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Cr, Ce, Nd:GGG crystal as active medium for efficient flashlamp pumped solid-state lasers

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The paper is the review of our recent results on investigation of spectroscopic and laser properties of Cr,Ce,Nd:GGG crystal as active medium for efficient near infrared lasers.

The fluorescence spectra of Nd³⁺ ions in GGG have been studied in the wavelength region corresponding to ⁴F_{3/2}-⁴I_{11/2} and ⁴F_{3/2}-⁴I_{13/2} transitions. Stimulated emission cross-sections of 1.062, 1.331 and 1.423 μm lasing lines have been calculated. Comparison with the emission cross-section data for Nd:YAG crystal has been carried out.

Co-doping of Nd:GGG crystal with Cr³⁺ and Ce³⁺ ions allows to suppress stable color centers formation in the crystal after UV irradiation and increase lasing efficiency. Nonradiative energy transfer from Cr³⁺ ions to Nd³⁺ ions in GGG has been studied. The 80% quantum efficiency of this process was found to result in 1.5-2 times increase of lasing efficiency (compared to Nd:GGG) for flashlamp pumped operation.

The thermal lens and lasing properties of Cr,Ce,Nd: GGG rods have been studied in free-running mode at 1.062, 1.331 and 1.423 μm wavelengths. The total efficiency more than 7%, 3% and 1.2% and average output power about 170 W, 70 W and 21 W were obtained for the single rod (6.3*100 mm) flashlamp pumped Cr,Ce,Nd:GGG laser at the 1.062, 1.331 and 1.423 μm laser lines, respectively. The lasing properties of Cr,Ce,Nd:GGG are compared with that of Nd:YAG and Nd:YAP crystals in the same conditions. The advantages of Cr,Ce,Nd:GGG crystals for the 1.331 μm and eye-safe 1.423 μm lasers are discussed.

The dual wavelength Cr,Ce,Nd:GGG laser operating simultaneously at 1.062 and 1.331 μm in free-running and acousto-optic Q-switching modes was realized and studied.

Lasing characteristics of Cr,Nd:GGG crystals with stable Cr⁴⁺ centers will be presented and discussed.