Modeling of fracture in piezoelectric ceramics by using boundary element method

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The boundary element method (BEM) has a number of advantages relative to finite difference method and finite element method, such as requiring only surface discretizations and exactly treating boundary conditions at infinity. However, it suffers from well-known drawbacks with regard to the computational efficiency, since the conventional BEM leads to a linear system of equations with dense coefficient matrix. Besides, the BEM is a semi-analytical method and thus is more accurate, especially for stress concentration problems such as fracture of structures and can be applied along with the other domain-based methods to verify the solutions to a problem for which no analytical solution is available.

This study presents an effective implementation of boundary element multiscale method in analyzing of piezoelectric ceramics. The method is applied based on constitutive equations and numerical modeling. This method can be easily used to get a better understanding of damage mechanism in the ceramic materials in order to improve the constitutive models and to support the future design of those materials. In this study, a multiscale method via boundary element method was introduced. Then bridges meso-scale to macro-scale by a damage parameter was performed. Based on results of presented investigations the following conclusions were formulated: (i) interface can lead to stress intensity in materials, (ii) the shape of interface can influence stress intensity.

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