Study of a propagating finite crack in functionally graded piezoelectric materials considering dielectric medium effect.

Summary: This paper provides a study of the problem of a propagating finite crack under in-plane loading in functionally graded piezoelectric materials (FGPMs). The analytical formulations are developed by Fourier transforms and the resulting singular integral equations are solved by using Chebyshev polynomials. By using a dielectric crack model with deformation-dependent electric boundary condition, numerical simulations are made to show the effects of the dielectric medium, the gradient of material properties and the speed of crack propagation on the fracture parameters, such as the stress, electric displacement and crack opening displacement intensity factors. A critical state for the electromechanical loading applied to the FGPMs is observed, which determines whether the traditionally impermeable (or permeable) crack model serves as the upper or lower bound for the dielectric model. The validity of this dielectric crack model is also examined by comparing the results of different existing crack models.

MSC:
74R10 Brittle fracture
74F15 Electromagnetic effects in solid mechanics
74G70 Stress concentrations, singularities in solid mechanics

Keywords:
functionally graded piezoelectric materials (FGPMs); propagating crack; dielectric crack

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References:


