International Journal of Solids and Structures

Volume 48, Issue 20, 1 October 2011, Pages 2987–2999

Dynamic fracture behavior of functionally graded magnetoelectroelastic solids by BIEM

Dedicated to Professor Dietmar Gross in the occasion of his 70th birthday

Tsviatko Rangelov[a], Yonko Stoynov[b], Petia Dineva[c]

[a] Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria

[b] Faculty of Applied Mathematics and Informatics, Technical University of Sofia, Sofia 1000, Bulgaria

[c] Institute of Mechanics, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria

http://dx.doi.org/10.1016/j.ijsolstr.2011.06.016, How to Cite or Link Using DOI

Permissions & Reprints

Abstract

Dynamic anti-plane fracture problem of an exponentially graded linear magnetoelectroelastic plane with a finite impermeable crack subjected to time-harmonic SH-waves is solved. Directions of wave propagation and material inhomogeneity are chosen in an arbitrary way. The fundamental solution for the coupled system of partial differential equations with variable coefficients is derived in a closed form by the hybrid usage of both an appropriate algebraic transformation for the displacement vector and the Radon transform. The formulated boundary-value problem is solved by a nonhypersingular traction boundary integral equation method (BIEM). The collocation method and parabolic approximation for the unknown generalized crack opening displacements are used for the numerical solution of the posed problem. Quarter point elements placed next to the crack-tips ensure properly modeling the singular behavior of the field variables around the crack tip. Fracture parameters as stress intensity factor, electric field intensity factor and magnetic field intensity factor are computed. Intensive simulations reveal the sensitivity of the generalized intensity factors (GIF) at the crack-tips to the material inhomogeneity, characteristics of the incident wave, coupling effects, wave-material and wave-crack interaction phenomena.

Highlights

► Exponentially graded cracked magnetoelectroelastic plane is studied. ► Finite impermeable crack subjected to time-harmonic SH-waves is considered. ► The fundamental solution is derived by the Radon transform. ► The boundary-value problem is solved by a nonhypersingular traction BIEM. ► Stress, electric field and magnetic field intensity factors are computed.

Keywords

Functionally graded magnetoelectroelastic solid; Anti-plane cracks; BIEM; GIF