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Title Deformation of Soft Matter

Abstract Condensed matter physics can be broadly divided into two areas: hard matter physics and soft matter physics. Deformability of soft solids (like rubbers, gels, *etc.*) are much higher compared to hard solids (*e.g.*, metals, ceramics, *etc.*). The extraordinary elastic properties of soft materials have proved them to be ideal candidates for a variety of applications. These include some widespread products: tires in vehicles, soles in shoes, and bands, belts, gaskets in machines are made of rubber. We developed a microscopic model for rubber elasticity and used the basic principles and methods of statistical mechanics to obtain the experimentally observed nonlinear elasticity behavior. Gels – in addition to their rubber-like high elasticity – can imbibe a large amount of solvent. This makes gels used in many products of everyday life, like contact lenses or absorbents in diapers and sanitary pads. Moreover, intense laboratory research is ongoing for many other high-tech applications, including usage of gels in microfluidic systems, tissue engineering, drug delivery, and sensors. We developed a scaling theory for deformation of gels, and tested it in a microfluidic system, which in fact, models common vascular diseases of embolism and occlusion. Both of our theories (for rubbers and for gels) are universal, which means that our results are independent of material chemistry. By understanding the deformation properties of rubbers and gels on a universal, fundamental and microscopic level, we can offer design strategies for these soft materials.