Finite Element Analysis of Damage-healing Behaviour in Self-healing Ceramic Materials

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ABSTRACT

The self-healing fiber-reinforced ceramic material (shFRC) developed by one of the authors is a new functional material [1-3]. The self-crack/damage-hearing function is one of most valuable phenomena to overcome the reliability decrease of blittle ceramics that are caused by non-acceptable cracking. When a crack propagates in this material, the self-healing occurs under high-temperature. Then, the strength of the material recovers to its initial state because the crack is re-bonded. The reason why the self-crack/hearing automatically attains the complete recovery of damaged strength is that the passive oxidation of self-healing agent, for example SIC, is caused by a crack it self. However, in order to apply the self-hearing ceramic material to machines and constractions , we have to develop the novel numerical simulation way.

In this study, we develop the constitutive model to analyse the self-healing ceramic materials within the framework of FEM. The isotropic self-hearing and damage constitutive model for ceramics material can describe not only the damage process under a certain boundary condition, but also the self-healing process under a high-temperature condition. The damage process is formulated based on the fracture mechanics [3], and the self-healing process is formulated based on the kinetic model of self-healing time and velocity [1]. Then, we apply the proposed model to analyses of homogeneous ceramic materials and unit cell model of fiber-reinforced ceramic material.

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