The Critical Role of Material Length in Amorphous Fracture

Gergely Molnar*[1] and Etienne Barthel

[1]Laboratoire de Mécanique des Contacts et des Structures [Villeurbanne] – Institut National des Sciences Appliquées de Lyon, Université de Lyon, Institut National des Sciences Appliquées, Centre National de la Recherche Scientifique : UMR5259 – France

Abstract

The talk that delves into the origins of fracture toughness in amorphous silica, focusing on the influence of a rounded crack tip and the limitations of linear elastic fracture mechanics. Griffith's theory states that in the absence of a sharp crack, the energy release rate becomes zero, rendering linear elastic fracture mechanics inadequate for assessing resistance in geometries featuring a rounded crack. To overcome this limitation, the talk employs coupled criterion and phase-field simulations to assess fracture initiation.
Through extensive large-scale atomic-scale simulations, the research identifies damage within the atomic structure. A finite element model update scheme is utilized to pinpoint the critical energy release rate and the regularization length scale during crack propagation.
In conclusion, the talk offers a comprehensive comparison of the identified properties, examining their consistency with the predictions of the homogeneous phase-field solution and the material's tensile strength. Furthermore, the research endeavors to contrast the outcomes of all three methodologies, thereby shedding light on the foundational assumptions that underlie continuum models, including phase-field and finite fracture mechanics. By exploring the interplay between crack geometry and fracture resistance, this study advances our understanding of fracture toughness in amorphous silica and contributes to the ongoing development of more accurate models for predicting fracture initiation and propagation in complex materials.

*Speaker