Investigation of Love Waves in a Piezoelectric Composite Structure with an Inhomogeneous Internal Stratum of Finite Depth

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An inhomogeneous thin internal stratum can not be avoided across the interface between two dissimilar materials, which is usually caused by non-uniform thermal distribution, interaction of different media, diffusion impurity or material degeneration and damage. We considered it as a functionally graded piezoelectric middle layer, and investigate its effect on Love wave propagation through equations of the linear theory of piezoelectricity. Theoretically, the material coefficients in this internal stratum are assumed to change in random functions along the thickness direction. For simplification the elastic and piezoelectric coefficients, dielectric permittivity, and mass density are assumed to change in a linear form but with different graded parameters during analysis. The power series technique is applied to solve the governing differential equations with variable coefficients attributed to the different graded parameters and its correction and convergence have been proved. As a special case, the influence of internal stratum resulting from piezoelectric damage and material bonding is investigated. Piezoelectric damaged and material bonding can make the higher modes appear earlier for electrical open case, and decrease the initial phase velocity and limit the existing region of fundamental Love mode for electrical shorted case. The conclusions are theoretically and practically significant for wave devices.

Keywords: Love waves, FGPM internal Stratum, Piezoelectric damage, Electromechanical Coupling, Power series technique