Stable Absorption Induced in $Ca_{0.28}Ba_{0.72}Nb_2O_6$ Crystals by Gamma Quanta Irradiation

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[1]**Abstract.** *The present work is devoted to investigation of stable additional absorption that is induced by gamma radiation in pure $Ca_{0.28}Ba_{0.72}Nb_2O_6$ single crystals.*

Key words: calcium barium niobate, gamma irradiation, stable color centers

I. Introduction

Ferroelectric crystals with the tetragonal tungsten bronze structure (TBS) are widely studied objects of physics of heterogeneous media. These systems are featured in a number of useful properties including piezoelectric, electro-optic, photorefractive and pyroelectric ones [1–2].

One of such material is calcium-barium niobate $Ca_xBa_{1-x}Nb_2O_6$ (CBN), which is better suited to potential applications because it has a much higher phase transition temperature than popular SBN [3].

The effect of gamma irradiation on TBS properties was studied for SBN crystal and changes of dielectric properties was associated with the stabilization of the ferroelectric phase of the material in an internal bias field generated by radiation-induced defects [4]. In this way the study of radiation defects in TBS crystal is important. One of the approaches of such study is investigation of stable absorption induced by ionizing irradiation. Up to now, the induced absorption changes was studied practically only in SBN:Ce for light irradiation [5].

II. Experimental

The pure CBN crystals were grown in Institute of Electronic Materials Technology (ITME) by the Czochralski technique. Samples for investigations were made in the form of plane-parallel polished plates of 0.9 mm thickness. The samples were irradiated with gamma quanta (1.25 MeV) from ^{60}Co with the absorbed dose of $3*10^4$ Gy. Optical absorption spectra were recorded with a Cary 5000 spectrophotometer. The value additional absorption (ΔK) induced by external influence was determined as

$$\Delta K = \frac{1}{d}\ln\frac{T_1}{T_2},$$

where d is the sample thickness, T_1 and T_2 are the sample transmission coefficients before and after irradiation, respectively.

III. Results

After irradiation with gamma-quanta with dose of $3*10^4$ Gy, a broad additional absorption (AA) bands in the range of 27000...10000 cm^{-1} arise. The AA spectrum consists of two bands with maxima near 24900 cm^{-1} and 14000 cm^{-1}. Also, very weak maxima near 17600 cm^{-1} and 11800 cm^{-1} were observed.

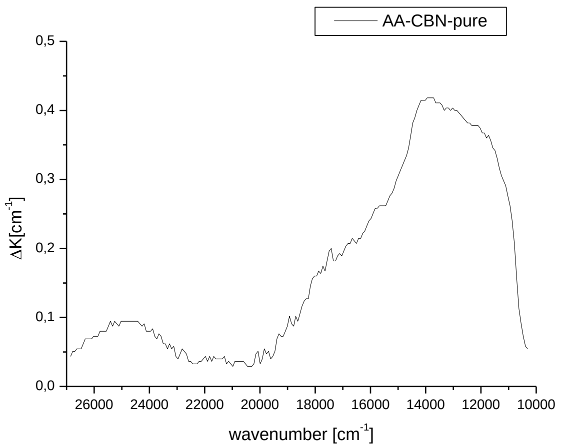

Fig. 1. Additional absorption of pure CBN irradiated by gamma quanta.

The observed additional absorption is caused with color centers creation based on genetic defects and impurities as a result of their recharging under gamma irradiation. Detailed analysis of this will be made in a separate paper.

IV. Conclusions

The irradiation of CBN crystal with gamma quanta produce a stable at room temperature coloration in visible – near-IR spectral range. This coloration is due to change of charge state of genetic defects and impurities.

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