Global Maxima of the Acousto-Optic Effect in $CaWO_4$ Crystals

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Acousto-optic effect, i.e. the diffraction of the electromagnetic wave on the acoustic one, is widely used in science and technique. Particularly, acousto-optic devices – modulators, deflectors, filters allow to control and process of light beam, to characterize of electromagnetic or acoustic waves, etc. The effectiveness of these devices strongly depends on the geometry of interaction, i.e. on the propagation directions of electromagnetic and acoustic waves. In general, the optimal geometry of acousto-optic interaction can be determined by extreme surfaces method proposed by in [1–2] as well as by its modification elaborated by authors of [3]. Here we use this method for optimization of the acousto-optic interaction (Bragg diffraction) geometry in $CaWO_4$ crystal interesting for applications in near-UV acoustooptic filters and Q-switching modulators for high-power solid-state lasers [4]. All calculations were carried out for the electromagnetic wavelength of 633 nm and the acoustic wave frequency of 100 MHz.

As it is shown, the maximal value of the acousto-optical figure-of-merit M_2 is equal to $8.9 \cdot 10^{-15}$ s^3/kg achieved in the case of isotropic diffraction of the ordinary light wave on the slow quasi-transversal acoustic wave. At that the incident light wave propagates along the direction determined by the angles $\theta = 2^o$, $\varphi = 72^o$ of the spherical coordinate system. The corresponding acoustic wave propagates in the direction determined by the angles $\theta_a = 92^o$, $\varphi_a = 104^o$ and polarized along ($\theta_f = 88^o$, $\varphi_f = 19^o$) direction. The velocity of this wave is equal to 2043 m/s and the effective elastooptic coefficient p_{ef} is about 0.11 for this type of diffraction.

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