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Moldable soft polymers through topology

Thomas E Kodger
Wageningen University & Research, The Netherlands

Man-made rubbers, have excellent mechanical toughness but are inherently stiff due to topological constraints are known as entanglements, which prevent polymer chains from crossing and act as crosslinks. Thus, entanglements place a theoretical lower bound on how soft elastomers can be made without adding liquid fillers; soft materials with Young's moduli, $E<0.2$MPa are composed of multiple components and are not chemically pure substances. By introducing liquid fillers to polymeric materials, the stiffness may be decreased, however, this swollen material is mechanically brittle and leaks the filler material upon deformation inhibiting their use in many applications. Additionally, this swelling with solvent hinders their ability to be formed or molded into structures. In this talk, I will discuss the synthesis of soft, moldable elastomers. This material is synthesized using controlled living polymerization techniques to fabricate a triblock copolymer with a middle block of silicone polymers in a 'bottlebrush' architecture which eliminates entanglements making the material soft without the necessity for the solvent. The triblock polymer includes functional end blocks composed of a thermoplastic, polystyrene, which undergoes a glass transition upon cooling, allow this material to thermoset reversibly, that is 3D printed. I will present the synthesis and mechanical characterization of this material and high-resolution 3D printing of finely detailed soft structures.

Biography

Thomas E Kodger completed his PhD from Harvard University in 2015 under Professor David Weitz and Postdoctoral studies from the University of Amsterdam with Professor Peter Schall. He is currently an Assistant Professor in the Physical Chemistry and Soft Matter Laboratory at Wageningen University & Research in The Netherlands having joined in 2017.

thomas.kodger@wur.nl

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