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Sol-gel synthesis and characterization of Er3+ doped and Yb3+ co-doped TiO2 nanoparticles

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New enhanced novel phosphors with high efficiency, persistent luminescence lifetime and intensity are needed for the development of various nano-technologically advancing industries. In this respect, this study will discuss the basic information on trivalent rare earth ions photoluminescence emission (down and up conversion emissions) in the UV/Vis/NIR regime and optical band-gap tuning based on rare earth ions doping and co-doping. Erbium-doped ytterbium co-doped titanium dioxide (TiO2) nanoparticles were prepared via sol-gel synthesis method. The sample characterization was mainly focused on the comparison of the undoped and doped TiO2 samples. The phase analysis and particle sizes of TiO2: Er3+ and TiO2: Er3+-Yb3+ nanocrystals were determined using an x-ray diffractometer (XRD) and transmission electron microscopy (TEM). The x-ray diffraction patterns confirmed the formation of an anatase TiO2 phase. UV/Vis spectroscopy was used to measure the reflectance characteristics of the sample, and the band gap was extrapolated from Kubelka-Munk relation. Phonon quantification in TiO2 was achieved using Fourier transform infrared (FT-IR) spectroscopy. The XPS technique was employed to confirm the formation of various defects. A laser beam with 980 nm wavelength was used to irradiate the sample, and the displayed emission lines of TiO2: Er3+ in the visible region of the electromagnetic spectrum confirmed up-conversion luminescence. Enhancement of up-conversion luminescence intensity due to Yb3+ co-doping was observed, indicating an efficient Yb-Er energy transfer process.

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MSc

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