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Non-Local Behavior of a Mixed-Mode Crack in a Functionally Graded Piezoelectric Medium

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Abstract : In this paper, the problem of a mixed-Mode crack embedded in an infinite medium made of a functionally graded piezoelectric material (FGPM) with crack surfaces subjected to electro-mechanical loadings is investigated. Eringen’s non-local theory of elasticity is adopted to formulate the governing electro-elastic equations. The properties of the piezoelectric material are assumed to vary exponentially along a perpendicular plane to the crack. Using Fourier transform, three integral equations are obtained in which the unknown variables are the jumps of mechanical displacements and electric potentials across the crack surfaces. To solve the integral equations, the unknowns are directly expanded as a series of Jacobi polynomials, and the resulting equations solved using the Schmidt method. In contrast to the classical solutions based on the local theory, it is found that no mechanical stress and electric displacement singularities are present at the crack tips when nonlocal theory is employed to investigate the problem. A direct benefit is the ability to use the calculated maximum stress as a fracture criterion. The primary objective of this study is to investigate the effects of crack length, material gradient parameter describing FGPMs, and lattice parameter on the mechanical stress and electric displacement field near crack tips.

Keywords : functionally graded piezoelectric material (FGPM), mixed-mode crack, non-local theory, Schmidt method
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