UNIVERSITY OF CONNECTICUT

INSTITUTE OF MATERIALS SCIENCE

# POLYMER SEMINAR

## "Soft Materials: Unconventional Networks Give Unprecedented Properties"


## Prof. Xuanhe Zhao
## Massachusetts Institute of Technology


## Friday, October 30, 2015
## 11:00 AM, IMS Room 20

## ABSTRACT


Soft materials emerging on the interface between engineering and biological systems are challenging our fundamental knowledge, inspiring technological innovations, and enabling impactful applications. For instance, mammalian muscles, tendons and cartilages, albeit containing ~70% water and having a wide range of rigidity (i.e., 100kPa~10MPa), can maintain impressively high fracture toughness (i.e., >1000 $Jm^{-2}$) under millions of cycles of loads. Marine mussels and barnacles secret soft glues to form robust adhesions (i.e., >100 $Jm^{-2}$) to rocks and metals in flowing water with high salinity. Camouflage animals such as cephalopods can dynamically vary hierarchical textures and colors of their skins within seconds to blend in diverse environments.

At MIT SAMs Lab, we integrate theory and experiments to understand the physics and mechanics of these intriguing biological materials and phenomena, and seek bio-inspirations to design new soft materials to achieve extraordinary properties. We propose that judicious designs of unconventional polymer networks such as interpenetrating networks, multimodal chain distributions, hybrid crosslinkings, transformable domains and fiber reinforcements represent a general strategy to achieve soft materials with extraordinary properties. Guided by this strategy and theoretical models, I will demonstrate examples of our recent designs including: (1) a set of new soft materials with similar water contents and moduli as muscles, tendons and cartilages but much higher fracture toughness (i.e., >10,000 $Jm^{-2}$) and anti-fatigue properties; (2) new underwater soft glues that bond to diverse solids including glass, ceramics, silicon, metals and polymers with interfacial toughness (i.e., >1500 $Jm^{-2}$) much higher than their natural counterparts; and (3) new active polymers that can change both topographic textures and colors under the control of programed voltages. I will conclude this talk by briefly discussing two emerging manufacturing strategies of soft materials: synthetic biology for new biopolymers and nanostructures, and 3D printing for new microstructures.


**For further information, please contact YoungHee Chudy at younghee.chudy@uconn.edu.*

IMS INSTITUTE OF MATERIALS SCIENCE