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Effects of annealing on luminescent properties of mixed lanthanum oxyorthosilicates co-doped Dy3+ and Pr3+ phosphors.
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For the past three decades, phosphors have made an impressive contribution to technological development for various applications including, solid-state lighting, solar cells, theft prevention, optical amplifiers, optical lasers, medicine, etc. We have investigated photoluminescent and cathodoluminescent properties of mixed lanthanum oxyorthosilicates co-doped with dysprosium (Dy3+) and praseodymium (Pr3+). When co-doped with Dy3+; Pr3+either act as a sensitizer or excitation energy absorber depending on the host material. Pr ions can exist in the trivalent (Pr3+) or tetravalent (Pr4+) state, but only the Pr3+ ions are optically active, while the Pr4+ ions are luminescence quenchers. Hence, it is important to reduce the amount of Pr4+ ions in any luminescence material to improve intensity of emitted light. We have prepared single and mixed host lanthanum yttrium oxyorthosilicates (La2-xYxSiO5, x = 0, 0.5, 1, 1.5 and 2) co-doped Dy3+ and Pr3+ powder phosphors using solution combustion synthesis. The materials were annealed at 950 ℃ in air and 5% H2 (in Ar) gas to reduce the oxygen vacancies and excess Pr4+ to Pr3+, respectively. The diffuse reflectance data showed an absorption peak around 376 nm, attributed to the O2-⟶Pr4+ charge transfer band. Both the band gap and luminescence properties of the samples were enhanced after annealing in 5% H2 (in Ar). This suggests that the amount of Pr4+ in the samples decreased as confirmed from the X-ray photoelectron spectroscopy results. The luminescence (PL and CL) showed evidence of energy transfer from Pr3+ to Dy3+ in some of the samples. The CIE coordinates of the samples (both PL and CL) showed tunable colour that was influenced by annealing atmospheres and La to Y ratio.

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