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Synthesis and photoluminescence properties of red-emitting NaLaMgWO₆:Sm³⁺,Eu³⁺ phosphors for white LED applications

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Abstract: A series of red-emitting NaLaMgWO₆:Sm³⁺,Eu³⁺ phosphors were successfully synthesized by the solid-state reaction method. The crystal structure, morphology and photoluminescence properties were investigated in detail. The NaLaMgWO₆ compound has monoclinic structure with the space group *C2/m*. Upon excitation of the near-ultraviolet light, the Sm³⁺ singly doped and Eu³⁺ singly doped phosphors exhibit red emission at 600 nm (⁴G_{5/2}→⁶H_{7/2} transition of Sm³⁺) and 617 nm (⁵D₀→⁷F₂ transition of Eu³⁺), respectively, while the Sm³⁺, Eu³⁺ co-doped phosphors show the characteristic transition of Eu³⁺ whether excited by 397 or 406 nm. This indicates the existence of the energy transfer from Sm³⁺ to Eu³⁺ ions. Furthermore, the mechanism of energy transfer and energy transfer efficiency were confirmed by the decay time of Sm³⁺ ion in NaLaMgWO₆:Sm³⁺,Eu³⁺ phosphors. The mechanism of energy transfer between Sm³⁺ and Eu³⁺ is proved to be dipole-dipole interaction, and the energy transfer efficiency of NaLa_{0.65}MgWO₆:0.05Sm³⁺,0.3Eu³⁺ phosphor is calculated to be 38.89%. The temperature dependent emission spectra demonstrate that the NaLaMgWO₆:Sm³⁺,Eu³⁺ phosphor has a good thermal stability with an thermal activation energy ΔE of 0.241 eV. The CIE chromaticity coordinate is calculated to be (x = 0.661, y = 0.339).

Keywords: Red phosphors, Photoluminescence, Energy transfer, White LEDs

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