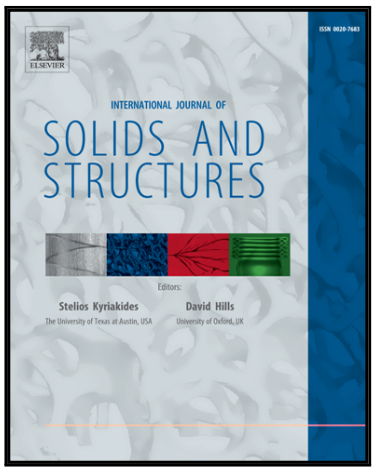

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A cohesive-zone crack healing model for self-healing materials

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Abstract

A cohesive zone-based constitutive model, originally developed to model fracture, is extended to include a healing variable to simulate crack healing processes and thus recovery of mechanical properties. The proposed cohesive relation is a composite-type material model that accounts for the properties of both the original and the healing material, which are typically different. The constitutive model is designed to capture multiple healing events, which is relevant for self-healing materials that are capable of generating repeated healing. The model can be implemented in a finite element framework through the use of cohesive elements or the extended finite element method (XFEM). The resulting numerical framework is capable of modelling both extrinsic and intrinsic self-healing materials. Salient features of the model are demonstrated through various homogeneous deformations and healing processes followed by applications of the model to a self-healing material system based on embedded healing particles under non-homogeneous deformations. It is shown that the model is suitable for analyzing and optimizing existing self-healing materials or for designing new self-healing materials with improved lifetime characteristics based on multiple healing events.

Keywords: Self-healing material, cohesive-zone model, multiple crack healing, fracture mechanics

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