Spectroscopic features of thermally stable red emitting Pr^{3+} doped sodium calcium metasilicate phosphor for w-LED applications

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Microcrystalline pure phase praseodymium doped $Na_4Ca_4Si_6O_{18}$ (NCMS: Pr^{3+}) phosphors have been synthesized and systematically characterized for implementation in w-LED applications. High temperature solid state reaction methodology has opted to prepare a series of NCMS: xPr^{3+} (x= 0.0, 1.0, 2.0, 3.0 and 4.0 mol%) phosphors. X-ray diffraction pattern has confirmed the phase purity and crystallinity of the as-prepared phosphor via comparing all the diffraction peaks with the standard pattern. The morphology of NCMS phosphor has been acquired in the micrometre range and captured through the FE-SEM technique under 5 μm resolution. Luminescent studies have been carried out in n-UV and visible regions to illustrate the excitation and emission spectra of NCMS: Pr^{3+} phosphor. PL spectrum exhibits the radiative emission at 611 nm under the most intense excitation peak at 480 nm for 1.0 mol% of Pr^{3+} doped NCMS phosphors. The optimized concentration of dopant ion has been achieved by following the energy transfer-based concentration quenching mechanism and found to be 1.0 mol% for NCMS phosphor. The chromaticity diagram represents the integrated emission color of the optimized NCMS:1.0 mol% Pr^{3+} phosphor falls in the red region with a color purity of 97.0% when stimulated with the blue light. Temperature dependent luminescence studies are evident that the thermal stability of the synthesized phosphor is quite high to withstand the operating temperature of LEDs. Thus, the investigated outcomes of this work encourage that the promising red-emitting NCMS phosphor can be beneficial in w-LED applications.

References

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