more functional solid surface, we studied the dynamics of the pseudo two-dimensional droplet, which was realized by floating a liquid drop on a surface of another liquid filled in a trough, advancing on a large solid surface patterned with well-defined geometry.

To compare the effect of surface geometry, we prepared two basic structured surface: triangle and circle. These patterns are designed based on Koch curve as a model of typical fractal geometry. Contact lines of the droplet are pinned and depinned at the edge of triangular structure, but they moved smoothly on the circular structured surfaces as shown in Fig.1. On the small structure, the difference of geometry is less effective for the pinning of contact lines. There would be two keys to describe the motion of contact lines; one is surface geometry and the other is structure size.

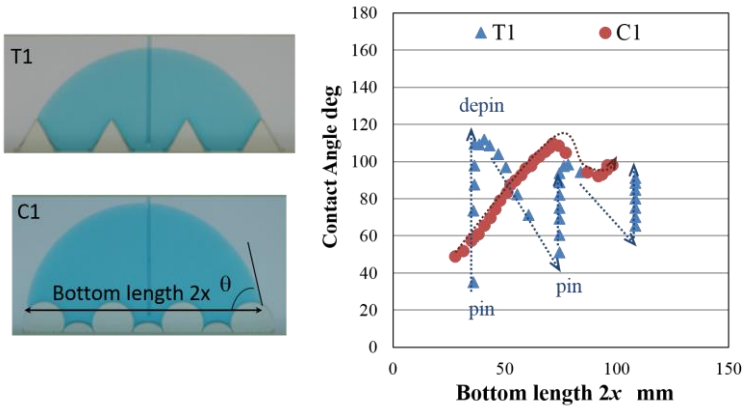

Fig.1 Contact line motion on mm size structure with pseudo two-dimensional droplet. Contact lines are pined at the edge of triangular structure, but they moved smoothly on the circular structure.

On the large structured surface which have triangular shape with different apex angles, the contact lines can move when the contact angle is equal to the Young's contact angle which are determined by the balance of the surface and interfacial tension immediate vicinity of the contact lines.

We also demonstrate that when the drop size is comparable to the surface structure, the geometry of the surface largely influences the contact line motion and advancing contact angle. As the drop size becomes larger, the advancing angle approaches to a single value, which is different from that is predicted by Wenzel model.