STRUCTURAL AND OPTICAL PROPERTIES OF Eu^{3+} /Tb^{3+} CO-DOPED $GdPO_4$ NANOPARTICLES

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Lanthanide-doped gadolinium phosphate ($GdPO_4$) nanoparticles constitute a versatile class of inorganic nanophosphors whose functional properties are strongly governed by crystal structure, particle size, and morphology. Achieving precise control over these parameters remains challenging, particularly in multicomponent systems where dopant interactions can significantly influence crystal growth and structural order. In this study, Eu^{3+}/Tb^{3+} co-doped $GdPO_4$ nanoparticles were synthesized via a hydrothermal method to systematically investigate the effects of precursor stoichiometry and dopant concentration on their structural and morphological evolution. Four Ln^{3+}:PO_4^{3+} molar ratios (1:25, 1:50, 1:100, and 1:200) were examined, while the Eu^{3+} content was varied from 0 to 5 mol% in $GdPO_4$:20 mol% Tb^{3+} samples. X-ray diffraction analysis revealed a progressive increase in crystallinity and crystallite size with increasing phosphate excess and decreasing Eu^{3+} concentration, with the highest degree of structural order observed at a Ln^{3+}:PO_4^{3-} ratio of 1:200. These findings demonstrate that both precursor stoichiometry and activator concentration play a critical role in crystal growth. Furthermore, photoluminescence measurements showed that varying the Eu^{3+} concentration in $GdPO_4$:20 mol% Tb^{3+} enables controlled tuning of the emission color from green to red. The established structure-composition-morphology correlations provide valuable insight into the rational design of $GdPO_4$-based nanophosphors with tailored optical and physical properties for advanced functional materials.

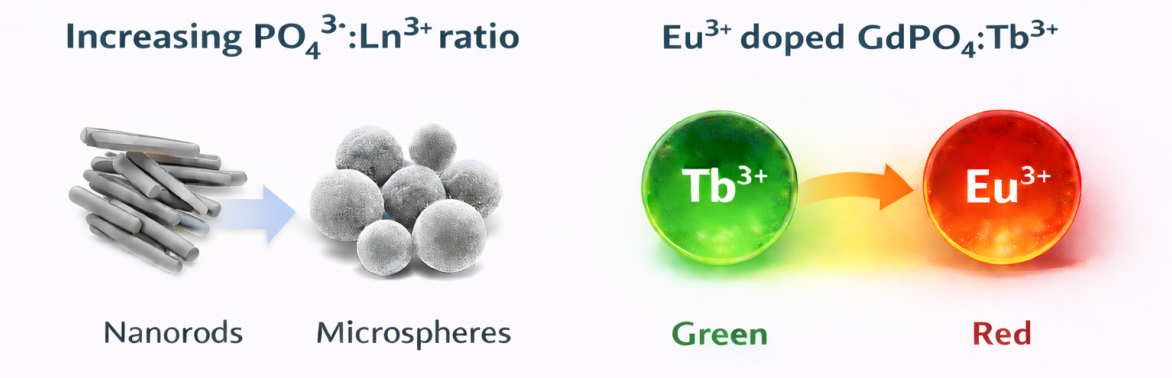

Fig. 1. Morphology evolution from nanorods to microspheres driven by Ln^{3+}:PO_4^{3+} ratio and gradual emission tuning from green to red via Eu^{3+} doping in $GdPO_4Tb^{3+}$ samples

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