Beitrag ID: **48** Typ: **Keynote**

Elastocapillary Adhesion of Compliant Microspheres

Dienstag, 9. November 2021 16:00 (45 Minuten)

Establishing an adhesive contact between two materials requires both that the surface energies favor the creation of interfacial area and that it is possible to form contact area given the geometry and material properties. While elasticity has long been understood to be important in determining the relative "stickiness" between non-conformal surfaces, in recent years capillarity has also emerged as playing key roles in adhesion with highly compliant materials in multiple ways. For example, recent studies have demonstrated that solid surface tension can compete with or dominate over bulk elasticity in governing contact mechanics on small length scales, and mounting evidence suggests that the internal free fluid phase of compliant polymer gels also contributes significantly to mechanical response via both poroelasticity and classic capillary wetting. In this work, we investigate the adhesion between polydimethylsiloxane (PDMS) gel microspheres and rigid glass substrates. By varying the stiffness and size of the microspheres as well as the surface energy of the substrate and directly imaging the adhered microspheres, we observe a range of adhesive contact geometries from classic elastic to quantitatively wetting-like behavior, always mediated by a phase-separated fluid contact zone. We understand our data with a theoretical model that incorporates elasticity, capillarity, and phase separation to capture the complete range of adhesive contact behavior.

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