Nondestructive Testing and Evaluation,
Vol. 21, No. 2, June 2006, 61–77

On cubic crystal anisotropy for waves with Rayleigh-wave polarization

A. A. ZAKHARENKO*

660037, Krasnoyarsk-37, 17701 Krasnoyarsk, Russia

(Received 8 March 2006; revised 29 March 2006; in final form 29 March 2006)

The anisotropy term $C^2 = [(C_{11} - C_{44})^2 - (C_{12} + C_{44})^2]/(C_{11}C_{44})$ for cubic crystals of the classes m3 and m3m, as well as the threshold velocity *V*th, were calculated. It was found that the surface two-partial Rayleigh type waves (RTW2) cannot exist in propagation directions with values of the $C^2 < -4$. It was also found that for the cubic crystals, such as RbCl, RbBr, RbI, Li_2O and KCN, there is a corresponding great positive $C^2 > 5$. The cubic crystal NaCN (m3m class) possesses the gigantic anisotropy term $C^2 = 48.71$. It was discussed that crystals with $C^2 >> 1$ could be suitable for investigation of possible existence of new supersonic surface waves with the phase velocity $V > V_l$, because the velocity $V^{th} \sim V_l$ of the bulk longitudinal wave: V_l(RbI) = 1.077*V*th and V_l(Li_2O) = 1.07*V*th. The supersonic surface waves with $V > V_l$ are promising, for example, for mobile communication to increase work frequency in GHz-devices, such as surface acoustical wave (SAW) filters, etc. Also, the existence condition $V > V_l$ for the new supersonic SAW possessing the Rayleigh polarization does not obey the existence condition $V < V_t$ for the Rayleigh SAW. The phase velocity range $V > V_l$, in which the new SAW can be found, is separated from the one $0 < V < V_t$ for the Rayleigh SAW by the one $V_t < V < V_l$ for leaky type waves. The universal existence condition $C^2 > -1 - C_{11}/C_{33} - 2\sqrt{C_{11}/C_{33}}$ for the RTW2-waves in both cubic and non-cubic crystals was also introduced. Possible applications are also discussed.

Keywords: Cubic crystal; Polarization; Rayleigh type waves (RTW2); Anisotropy

PACs: 43.35.Cg; 43.35.-c;

1. Introduction

Surface acoustical waves (SAW) polarized in the sagittal plane can propagate on the surface of a bulk isotropic medium that was initially discovered by Rayleigh (1885). The sagittal plane is formed by the vector **N** showing the propagation direction and the normal to the free surface directed along the *Z*-axis as shown in figure 1. The other unique wave type can propagate in a plate, consisting of an isotropic material, which represents the Lamb wave (Lamb 1917). The Lamb waves have polarization, like the one of the surface Rayleigh type waves. Both symmetric and anti-symmetric modes of the Lamb (type) waves can exist.

* Email: aazaaz@inbox.ru

Nondestructive Testing and Evaluation
ISSN 1058-9759 print/ISSN 1477-2671 online © 2006 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/10589750600779704