Spectroscopic analysis of a novel Nd3+-activated barium borate glass for broadband laser amplification

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Abstract

Spectroscopic parameters of a novel Nd3+-activated barium borate (BBONd) glass have been analyzed for broadband laser amplification. The Judd–Ofelt (JO) intensity parameters were determined through a systematic analysis of the absorption spectrum of Nd3+ ions in the BBONd glass. High values of the JO intensity parameters reveal a great centro-symmetrical loss of the Nd3+ sites and high covalency degree of the ligand field. The very high Ω6 intensity parameter value makes evident both a great structural distortion of the Nd3+ sites and a strong electron–phonon coupling between Nd3+ and free OH− ions, which is consistent with the phonon energy maximum (3442.1 cm−1) recorded by Raman spectroscopy. This strong electron–phonon coupling favors high effective bandwidth and gain bandwidth values of the laser emission (4F3/2 → 4I11/2) of Nd3+ ions. The electric-dipole oscillator strengths of all the Nd3+ absorption transitions, and in particular that of the hypersensitive transition (4I9/2 → 4G5/2), are enhanced by this great structural distortion of the host. Broadband laser amplification of the 4F3/2 → 4I11/2 emission (1062 nm) of Nd3+ ions in the BBONd glass pumped at 805 nm (4I9/2 → 4F5/2 + 2H9/2) is evaluated through the main fluorescent parameters in competition with non-radiative processes. In general, the BBONd glass exhibits spectroscopic parameters comparable with those reported in the literature for broadband laser amplification into the IR region.