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Cathodoluminescence properties of SiO_2:$Pr^{3+}$and $ZnO{\cdot}SiO_2$:Pr^{3+} phosphor nanopowders

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ABSTRACT:

The successful incorporation of ZnO nanoparticles in Pr^{3+}-doped SiO_2 using a sol–gel process is reported. SiO_2:Pr^{3+} gels, with or without ZnO nanoparticles, were dried at room temperature and annealed at 600 °C. On the basis of the X-ray Diffraction (XRD) results, the SiO_2 was amorphous regardless of the incorporation of Pr^{3+} and nanocrystalline ZnO or annealing at 600 °C. The particles were mostly spherical and agglomerated as confirmed by Field Emission Scanning Electron Microscopy. Thermogravimetric analysis of dried gels performed in an N_2 atmosphere indicated that stable phases were formed at ≥900 °C. Absorption bands ascribed to $^3H_4$-$^3P_{(J = 0,1,2)}$, $^1I_6$ and $^1D_2$ in the UV–VIS region were observed from SiO_2:Pr^{3+} colloids. The red cathodoluminescent (CL) emission corresponding to the $^3P_0 \rightarrow {}^3H_6$ transition of Pr^{3+} was observed at 614 nm from dried and annealed SiO_2:Pr^{3+} powder samples. This emission was increased considerably when ZnO nanoparticles were incorporated. The CL intensity was measured at an accelerating voltage of 1-5 keV and a fixed beam current of 8.5 μA. The effects of accelerating voltage on the CL intensity and the CL degradation of SiO_2:Pr^{3+} and $ZnO{\cdot}SiO_2$:Pr^{3+}were also investigated using Auger electron spectroscopy coupled with an Ocean Optics S2000 spectrometer.