Cooperative Excitation of Tb^{3+} in CaF_2:TbF_3:YbF_3 crystal

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Diode-pumped solid-state lasers usually operate in the near-infrared spectral region, and radiation in the visible is obtained by nonlinear conversion to the corresponding harmonics, as well as by parametric generation. Recently, there has been an increase in interest in lasers generating directly in the visible spectral range. To date, a number of semiconductor diodes and lasers have been created that operate in the blue and near-ultraviolet spectral regions. They can excite rare earth active ions directly to higher energy levels to produce visible emission [1,2]. Other possibilities of such excitation are the use of up-conversion processes in the same ion or the transfer of energy from other dopant ions.

In this report, we investigated the excitation of Tb^{3+} ion in CaF_2 by two-photon energy transfer from Yb^{3+} ions. The composition of the investigated sample CaF_2:TbF_3:YbF_3 was 0.90:0.05:0.05. The excitation was carried out by a diode laser with a wavelength of 960 nm and a power of up to 1.5 W. The emission spectrum revealed a wide luminescence band of Yb^{3+} at 880-1040 nm and the number of luminescence lines of Tb^{3+} at 485, 540, 585, 620 and 640-680 nm. The intensity of the Yb band linearly depended on the power of the diode. While the intensity of the lines of Tb^{3+} ion depended quadratically on the diode power due to the cooperative energy transfer from two Yb^{3+} ions to one Tb^{3+} ion [3]. Judd-Offelt analysis showed that there were no noticeable changes in the spectral parameters of Tb^{3+} ions in CaF_2 crystal depending in the presence or absence of Yb^{3+} ions. The results showed that CaF_2:TbF_3:YbF_3 crystals can find potential applications as an active element of visible lasers pumped by widespread GaAs laser diodes.

References

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