Computational Modeling of Ductile Fracture Processes

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ABSTRACT

Two fundamental questions in the mechanics and physics of fracture are: (i) What is the relation between observable features of a material's microstructure and its resistance to crack growth? (ii) What is the relation between observable features of a material's microstructure and the roughness of the fracture surface? An obvious corollary question is: What is the relation, if any, between a material's crack growth resistance and the roughness of the corresponding fracture surface? 3D finite element calculations of mode I ductile crack growth aimed at addressing these questions will be discussed. In the calculations, ductile fracture of structural metals by void nucleation, growth and coalescence is modeled using an elastic-viscoplastic constitutive relation for a progressively cavitating plastic solid. A material length scale is introduced via a discretely modeled microstructural feature, such as the spacing of inclusions that nucleate voids or the mean grain size. A particular focus will be on the use of such analyses to suggest the design of material microstructures for improved fracture resistance.