Polymer Seminar

February 14, 2025

11:15 am Science 1 - Room 1002

Host: Mu-Ping Nieh

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Investigating the Interplay Between Deformation and Optical Properties at the Nanoscale

Abstract: Mechanical stress plays a vital role in diverse processes, from tissue development and cancer progression to failure of structural materials in aviation components. To fully understand those processes, we need sensors that can readout high-resolution mechanical signals in a non-invasive manner. Metallic nanoparticles are promising candidates for such sensors, as they exhibit novel mechanical properties, versatile surface chemistry and robust, sensitive absorbance of visible light. In this talk, I will discuss the interconversion between the optical properties of metallic nanoparticles and mechanical deformation, either of the particles themselves or of their surroundings. In the first case, we use the shape-dependent plasmon resonance spectra of gold nanoparticles to study their deformation under high pressure in a diamond anvil cell. We further connect these measurements with Raman spectroscopy of the surrounding soft matter to investigate the organic-inorganic interface under pressure. In the second case, we examine the correspondence between the plasmon resonance of gold nanorods and the structural collapse of hydrogel microbeads surrounding them. In that system, we find that heterogeneous crosslinking in the hydrogel leads to heterogeneous collapse and a lack of correlation between the optical response and the collapse of the exterior of the hydrogel. These studies give insight into both the promise and limitations of metallic nanoparticles as optomechanical sensors and shed light on how to improve their performance in the future.

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