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Surface tension and deformation in soft adhesion

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Modern contact mechanics was originally developed to account for the competition between adhesion and elasticity for relatively stiff deformable materials like rubber, but much softer sticky materials are ubiquitous in biology, engineering, and everyday consumer products. In such soft materials, the solid surface tension can also play an important role in resisting shape change, and significantly modify the physics of contact with soft matter. We report indentation and pull-off experiments that bring small, rigid spheres into adhesive contact with compliant silicone gel substrates, varying both the surface functionalization of the spheres and the bulk elastic properties of the gels. We map the resulting deformation profiles using optical microscopy and image analysis. We examine the substrate geometry in light of capillary and elastic theories in order to explore the interplay of surface tension and bulk elasticity in governing soft adhesion.