Electrooptic Effect in Non-Centrosymmetric $CsLiB_6O_{10}$ Borate Crystals

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Abstract

Electrooptic coefficient of $CsLiB_6O_{10}$ crystals has been experimentally determined as r_{63}=3.3×10^{-12}m/V. The half-wave voltage for $CsLiB_6O_{10}$ ($U_{\lambda/2}$=26 kV) is three orders of magnitude larger than that of the known KDP crystals.

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Non-centrosymmetric borate crystals, such as β-BaB_2O_4 (point group of symmetry *3m*), $Li_2B_4O_7$ (*4mm*) and LiB_3O_5 (*mm2*), are widely used for optical harmonics generation and parametric oscillation (see, e.g., [1,2]). The advantages of application of these crystals in laser radiation controlling follow from their wide range of transparency [3], high optical damage threshold [4] and nonlinear-optic figure of merit [1]. On the other hand, these crystals could be also useful as electrooptic (EO) materials. The EO coefficients of some of the borate crystals are presented in Table 1 as an example.

Table 1. EO coefficients of borate crystals according to the literature.

r_{ij}, 10^{-12} m/V	β-BaB_2O_4 (group *3m*)	$Li_2B_4O_7$ (group *4mm*)
r_{11}	9.52 [5]	0
r_{13}	-	3.74 [6]
r_{33}	-	3.67 [6]
r_{51}	6.68 [5]	-0.11 [6]

$CsLiB_6O_{10}$ crystals are quite new representatives of the borate family [7]. They belong to the point group of symmetry *42m*. It is interesting to note that the symmetry group of caesium-lithium borate is the same as that of the well-known EO material, KDP crystals. In case of EO crystals belonging to that symmetry group, the coefficient r_{63} is usually utilized. The aim of the present paper is determination of that coefficient for $CsLiB_6O_{10}$ crystals.

The EO effect in $CsLiB_6O_{10}$ crystals has been studied with the Senarmont method at the laser wavelength of λ=632.8nm. The electric field has been applied along <001> axis and the light has propagated in the direction <001>.

The dependence of optical birefringence on the electric field strength presented in Figure 1 turns out to be linear.

The EO coefficient has been calculated with the formula

$$r_{63} = \frac{2\delta(\Delta n)_{12}}{n_0^3 E_3}. \qquad (1)$$

It is found to be equal to r_{63}=3.3 ×10^{-12}m/V, while the corresponding half-wave voltage is $U_{\lambda/2}$=26kV. One can see that the latter value for $CsLiB_6O_{10}$ crystals is three orders of magnitude greater than that characteristic of the KDP crystals [8]. Nevertheless, the damage threshold

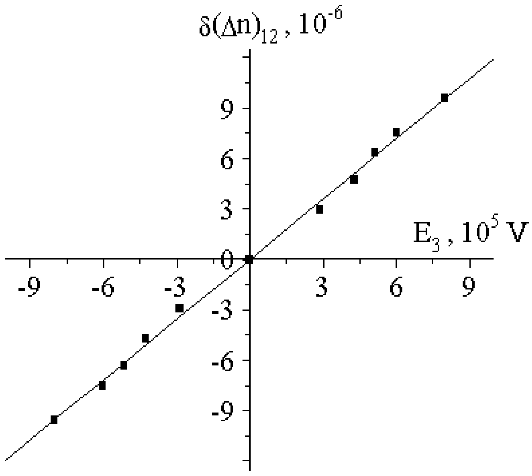

Fig. 1. Dependence of EO birefringence change in $CsLiB_6O_{10}$ crystals versus the electric field at λ=632.8 nm, T=22^{0}C.

for the crystals under test is essentially higher in comparison with the KDP (26GW/cm^2 for $CsLiB_6O_{10}$ [4,9] and 17 GW/cm^2 for the KDP [10]). Thus, $CsLiB_6O_{10}$ crystals may be used for a high-power laser Q-switching.

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