A phase-field method for computational modeling of ductile fracturing with interfacial damage in heterogeneous metallic materials — CFRAC 2019

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ABSTRACT

Ductile fracture in metallic materials is the result of voids nucleation, growth, and coalescence of voids, leading to a progressive loss of load carrying capacity, until failure. The fracture of ductile material occurs after microvoids or shear bands develop in the metal matrix, around the inclusions or other discontinuities such as grain boundaries. In this work, we propose an extension of the phase field ductile model [1, 2] for modeling interactions between interfacial damage and bulk cracking in heterogeneous metallic materials. The involved extensions comprise: (a) taking into account interfacial damage between the inclusions and the matrix by using Level-Set (LS) functions which represent all interfaces [3]; (b) Considering unilateral contact for modeling ductile fracture; (c) the capability of the model to describe large 3D, ductile cracks propagation and interaction in heterogeneous metallic materials. The developed numerical framework is based on the phase field method with a regularized description of both bulk and interface discontinuities, extended to a fully coupled elastoplastic mechanical framework. A simple and reliable numerical technique is introduced for this model to construct the complex elastoplastic consistent tangent operator.

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