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Production and Characterization of Ce3+: Si2N2O Phosphors for White Light-Emitting Diodes

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Abstract : Si2N2O (Sinoite) is an inorganic-based oxynitride material that reveals promising phosphor candidates for white light-emitting diodes (WLEDs). However, there is now limited knowledge to explain the synthesis of Si2N2O for this purpose. Here, to the best of authors' knowledge, we report the first time the production of Si2N2O based phosphors by CeO2, SiO2, Si3N4 from main starting powders, and Li2O sintering additive through spark plasma sintering (SPS) route. The processing parameters, e.g., pressure, temperature, and sintering time, were optimized to reach the monophase Si2N2O containing samples. The lattice parameter, crystallite size, and amount of formation phases were characterized in detail by X-ray diffraction (XRD). Grain morphology, particle size, and distribution were analyzed by scanning and transmission electron microscopes (SEM and TEM). Cathodoluminescence (CL) in SEM and photoluminescence (PL) analyses were conducted on the samples to determine the excitation, and emission characteristics of Ce3+ activated Si2N2O. Results showed that the Si2N2O phase in a maximum 90% ratio was obtained by sintering for 15 minutes at 1650oC under 30 MPa pressure. Based on the SEM-CL and PL measurements, Ce3+: Si2N2O phosphor shows a broad emission summit between 400-700 nm that corresponds to white light. The present research was supported by TUBITAK under project number 217M667.

Keywords : cerium, oxynitride, phosphors, sinoite, Si_2N_2O

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