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Nd^{3+}: Si_2N_2O (Sinoite) Phosphors for White Light Emitting Diodes

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Abstract : A silicon oxynitride (Si2N2O), the mineralogical name is “Sinoite”, reveals the outstanding physical, mechanical and thermal properties, e.g., good oxidation resistance at high temperatures, high fracture toughness with rod shape, high hardness, low theoretical density, good thermal shock resistance by low thermal expansion coefficient and high thermal conductivity. In addition, the orthorhombic crystal structure of Si2N2O allows accommodating the rare earth (RE) element atoms along the “c” axis due to existing large structural interstitial sites. Here, 0.02 to 0.12 wt. % Nd3+ doped Si2N2O samples were successfully synthesized by spark plasma sintering (SPS) method at 30MPa pressure and 1650oC temperature. Li2O was also utilized as a sintering additive to take advantage of low eutectic point during synthesizing. The specimens were characterized in detail by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD) and cathodoluminescence (CL) in SEM and photoluminescence (PL) spectroscopy. Based on the overall results, the Si2N2O phase was obtained above 90% by the SPS route. Furthermore, Nd3+: Si2N2O samples showed a very broad intense emission peak between 400-700 nm, which corresponds to white color. Therefore, this material can be considered as a promising candidate for white light-emitting diodes (WLEDs) purposes. This study was supported by TUBITAK under project number 217M667.

Keywords : neodymium, oxynitride, Si_2N_2O, WLEDs
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