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Structural and upconversion properties of $\text{Er}^{3+}/\text{Yb}^{3+}$ doped zinc titanate for potential applications in bio-imaging

ABO₃ perovskite materials are gaining interest due to their applications in materials, electronics, and photovoltaics [1]. One type of ABO₃ is ZnTiO₃, this material is highly favored because of its outstanding mechanical, optical, and insulating properties [2, 3]. It has been applied in various applications such as paint pigments, sorbents, microwave dielectrics, catalysts, dielectric materials, solar cells, photocatalysis, antibacterial agents, and gas sensors [4, 5, 6, 7]. Upconverting nanomaterials are used in a variety of applications, mostly in displays, the visualization of biological objects, data storage, lasers, sensors, optical imaging, and photodynamic therapy or in the development of solar panels, to name a few [8, 9, 10].

In this study, the host material zinc titanate and Yb³⁺/Er³⁺ doped ZnTiO₃ was synthesized using the Hoodia Gordonii ethanoic extract.

The XRD showed that hexagonal Ecdrewsite structure was synthesized with the most intense peak corresponding to ZnTiO₃ at around $2\theta=35^\circ$ [110], the intensity of the peaks reduced with doping concentration, and a peak shift was observed indicating incorporation of dopant. Raman results confirmed the production of ZnTiO₃ and the peak shift due to dopant atoms occupying the lattice sites. The most intense vibrational mode at 350 cm⁻¹ corresponds to the Ag mode of ZnTiO₃; this agrees with the XRD phase analysis. The SEM micrographs showed a mixture of highly agglomerated morphologies ranging from platelets to rods, this is consistent with the formation of mixed-phase particles. The upconversion measurements showed a green emission centered around 550 nm, and this was confirmed by the CytoViva microscope. The upconversion properties of this material show that it has a potential use in bio-imaging and photodynamic therapy.

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