Cooperative up-conversion processes in $SrAl_4O_7$:Yb and $SrAl_4O_7$:Yb,Tb and their dependence on charge compensation by Na.

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Streszczenie

A detailed analysis of the luminescence behaviour of Yb^{3+}-doped and Yb^{3+}-Tb^{3+} co-doped strontium aluminates powders: $Sr_{1-x}Yb_xAl_4O_7$ (x=0.002–0.07) and $Sr_{1-x-y}Yb_xTb_yAl_4O_7$ (x=0.03; y=0.002–0.02) were performed. The studies of singly doped samples show that direct excitation of Yb^{3+} by means of $^2F_{7/2}$-$^2F_{5/2}$ absorption at 900–980 nm leads to Stokes Yb^{3+} emission in the range of 970–1130 nm as well as bluish-green Yb^{3+} cooperative luminescence (CL) whose energy doubles that of the NIR one. The effect of activator concentration and charge compensation through Na^+ co-doping on both Yb^{3+} emissions were also studied. It was found that Na^+ addition enhanced Stokes Yb^{3+} photoluminescence brightness, while the cooperative emission intensity appeared to be lower. In doubly Yb^{3+}-Tb^{3+} doped materials excitation at 980 nm led to cooperative sensitization of the Tb^{3+} $^5D_4$ level giving rise to its green $^5D_4 \rightarrow {}^7F_J$ (J=$^7F_6$-$^7F_3$) up-conversion luminescence with the dominant component around 542 nm. The cooperative energy transfer (CET) mechanism was proposed basing on the results obtained from emission and absorption spectra, decay kinetics as well as the dependence of UC luminescence intensity on NIR excitation power.

Słowa kluczowe

optical materials, Yb3+ luminescence, Tb3+ luminescence, defects, energy transfer

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