Observing the crack tip behavior at the nanoscale during fracture of ceramics

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Abstract

To understand fracture and make brittle materials more ductile, we rely on modeling what happens at a crack tip. However, observing a crack tip in a brittle material is challenging as cracks propagate fast, and the events that we are interested in observing occur at the nanoscale or below. The unsolved challenge is to observe the movement of the crack front at the nanoscale while extracting quantitative information. In this presentation, I will be showing how we address this challenge by monitoring stable crack growth inside a transmission electron microscope (TEM) in a range of brittle and tougher ceramics. Our analysis demonstrates how transformation toughening, previously thought to be effective at the microscale and above, promotes crack deflection at the nanoscale and increases the fracture resistance. This work will help in linking continuous and atomistic models and support the design of the next generation of stiff, strong, and tough materials.

Link to the recent paper:

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