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Analytical studying the group velocity of three-partial Love (type) waves in both isotropic and anisotropic media

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Impossibility to observe the non-dispersive Zakharenko type waves (ZTW) for the three-partial Love type waves (LTW3) is analytically shown for layered systems consisting of a layer on a substrate, in case either isotropic or anisotropic materials with the anisotropy factor $\alpha_f = (C_{44}C_{66} - C_{46}^2)^{1/2}/C_{44}$. The other solutions of new dispersive waves were also considered in addition to the LTW3-waves. The interesting structures Au/Muscovite and Au/Biotite were numerically investigated concerning the LTW3-waves. Monoclinic crystal Muscovite is likely for substrates with the speed $V_{t4} = (C_{44}/\rho)^{1/2} = 5053$ m/s and $\alpha_f \sim 2.08$ that gives $\beta_M = V_{t4}\alpha_f = 10{,}510$ m/s $\sim V_t^{[100]}$(Diamond) $= 12{,}800$ m/s. Possibility to find supersonic LTW-waves in piezoelectric crystals with $\beta \sim 20{,}000$ m/s is also discussed. Such the β will be greater than the speed $V_l \sim 17{,}500$ m/s of the bulk longitudinal wave for Diamond. Also, the first- and second-order derivatives of the group velocity V_g, as well as the first-, second- and third-order derivatives of the phase velocity V_{ph} were analytically obtained and shown in dependence on the layer thickness kh, where k is the wavenumber in the wave propagation direction. The obtained results of the derivative calculations of the group velocity V_g could be useful for finding inflexion points in dependence of the group delay time $\tau(kh) = L/V_g$ (L is a gone distance) in dispersive delay lines, as well as for production automation of different filter and sensor on dispersive waves.

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1. Introduction

Since Love (1911) has discovered the surface acoustical waves polarised perpendicular to the sagittal plane in waveguides consisting of an isotropic layer on an isotropic substrate (figure 1), much work appeared concerning these classical three-partial Love waves (LW3). It is noted that both the x_1- and x_3-axes in the figure lie in the sagittal plane. Probably, the most famous works are the classical and excellent books (Farnell 1978, Dieulesaint and Royer 1980). The classical LW3-waves can propagate in layered systems consisting of both isotropic materials, as well as in crystals in the so-called highly-symmetric propagation directions. For crystals with monoclinic symmetries such as the point group symmetries *m*, 2, 2/*m*, the waves will be the LTW3-waves with the elastic anisotropy factor (Maerfeld and Lardat 1969, Lardat *et al.* 1971) $\alpha_f = (C_{44}C_{66} - C_{46}^2)^{1/2}/C_{44}$. There can be $\alpha_f = 1$ for both

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