New Sol-gel Method for Synthesis of Dy-doped Yttrium Disilicate Phosphor not from TEOS but Sodium Silicate Solution

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Yttrium disilicate/pyrosilicate ($Y_2Si_2O_7$), which occurs naturally as yttrialite, is a mixture of rare earth silicates that displays interesting structural properties because of its high refractoriness (mp = 1775 °C) and stability in oxidizing environments. Yttrium disilicate offers a wide band gap and excellent thermal and chemical stability compared to other well-studied phosphors such as ZnS and CdS. It has been shown to be one of the most efficient host lattices for rare earth ions, which substitute Y^{3+} ions [1, 2]. Yttrium silicates doped with different metallic ions exhibit attractive luminescent properties for potential applications, such as plasma displays, laser materials and high-energy phosphors [3]. The synthesis methods frequently used to obtain $Y_2Si_2O_7$ are the conventional solid-state reaction, sol-gel and hydrothermal process. The sol–gel process is based on the polycondensation of hydrolyzed alkoxides or colloidal dispersions, therefore non-substituted and substituted silicon alkoxides are used as source of Si, typically $Si(OC_2H_5)_4$ (TEOS) or $CH_3–Si(OC_2H_5)_3$ (MTEOS). In the present work, a new method to synthesize Dy-doped yttrium disilicate ($Dy_{0,05}Y_{1,95}Si_2O_7$) phosphors is proposed using a combination of sol-gel and coprecipitation techniques. The gel of silica particles were obtained by surfactant-assisted sol-gel process [4], from sodium silicate solution, an unusual precursor of Si. Then yttrium and dysprosium were co-precipitated over these particles. Pure α-phase and β-phase of $Y_2Si_2O_7$ were obtained after calcining the synthesized precursor at 1100°C and 1400°C respectively (Fig. 1). β-phase showed superior luminescence efficiency (Fig. 2).

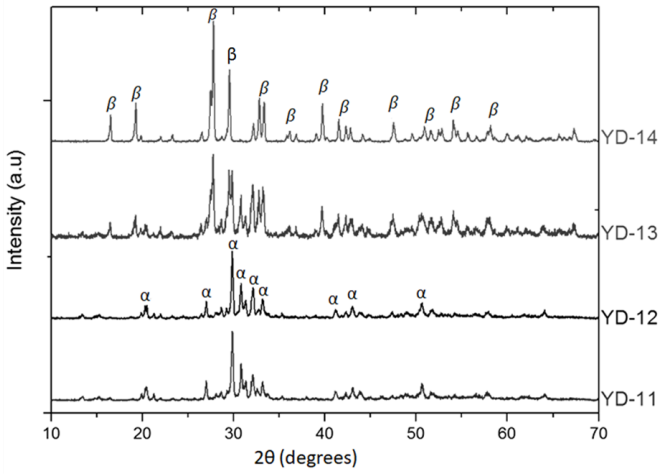

Fig. 1- XRD patterns of Dy^{3+}-$Y_2Si_2O_7$ samples calcined at 1100 °C (YD-11), 1200 °C (YD-12), 1300 °C (YD-13) and 1400 °C (YD-14)

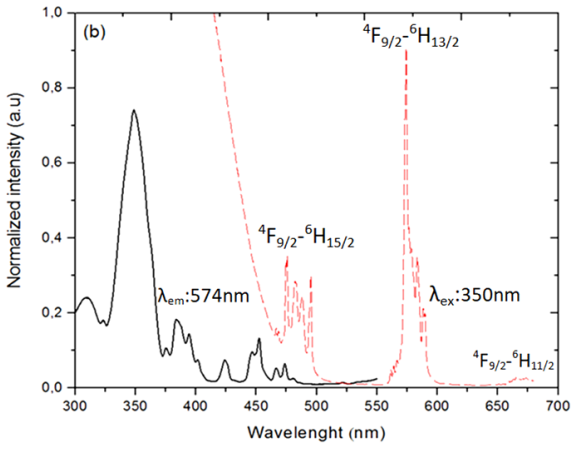

Fig. 2- Room-temperature emission (dashed line) and excitation (solid line) spectra for the β-phase of Dy^{3+}-$Y_2Si_2O_7$ (sample YD-14)

References

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