ROLE OF TITANIUM IN STABILIZING THE LASING PARAMETERS OF NEODYMIUM GLASSES

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During a study of the possibility of increasing the photosensitivity of neodymium-activated glasses during generation of stimulated radiation, it was determined that, besides the addition of cerium dioxide [1], the addition of titanium dioxide to the glass composition had a favorable effect.

The investigations were carried out with rods 10 mm in diameter and 130 mm in length made of SiO$_2$-K$_2$O-B$_2$O$_3$-system glass with 2 wt. % Nd$_2$O$_3$. The content of the variable matrix components was varied by varying SiO$_2$. The test conditions were similar to those in [1].

The active element and an IFP-1200 lamp in a head with a hollow glass silver-coated reflector 40 mm in diameter were cooled with flowing distilled water. The dielectric mirrors of the cavity had $r_1 = 60\%$ and $r_2 = 99.2\%$. The interval between the pulses ensured thermal relaxation in the rod. The photosensitivity of the investigated glasses was evaluated according to the value of the lasing energy which remained after irradiation of the rod with 500 flashes of unfiltered radiation from an IFP-1200 lamp with a pumping energy of 500 J.

As is evident (Fig. 1, curve 1), the photosensitivity of the glasses increased with increasing TiO$_2$ concentration. Constancy of the lasing parameters was practically achieved with a titanium dioxide content of 12 wt. %. However, a 1% increase in the TiO$_2$ concentration led to a $1.5 \times 10^{-7}$ deg$^{-1}$ increase in the thermooptical constant of the glasses.

In their turn, the luminosity characteristics of the laser's stimulated radiation were lowered with increasing thermooptical constant [2, 3].

Because of this, different variations of the TiO$_2$-CeO$_2$ ratio were investigated. Comparative results of a photosensitivity test, which were obtained for three and more rods of each composition, are shown in Fig. 1. As is evident, the curves of the photosensitivity in relation to TiO$_2$ and CeO$_2$ contents have an identical nature. Similarly to the case of GLS-1 glass [1], the minimum photosensitivity occurred for low CeO$_2$ concentrations of 0.3-0.5 wt. %. The absolute values of the photosensitivity of this glass with only cerium dioxide (Fig. 1b, curve 1) in the range of 0-3 wt. % CeO$_2$ were somewhat higher than in the case of GLS-1. The obtained results show that constancy of the lasing parameters of the neodymium glasses for the pumping conditions which were used was achieved with TiO$_2$-CeO$_2$ contents of 3 and 5 or 5 and 3 wt. % and more.

The results of a test of the lasing parameters of active elements during pumping with 500 flashes with a pumping energy of 500 J for three and more rods of each type of glass are shown in Fig. 2. The initial inactive absorption of the glasses which were used was varied within the range of 0.001-0.002 cm$^{-1}$, and the
Fig. 1. Nature of the change of the lasing energy after 500 flashes for the glasses in relation to the TiO₂ concentration (a) for CeO₂ contents of 0 (1), 0.3 (2), 1 (3), 3 (4), and 5 wt. % (5) and in relation to the CeO₂ concentration (b) for TiO₂ contents of 0 (1), 1 (2), 3 (3), 5 (4), and 12 wt. % (5).

Fig. 2. Change in the lasing energy with the number of flashes for glasses with TiO₂–CeO₂ contents of 0 and 0 (1), 0 and 0.3 (2), 0 and 1 (3), 1 and 5 (4), 3 and 0.3 (5), 3 and 0.5 (6), 3 and 1 (7), 3 and 3 (8), 5 and 0.3 (9), 12 and 1 (10), and 12 and 3 wt. % (11).

As is evident from Fig. 2, the nature of the lasing-energy change with the number of flashes was identical for the types of glasses which were used and was similar to the results of the test of rods made of GLS-1 glasses with variation of the cerium dioxide content [1].

In glasses with 5 and 3% or 3 and 5% TiO₂ and CeO₂, the lasing energy from the number of flashes remained constant and coincided within the limits of error with curves 10 and 11 (Fig. 2).

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LITERATURE CITED