Studies on the adhesion, coalescence and detachment of polymer thin films and biological micro/nano structures

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In this poster, I will highlight my recent research activities on understanding the adhesion, friction and fracture behaviors of polymers and biomaterials, which also have technological applications, for example, in developing advanced high-performance materials.

One of my current research activities is to study the transition between solid- and liquid-like contact adhesion mechanics and failure of materials, which has always been a challenge in materials science and engineering. We have studied both polymeric system and simple sugars, from which we have discovered a novel transient feature (i.e. well-ordered surface waves/ripples) during the adhesion (coalescence) of two soft surfaces; and identified that the detachment of adhesive contacts was manifested by crack nucleation and propagation at one extreme (i.e. the pure solid state) and the snapping of a liquid bridge at the other. In contrast, the crack propagation changed into rounded fingers in the transition from brittle to ductile cracks. These studies have provided insights on the behaviors of surface and interfacial films on micro/nano scales; they have also revealed new pattern-forming mechanisms that could provide current industries a new approach to fabricate microstructures.

In addition to understand the fundamentals from simple modeling systems, we have also investigated several such naturally-occurred adhesive and anti-adhesive systems as gecko toe pads (one excellent dry adhesive system) and human cartilage surface (super lubrication system). These studies have provided us with insights on designing high-performance artificial adhesive and anti-adhesive devices.

I would also like to discuss about my future research interest in the fields of adhesion science and interfacial engineering.