

Attenuation of Hypersonic Waves in Lithium Niobate Crystals with Impurities

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In the present work, the attenuation of longitudinal and transverse acoustic waves in pure and Mg, Zn, Cu and Cr doped Lithium Niobate crystals has been investigated. The weight concentration of above-mentioned impurities in the investigated samples ranged from 0.01-0.02 percent. The measurements of the attenuation coefficient were carried out by a Bragg light scattering method at the temperatures of 295 and 480 K. Piezoelectric transducers of Lithium Niobate of appropriate cuts are used to excite the longitudinal and the transverse acoustic waves with the frequencies of 0.3-1.8 GHz. The quantity and frequency dependence of the attenuation coefficient of the acoustic waves were determined from the measurements of the dependence of the scattered light intensity from the distance to the piezotransducer along the direction of the acoustic wave propagation. The results of these measurements show that in crystals with impurities there are observed changes in the attenuation of acoustic waves. It is also shown that the influence of impurities on the attenuation of longitudinal or transverse waves is different. The impurity of Cr causes an increase in the attenuation of longitudinal waves of 20-50%, but at the same time it decreases the attenuation of transverse waves almost in two times. At the same time impurities of Cu, Zn, Mg reduce the decrease of attenuation the longitudinal waves in 1.5-2 times and insignificantly increase of the attenuation of the transverse waves. The obtained results are interpreted in the framework of various mechanisms of attenuation including the electron-phonon, Akhiezer and Landau-Khalatnikov mechanisms. The influence of dielectric losses on the attenuation of piezoactive acoustic waves in LiNbO_3 crystals is also discussed.