



Tailoring Network Features to Control the Mechanical Properties of Materials

Sinan Keten

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Abstract:

In this talk, I will summarize recent advances in computational design of materials that make use of network topologies to attain exceptional mechanical properties. I will first present molecular simulations and machine learning approaches that we established to describe molecular and mesoscale networks formed from polymers and polymer-grafted nanoparticle systems. Following this, I will present strategies from a network design perspective for achieving higher strength, toughness, and impact tolerance in these soft materials. Strategies at the nanoscale include nanoconfinement, which depending on the context and definition may have very different effects on mechanical properties as will be exemplified for polymer-grafted nanoparticles, hydrogels and spider silk. At a higher length-scale, architected network materials from magneto-elastic unitary assemblies will be presented to showcase macroscale systems that recapitulate salient features of biological and polymeric soft materials such as dynamic sacrificial bonds and hidden length for high toughness. I will conclude with some thoughts on how to translate these findings to new material concepts that could be explored further with synergistic experiments and simulations.

Bio:

Sinan Keten is the Jan and Marcia Achenbach Professor of Civil & Environmental Engineering, Mechanical Engineering, and Biomedical Engineering (by courtesy) and the Associate Chair of the Dept. of Mechanical Engineering at Northwestern University. He joined Northwestern University faculty in 2010 after obtaining his Ph.D. from MIT. His research expertise is on computational materials design and mechanics with an emphasis on soft matter, and he has co-authored over 150 journal articles in this area. Prof. Keten has received several honors including the Presidential Early Career Award for Scientists and Engineers (PECASE), Office of Naval Research Young Investigator Award, and several awards from the American Society of Mechanical Engineers (ASME), Society of Engineering Science (SES), and American Society of Civil Engineers. He is a Fellow of the American Physical Society and ASME and currently serves as the Past-President of SES.



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