Cooperative energy transfer in Yb^{3+}–Tb^{3+} co-doped $CaAl_4O_7$ upconverting phosphor.

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Streszczenie

Tb^{3+} and Yb^{3+} co-doped calcium aluminate powders: $Ca_{1-x-y}Yb_xTb_yAl_4O_7$ (x = 0.02–0.06; y = 0.02), $Ca_{1-x-y}Yb_xTb_yAl_4O_7$ (x = 0.03, y = 0.01–0.07), $Ca_{1-x-y}Yb_xTb_yAl_4O_7$ (x = 0.01–0.05, y = 0.01) were synthesized by a modified Pechini citrate process and their optical properties were investigated. Upon excitation at 245 nm all studied samples yielded relatively strong Tb^{3+} luminescence corresponding to the $^5D_4 \rightarrow {}^7F_J$ and $^5D_3 \rightarrow {}^7F_J$ transitions with the dominant component around 542 nm. The direct excitation of two Yb^{3+} ions at 980 nm led to cooperative sensitization of the Tb^{3+} $^5D_4$ level giving rise to its green up-conversion luminescence. The up-conversion emission was also observed from higher $^5D_3$ level of Tb^{3+}, which is rather rare in high phonon frequency host materials. The effect of activator concentration and charge compensation by co-doping with Na^+ ions on luminescence properties were studied. It was found that Na^+ addition lowers disturbance/distribution of activator ions local symmetries and enhanced Stokes Tb^{3+} photoluminescence brightness, while the up-conversion emission intensity does not appear to change noticeably then.

Słowa kluczowe

optical materials, oxides, luminescence, Electronic structure, Defects

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