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Sol-gel preparation and characterization of Er3+ doped TiO2 luminescent nanoparticles

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Abstract

The present paper reports on down-and up-conversion luminescence behaviour of sol-gel derived erbium doped titanium dioxide with anatase structure. Through combined structural, optical and electron microscope analysis, effective and influence of Er(sup)3+ doping into TiO(sub)2 lattice has been demonstrated using X-Ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM), and optical reflectance spectra. XRD results showed only anatase diffraction peaks of TiO(sub)2, indicating the formation of a pure anatase phase even after Er(sup)3+ incorporation into TiO(sub)2 lattice. Selected Area Electron Diffraction (SAED) confirmed that the synthesized TiO2 nanoparticles are polycrystalline in nature which correlated well with XRD findings. Upon excitation at 320 nm, two down-conversion contributions at 378 nm and 435 nm attributed to indirect band gap and defect-related emissions, respectively were observed from both pure and Er(sup)3+ doped TiO(sub)2 nanoparticles. On the other hand, strong green up-conversion emission centred at 544 nm ascribed to (sup)4S(sub)3/2 (sup)4I(sub)15/2 transition of Er(sup)3+ was observed under 980 nm laser excitation for all Er(sup)3+ doped TiO(sub)2 samples. This result analysis brings insight on understanding of structural, optical and luminescence properties of Er(sup)3+ doped TiO(sub)2 nanoparticles for use in solar cells and bio imaging devices.