Implications of heterogeneity on toughening in solids
Hossain, Md, zubaer@caltech.edu; Bhattacharya, Kaushik, California Institute of Technology, United States; Bourdin, Blaise, Lousiana State University, United States

ABSTRACT
Heterogeneity is prevalent in almost all solids at some length scales, but it is a challenging task to determine its macroscopic implications, particularly in the context of fracture. Consequently, the understanding of the relation between macroscopic toughness and the microstructural details of a solid remains elusive, which severely limits our ability to design tougher materials for use in practical applications. This discussion will describe the development of a notion of effective toughness in heterogeneous media using a novel boundary condition, named surfing boundary condition. It is found that macroscopic toughness is very different from the weighted surface area of the crack set. Results also indicate that elastic heterogeneity alone can have a profound influence on toughening, and it can induce toughening asymmetry depending on the direction and sense of crack propagation. The findings provide critical insights for designing materials with improved mechanical properties.