Modelling of crack propagating through heterogeneous material using a phase field approach

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Résumé

The phase field models of crack propagations have gained popularity in the recent years and they have been shown to reproduce well complex crack paths and instabilities in homogeneous material. Since many materials are heterogeneous and present fracture paths that are clearly affected by the presence of heterogeneities, it is highly desirable to be able to describe crack paths in heterogenous materials. In this case, the use of phase field models is promising since heterogeneities can be introduced by considering varying parameters of the phase field equation or of the elastic equation. The former would correspond to changes in the fracture energy or in the nucleation threshold (i.e. material strength). In the situation where the fracture energy is varying smoothly the model have been proven to provide correct results. In situations where the heterogeneities correspond to different phases and where material properties change abruptly the results that have been presented are looking correct. However a quantitative comparison with well controlled experiments or theoretical predictions is missing.
Here I will present simulations of a simple test case where the crack meets a wedge inclusion ith higher fracture energy. The numerical simulation results will be compared to prediction made in the framewoork of the Linear elastic Fracture Mechanics (LEFM). The results indicate that depending on the way the inclusion is introduced in the phase field model, either there is a very good agreement with small discrepancies that are related to the diffuse nature of the phase field crack or there is no agreement at all when the inclusion fracture energy is high enough to prevent crack propagation.

The consequences of these results on the modeling of crqack propagation in heterogenous material will be discussed.

Mots-Clés: Fracture, Heterogeneite

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