SYNTEHIS AND CHARACTERIZATION OF Pr^{3+} DOPED YTTRIUM SILICATE VIA SOL-GEL METHOD

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Abstract

$Y_2SiO_5:Pr^{3+}$ is a widely recognized optical material that is utilized for the conversion of visible blue light into ultraviolet-C radiation (UV-C), thus producing conceivable antibacterial effects [1]. The silicate in question exhibits two distinct allotropic forms. The first form is observed at lower calcination temperatures and exhibits a monoclinic crystal structure with space group P21/c (X_1). The second form, on the other hand, is observed at higher temperatures and possesses the space group I*/a (X_2) [2]. Nevertheless, the literature often fails to adequately address the significance of ensuring the homogeneity of the reaction precursor while synthesizing these silicates. The diffusion coefficient of ions in SiO_2 and Y_2O_3 is influenced by temperature, as indicated by their high melting temperatures. This temperature dependence is observed even at a temperature of 1000°C [3].

The objective of this study is to synthesize Pr^{3+}-doped yttrium silicate using two distinct methodologies. The initial approach involved the utilization of pre-synthesized oxide precursors, while the subsequent method capitalized on co-precipitated oxides. Subsequently, the samples underwent calcination processes at temperatures of 1350 °C and 1050 °C, respectively, as per the aforementioned methods. In the initial scenario, the discrepant velocities observed in the hydrolysis and condensation reactions of tetraethyl orthosilicate, as well as the precipitation of Y^{3+}, no longer exert an impact on the uniformity of the precursor substances. The aforementioned approaches offer a precise means of controlling the composition and uniformity of the synthesized products, rendering them a favorable option for the advancement of superior materials. The produced materials were subjected to analysis using X-ray diffraction (XRD), photoluminescence spectroscopy, and first antimicrobial assays.

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References

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