Visualization of UV-induced photorefractive damage in LBO crystals.

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Abstract – UV-induced bulk degradation in LBO crystals was discovered. Long term generation of third or fourth harmonics of Yb pulsed fiber laser result in to bulk defects formation. Different approaches were used to visualize them and estimate their dimensions. The defects microstructure was observed by using the dark field method. Optical absorption in the crystals with defects was measured by using photothermal methods (PCI-3 device).

Keywords—LBO, UV-induced defects, bulk defects, UV-lasers, third harmonic generation, forth harmonic generation, 355 nm, 266 nm

One of the methods to produce UV laser radiation is a harmonic generation of fundamental Yb laser radiation in non-linear optical crystals. Generally the lifetime of such lasers depends on quality and the resistance to UV influence of used crystals. It is noted that during long term third harmonic generation a damage of the crystal is appeared [1, 2]. This damage leads to the degradation of power and beam quality of generated UV radiation.

In this paper we propose the simple methods for visualization UV-induced bulk defects formed in LBO crystals during long term third (THG) or fourth (FHG) harmonic generation.

The first method is measurement of spatial distribution of optical absorption in the surface and bulk of crystals using photothermal methods [3]. The device setup and obtained absorption distribution are shown in Fig. 1. Studied crystal was used in long term FHG in two different points. Two appropriate peaks of UV-induced absorption were detected (Fig. 1).

![Fig. 1. Experimental setup of optical absorption measurement device and obtained distribution of absorption (circles “1” and “2” shows the defects).](image1)

This crystal was also studied by second methods based on observation of diffraction of light passed through the defect [4]. Experimental setup and obtained image are shown on the Fig. 2. Two defects which were found by the first method are observed on the image.

![Fig. 2. The defects visualization setup by diffraction method.](image2)

![Fig. 3. The defects visualization setup by dark field method.](image3)

From proposed methods of visualization of the defects the most informative is the dark field method (Fig. 3). By this method was observed that UV-induced defects are located in the bulk of the crystals. This approach allows observing the defects microstructure (Fig. 4).

![Fig. 4. Results of visualization of the defects by dark field method.](image4)

References


