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Luminescence properties of Bi³⁺ doped YPO₄ powder produced using combustion synthesis

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Phosphor materials, which absorb energy and emit light, have numerous applications and continue to develop as technology progresses. Past studies have identified YPO₄ as a suitable host material for luminescent rare earth ions. However, Bi ions also show luminescence in various regions of the spectrum depending on their valence state as well as the host material and are being investigated as an alternative to expensive rare earth elements. Bi³⁺ doped YPO₄ was synthesized by the combustion method at 600 °C using urea as the fuel. Samples were then reduced in a mixture of hydrogen gas (5%) in argon at different temperatures. The structure was confirmed by X-ray diffraction. Photoluminescence measurements excited at 230 nm resulted in broad band emission in the ultraviolet range of 280 - 400 nm, with the peak at 330 nm attributed to the $\text{Bi}^{3+} \text{P}^{1+} \rightarrow \text{Bi}^{1+} \text{S}^{0+}$ transition of Bi³⁺ ions. The optimum Bi doping concentration and annealing temperature were established as 0.5 mol% and 800 °C, respectively. The excitation and emission wavelengths are similar to those reported for Ce doped YPO₄, suggesting that Bi may be considered as an alternative to this rare earth element. Although this ultraviolet emitting phosphor cannot be used for lighting or display applications, it could be used for ultraviolet lamps which have forensic, medical and industrial applications.

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