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Analysis of excitation mechanisms of Ho^{3+} upconversion luminescence in Ho^{3+}:LiYbF4 (0.2 at %) crystal via photographs of its longitudinal cross sections and via spectral and kinetic characteristics

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Abstract

© 2016, Pleiades Publishing, Ltd.The results of a complex analysis of the excitation mechanisms of the up conversion luminescence of Ho3+:LiYbF4 (0.2 at %) crystal are presented. The spatial distribution of the upconversion luminescence intensity is studied by the photographs of longitudinal cross sections at different positions of the laser beam waist with respect to the sample. The surface power density of the pump laser diode radiation (0.755 W, λ = 933 nm) was changed by focusing the beam (similar to Z-scanning). The dependences of the longitudinal luminescence cross sections, as well as of the spectral and kinetic characteristics of Ho3+ and Yb3+ luminescence, on the position of the laser beam waist are determined. It is found that there exist two different mechanisms of the population of the energy levels of Ho3+ ions from which green and red luminescence occur, namely, cooperative sensitization of luminescence and absorption of induced photon groups (JETP Letters, 102 (5), 279 (2015)). It is shown that the contributions of these mechanisms vary both in time and over the crystal volume. All the observed spatial, spectral, and temporal specific features of the upconversion luminescence of Ho3+:LiYbF4 (0.2 at %) crystal are qualitatively explained.

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