

Elaboration et caractérisation des couches minces de TiO₂ dopées à l'erbium, à différentes températures et épaisseurs

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Abstract : This study is to develop and characterize thin films of titanium oxide (TiO₂) doped with different erbium content (5, 7 and 10% by volume) and processed in a temperature range 400-500 ° C. obtained by the sol-gel. These thin films are deposited on glass substrates and porous silicon. We have demonstrated the influence of the thickness, the rate of dopant and annealing temperature on optical properties, structural and thermal properties of thin films and xerogels. For this, various investigative techniques were used: DSC, XRD, Raman spectroscopy, scanning electron microscope (MEB), atomic force microscopy (AFM) and UV-visible spectroscopy. The results obtained by DSC show that the doping of TiO₂ with erbium produces a first shift conversion of TiO₂ to the low temperatures of 338 ° C to 260 ° C. So doping with erbium leads to an early acceleration of the crystallization of titanium oxide compared to the undoped state. For cons, the same addition of 5%, 7% and 10% of Er³⁺ also causes a shift of the second transformation to the high temperatures of 357 ° C to 383 ° C. So it causes a delay of crystallization, but the formation of other phases. The DRX of thin films show the one hand, the addition of 5%, 7% and 10% of Er in the matrix of TiO₂ causes in addition to the training phase of anatase and brookite, the presence of other phases: Rutile, Er₂Ti₂O₇, Er₂TiO₅, Er₂O₃ and secondly, the Raman spectrum confirms these results. The SEM micrographs show that the thin layer is homogeneous and free from cracking. They reveal a nanostructuring of thin layer which consists of nano grains consistent with the sizes. While the AFM images show that they are composed of many nanocrystals with high density on the substrate. The size of these nano-grains, the end appears on the surface of the deposit increases with the doping with erbium. They also reveal that the nanograins are spontaneously organized in a certain order. The transmission spectra of thin films of titanium oxide doped indicate that they are transparent in the visible and opaque in the UV. The calculation of the refractive index and porosity of thin films of erbium-doped TiO₂, from the transmittance spectra, shows a fluctuation of the latter depending on the annealing temperature, thickness and grade erbium. While the optical gap increases.

Keywords : TiO₂, Thin films, Er³⁺, sol-gel, anatase, Brookite, rutile, Er₂Ti₂O₇, Er₂TiO₅, Er₂O₃