Wet adhesion in soft materials and structures

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ABSTRACT

Phenomena related to wet adhesion are commonly observed in nature and engineering devices. If the materials and the structures are stiff and big, mechanical deformation usually has negligible influence on the wet adhesion. However, deformation can dramatically affect the wet adhesion in soft materials or structures with small sizes. In the discussion, I am going to give two examples to illustrate the effect of structural deformations on the wet adhesion. I will first present our recent analytical result of force-separation curve between two soft materials connected by a liquid droplet. How the force-separation curve and rupture point of the liquid droplet depends on the modulus of the material will be discussed. Second, I will show the effect of deformation of beams on capillary condensation phenomena. In an environment containing unsaturated vapor, liquid droplet may form in the gap between two beams which are close enough to each other, which is so-called capillary condensation. When the two beams are compliant, our calculations show that deformation of beams can facilitate capillary condensation, which in turn makes the two beams adhere to each other.