Elaboration et caractérisation des couches minces de TiO2dopées à l'erbium, à différentes températures et épaisseurs

BENACHOUR Med Cherif

Soutenue en: 2011

Abstract : This study is to develop and characterize thin films of titanium oxide (TiO2) dopedwith different erbium content (5, 7 and 10% by volume) and processed in a temperature range400-500 ° C. obtained by the sol-gel. These thin films are deposited on glass substrates andporous silicon. We have demonstrated the influence of the thickness, the rate of dopant andannealing temperature on optical properties, structural and thermal properties of thin films andxerogels. For this, various investigative techniques were used: DSC, XRD, Ramanspectroscopy, scanning electron microscope (MEB), atomic force microscopy (AFM) andUV-visible spectroscopy.The results obtained by DSC show that the doping of TiO2 with erbium produces afirst shift conversion of TiO2 to the low temperatures of 338 ° C to 260 ° C. So doping witherbium leads to an early acceleration of the crystallization of titanium oxide compared to theundoped state. For cons, the same addition of 5%, 7% and 10% of Er 3 + also causes a shift ofthe second transformation to the high temperatures of 357 ° C to 383 ° C. So it causes a delayof 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 thematrix of TiO2 causes in addition to the training phase of anatase and brookite, the presenceof other phases: Rutile, Er2Ti2O7, Er2TiO5, Er2O3 and secondly, the Raman spectrumconfirms these results.The SEM micrographs show that the thin layer is homogeneous and free fromcracking. They reveal a nanostructuring of thin layer which consists of nano grains consistentwith the sizes. While the AFM images show that they are composed of many nanocrystalswith high density on the substrate. The size of these nano-grains, the end appears on thesurface 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 aretransparent in the visible and opaque in the UV. The calculation of the refractive index andporosity of thin films of erbium-doped TiO2, from the transmittance spectra, shows afluctuation 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