

Correlation between structure and photoluminescence properties of thin films of TiO_2 doped Er^{3+} , obtained by the sol-gel process

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Abstract : In this work, we are interested to the study of the influence of structure on photoluminescence properties of Er^{3+} doped TiO_2 thin films, dip-coated by the sol-gel method. TiO_2 thin films and powders obtained are doped with different rates of Erbium (0.1, 0.5, 1, 3 at %) and have undergone an annealing at 450°C . Thin films and powders thus obtained were characterized by different techniques: differential scanning calorimetric (DSC), infrared spectroscopy FTIR, Raman spectroscopy and photoluminescence. (DSC) results show that the Erbium causes a shift of the transformation from amorphous TiO_2 to anatase crystalline state to the low temperatures and the latter varies according to the percentage of erbium. While the FTIR shows strong absorption peaks around 438 cm^{-1} and 612 cm^{-1} corresponding respectively to the vibration Ti-O-Ti and Ti-O of TiO_2 . In contrast the Raman spectra show the presence of two phases' anatase and brookite in the case of un-doped thin films and the disappearance of the brookite in those doped with Erbium and annealed at 450°C . Finally, the photoluminescence curves show the green and red up-conversion emissions. Green emissions are positioned in the range of 520-570 nm ($^2\text{H}_{11/2}$, $^4\text{S}_{3/2}$, $^4\text{I}_{15/2}$), and then for those of the red they are set in the range 640-690 nm ($^4\text{F}_{9/2}$, $^4\text{I}_{15/2}$). We also note that the emission intensity of red and green gradually increased when the erbium rate increases.

Keywords : TiO_2 doped Er^{3+} , sol-gel, photoluminescence properties