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Spectral Properties and Thermal Quenching of Mn^{4+} Luminescence in Silicate Garnet Hosts $CaY_2Mg\mathit{M}AlSi_2O_{12}$ (M = Al, Ga, Sc) *

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Multi-component silicate garnet ceramics $CaY_2Mg\mathit{M}AlSi_2O_{12}$ comprising different cations M = Al, Ga or Sc in octahedral sites doped with Mn^{4+} ions have been synthesized and studied as novel red-emitting phosphors aiming at warm white *pc*-LED applications. All synthesized phosphors exhibit Mn^{4+} luminescence in rather deep red region, the shortest-wavelength spectrum of Mn^{4+} luminescence (peak wavelength at 668 nm) being obtained for the host with the largest cation $M^{3+} = Sc^{3+}$ in the octahedral site. The effect of increasing the energy of the emitting Mn^{4+} ^2E level with the size of the host cation in octahedral sites is supposed to be the result of decrease of the covalence of the „Mn^{4+}-ligand" bonding with increase of the interionic $Mn^{4+}-O^{2-}$ distance. All studied phosphors demonstrate rather poor thermal stability of Mn^{4+} photoluminescence with a thermal quenching temperature $T_{1/2}$ below 200 K, the lowest value being observed for the host with M = Sc. As expected, the decrease of the energy of the $O^{2-} - Mn^{4+}$ charge-transfer state is observed with the increase of the M^{3+} cation radius, i.e. with the increase of the $O^{2-}-Mn^{4+}$ interionic distance. The thermal quenching temperature of Mn^{4+} luminescence in the studied phosphors correlates with the energy of the $O^{2-}-Mn^{4+}$ charge transfer state which is supposed to serve as a quenching state for Mn^{4+} luminescence.

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