World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:12, No:05, 2018

Shear Surface and Localized Waves in Functionally Graded Piezoactive Electro-Magneto-Elastic Media

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Abstract : Recently, the propagation of coupled electromagnetic and elastic waves in magneto-electro-elastic (MEE) structures attracted much attention due to the wide range of application of these materials in smart structures. MEE materials are a class of new artificial composites that consist of simultaneous piezoelectric and piezomagnetic phases. Magneto-electro-elastic composites are built up by combining piezoelectric and piezomagnetic phases to obtain a smart composite that presents not only the electromechanical and magneto-mechanical coupling but also a strong magnetoelectric coupling, which makes such materials highly valuable in technological usage. In the framework of quasi-static approach shear surface and localized waves are considered in magneto-electro-elastic piezo-active structure consisting of functionally graded 6mm hexagonal symmetry group crystals. Assuming that in a functionally graded material the elastic and electromagnetic properties vary in the same proportion in direction perpendicular to the MEE polling direction, special classes of inhomogeneity functions were found, admitting exact solutions for coupled electromagnetic and elastic wave fields. Based on these exact solutions, defining the coupled shear wave field in magneto-electro-elastic composites several modal problems are considered: shear surface waves propagation along surface of a MEE half-space, interfacial wave propagation in a MEE oppositely polarized bi-layer, Love type waves in a functionally graded MEE layer overlying a homogeneous elastic half-space. For the problems under consideration corresponding dispersion equations are deduced analytically in an explicit form and for the $BaTiO_3$–$CoFe_2O_4$ crystal numerical results estimating effects of inhomogeneity and piezo effect are carried out.

Keywords : surface shear waves, magneto-electro-elastic composites, piezoactive crystals, functionally graded elastic materials
Conference Title : ICAMAME 2018 : International Conference on Aerospace, Mechanical, Automotive and Materials Engineering
Conference Location : Barcelona, Spain
Conference Dates : May 17-18, 2018