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Protocol for Dy³⁺ modified NaCaVO₄ Nanophosphors in Solid-State Lighting Applications: Structural and Luminescence Investigations

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The combustion process was used to synthesize the dysprosium (Dy³⁺) doped Sodium Calcium Vanadate (NaCaVO₄) phosphor. The structural, optical and morphological investigations were carried out with the dopant concentrations ranging from x = 0 to 3 mol% for which X-Ray diffraction, photoluminescence spectroscopy, SEM and UV-Vis spectroscopy were studied. We have explored that the XRD results indicate vibrant, clear, and well-defined peaks that are matched to the NaCaVO₄ standard card confirming that the phosphor powder crystallized in orthorhombic phase with space group Cmc₂m. From the FESEM pictures, the particles had an agglomerated morphology with irregular shapes and sizes in the nm range. The PL properties of undoped and Dy³⁺ doped NaCaVO₄ were investigated using a 310nm excitation source to determine the suitability for use in displays. The emission spectrum exhibited two sharp peaks at (450-500) nm and (550-600) nm and a weak peak at (650-700) nm which is assigned to Dy³⁺ emission transitions of 4F_{9/2} → 6H_{15/2} (blue), 4F_{9/2} → 6H_{13/2} (yellow) and 4F_{9/2} → 6H_{11/2} (red). Doping of NaCaVO₄ with Dy³⁺ for x = 0.25 to 3 mol% concentrations resulted in the band gap modifications in the range of 3.341 to 3.866 eV. The material that we have taken up might be investigated as a new phosphor that could be activated by UV light emitting diode (LED) light for solid state lighting and display applications.

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