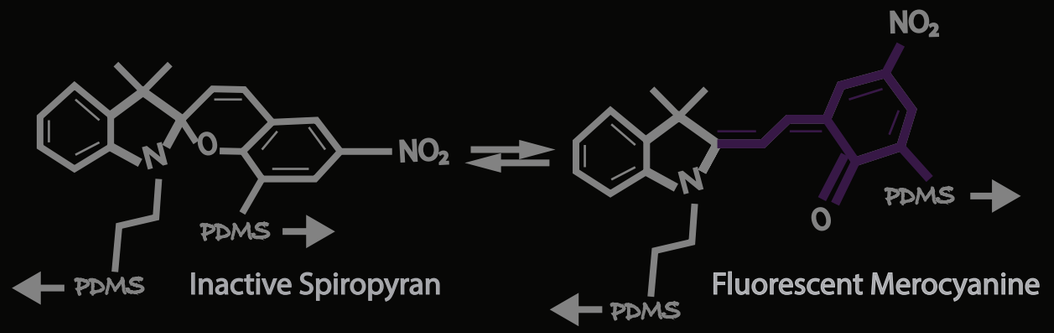
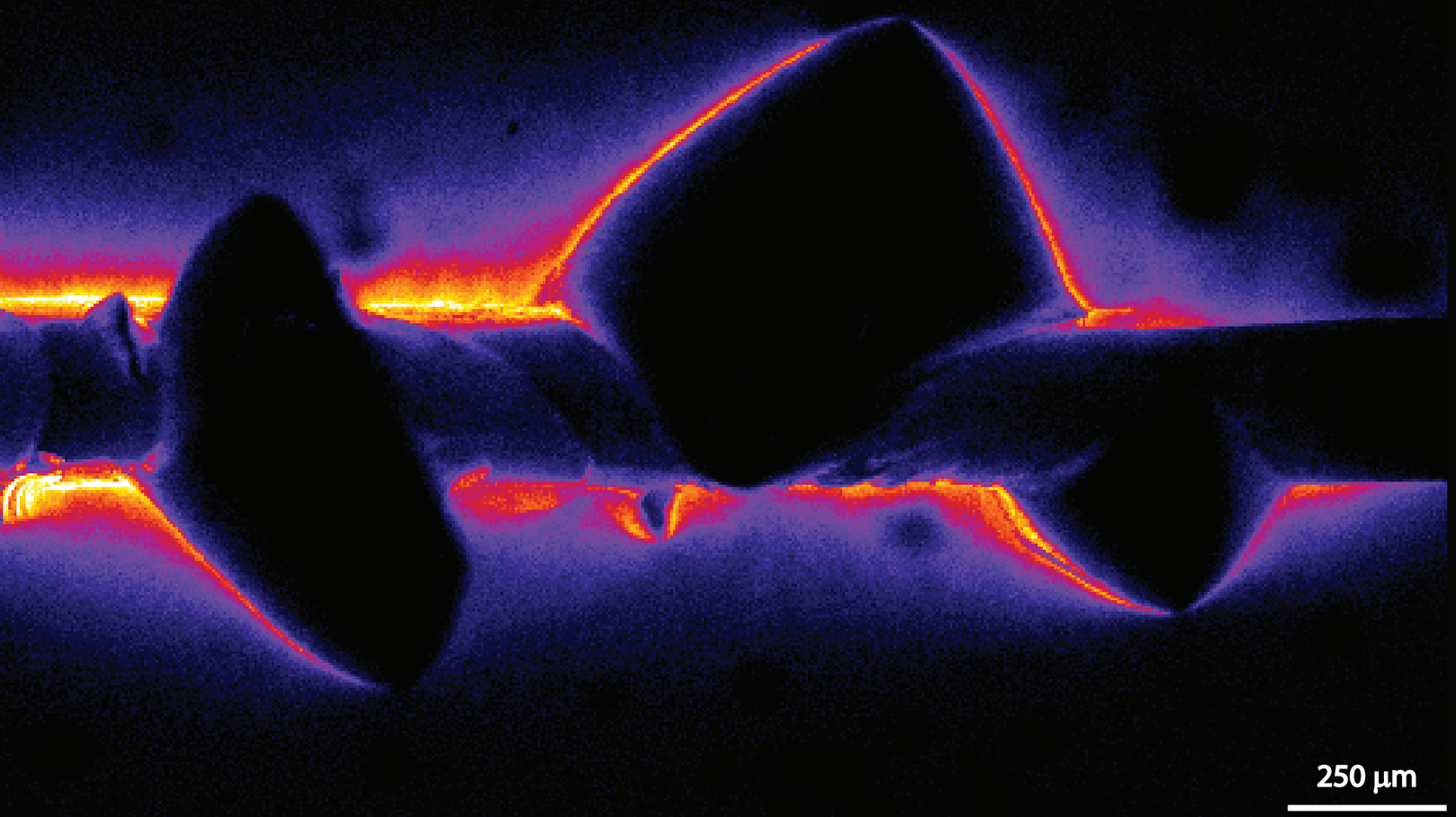
Monitoring Localized Stresses Using Mechanophores

Nazmul Haque [a], Chelsea S. Davis [b]
[a] School of Materials Engineering, Purdue University
[b] Department of Mechanical Engineering, University of Delaware





Here it shows a direct observation of damage in a mechanophore (MP) functionalized PDMS matrix due to localized stresses in the fiber-reinforced composite.

Spiropyran (SPN) MP-incorporated PDMS gets mechanically activated when the C — O spiro bond is broken, causing a molecular rearrangement to the merocyanine form that results in a color change and fluorescence. The fluorescent response will only occur once critical mechanical strain energy is reached in the system to overcome the intrinsic activation energy. After the activation energy threshold has been exceeded, the fluorescence intensity increases with additional applied mechanical strain energy. As the applied force (F) increases, the activation rate of the MPs increases. Thus, the highest MP activation is readily detected in the areas of highest F or stress (σ) which enables visualization of force distribution.