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Hydrothermal Synthesis of ZnO-TiO₂: Yb³⁺/Ho³⁺ Phosphor Heterostructures for Up-conversion Luminescence Applications.

ZnO-TiO₂:Yb³⁺/Ho³⁺ phosphor heterostructures were successfully synthesized by the hydrothermal process. The structure, morphology and upconversion (UC) luminescence properties of the prepared heterostructures were investigated. The mixed oxides of ZnO and TiO₂ anatase and rutile were confirmed by X-ray diffraction (XRD). Scanning electron microscopy (SEM) revealed the agglomerated and spherical morphology of the prepared nanophosphor. Transmission electron microscopy (TEM) confirmed that the particles of the prepared heterostructures are in the nanoscale range. Diffuse reflectance spectra (DRS) exhibited several absorption bands at 453, 488, 540 and 647 nm associated with the transitions of Ho³⁺ ion: 5I₈ → 5G₆, 5I₈ → 5F₃, 5I₈ → 5F₄/ 5S₂, and 5I₈ → 5F₅, respectively. Due to the doping concentration of Ho³⁺ and Yb³⁺ ions, the nanocomposite's estimated optical band gap energy increased. The UC emission spectra upon excitation wavelength of 980 nm revealed two emission peaks located at 545 and 661 nm from the doped nanocomposite. These emission peaks can be attributed to 5S₂/5F₄ → 4I₈ and 5F₅ → 5I₈ transitions of Ho³⁺ ions, respectively. The Commission Internationale de l'Éclairage (CIE) analysis revealed that the emission colour is towards the greenish region. The sample with the best UC luminescence intensity was ZnO-TiO₂:0.1mol%Ho³⁺/9mol%Yb³⁺, which showed good stability after an initial intensity decrease of ~15% during degradation assessment.

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