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Novel Luminescent Properties and Thermal Stability of Non-Rare-Earth Ca- α -Sialon:Mn²⁺ Phosphor

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Abstract

Recently, transition metal Mn²⁺ ions emerged as a potent competitor of generally used rare-earth elements due to its abundant reserve and cheaper cost. In this work, the transition metal Mn²⁺ doped Ca- α -sialon phosphor with compositions of Ca_{1-x}Si₉Al₃ON₁₅:xMn²⁺ was designed and successfully prepared by high-temperature solid-state method. The produced Mn²⁺ doped Ca- α -sialon phosphor exhibits a dominant orange-red emission centered at ~600 nm upon UV light excitation of 265 nm, which is ascribed to the characteristic ⁴T₁(⁴G)–⁶A₁(⁶S) transition of Mn²⁺. The band gap energy (5.61 eV) of the phosphors was calculated based on UV-vis diffuse reflectance spectra. Spectroscopy of temperature-dependent emission demonstrates that the luminescence of the optimized Ca- α -sialon:0.12Mn²⁺ composition exhibits a good color stability against heat and excellent resistance to thermal impact, due to its high activation energy of 0.284 eV. Further, the Electron Paramagnetic Resonance (EPR) spectra were recorded to elucidate the structural characteristic of Mn²⁺ and possible vacancy defects in phosphors. The internal quantum efficiency of the prepared product reaches up to ~48.2%. All the results inform that this kind of phosphors may

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