CMCC Mechanochemistry Discussions

Online Seminar Series

Illuminating Interfacial Mechanics: Utilizing Mechanophores to Quantify Stress in Polymer Composites

Livestreaming at 10:00 AM (CT)

THURS., February 20, 2025

on the CMCC YouTube Channel:
https://www.youtube.com/channel/UC7eCYPKbGTKpgO7W2bNABxg

Dr. Chelsea Davis
University of Delaware
https://polymerinterfacialmechanics.com/

Many properties of polymeric systems are determined almost exclusively by the interfaces between various material components. The research in the Illuminating Interfacial Mechanics Lab focuses on the development of novel measurement tools to assess the micromechanical behavior of polymer surfaces and interfaces while observing the resulting deformation with various microscopy techniques. This talk will focus on the role of interfacial strength on the stress field developed upon loading in the matrix of a glass/polymer composite. Here, we utilize a mechanically-activated fluorescent dye molecule (referred to as a mechanophore, MP) to visualize stress gradients that develop around a rigid inclusion upon mechanical deformation. By coupling our experimental observations of mechanophore activation intensity with finite element analysis of the local stress states in the loaded composites, a novel approach to quantitatively calibrate the MP fluorescent activation intensity is established. We then apply our calibration to several test cases of silica/elastomer composites with dramatically different levels of interfacial strength and varied geometries. This mechanophore/mechanical deformation approach enables stress fields to be directly observed in a powerful new way via confocal fluorescence imaging in a mechanically loaded polymer composite. Further experiments explore fiber reinforced polymer matrix composites, stress localization effects of fiber end geometry, and fiber fragmentation mechanics. This new approach enables direct quantification of stress distribution within polymer matrix composites towards better characterizing complex stress states in situ.

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