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Investigation about Nano Structural and Optical Properties of Titanium Oxides

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ABSTRACT
Tio_2 /glass multilayer in high vacuum condition and vertical accumulation angle has been determined prepared by resistance evaporated method with 50.3 nm thickness. Accumulated temperature of Tio_2 layer was 28°c . The Atomic Force Microscopy (AFM), optical Spectroscopy and XRD analyses are perfectly accomplished for this multilayer.

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INTRODUCTION

Nano structural materials have attracted a great deal of attention in the last few years for their unique characteristics that cannot be obtained from conventional macroscopic materials .Owing to quantum size effects and surface effects , nano particles can display novel optical , electronic , chemical , magnetic and structural properties that might find many important technological applications [1].

Extensive investigation of Tio_2 thin films are caused by actual perspectives of their applications in photo catalytically and biomedical materials due to a complex of their important properties such as high dielectric constant, photo catalytically activity, bioactivity [2-3].

Titanium dioxide (Tio_2) is a well known material and it's used in pigments, solar cells and sunscreens.

Titanium - dioxid injection has been developed as new environmental mitigation technology for BWRS. It utilizes a photoelectrical effect of irradiated Tio_2 to reduce ECP in the reactor water. Micro particles of Tio_2 are injected in to the reactor water to form a deposit on the surface of reactor internals ad recirculation piping. Cherenkov radiation in the reactor core region is the light source for photo –excitation of Tio_2 . Thus, Tio_2 injection is thought to be an effective mitigation technique for reactor internals and vessel penetrations without any hydrogen addition [4-5].

In order to fabricate nanoparticles of titanium dioxide, there is a large number of synthesis methods and studies .all these methods provide the three crystalline phases , rutile , anatase and brookite , as well as an amorphous phase.thise last phase can be transformed , by a heat treatment , to the more stable rutile or anatase phases[6].

Experimental Details:

First we wash glass substratum whose quality is laboratory lamina by distilled water and washer material then clean it in a supersonic bath by acetone for 15 minutes and then by pure alcohol for 15 minutes . For the purpose of forming Tio_2 layer, we use the white powder of Tio_2 in a boat whose quality is tungsten and then install it in a required place. We locate substratum vertically on the top of the boat and in a space of 45 cm of boat on the top of the holder, then block the container and reach vacuum (emptiness) ($10^{-3} tor$) by rotary pump, and then we reach a higher vacuum about ($10^{-6} tor$) by turbo molecular pump. Now Tio_2 powder starts evaporating and complete memento layer near 50.3 nm and the final thickness of built multilayer in the procedure is about 50.3 nm which is determined by crystal quartz device. AFM and XRD analysis were used for determination of nano structure and crystallographic direction of multi layer. Spectrophotometer device were used in visible light wave length range to obtain optical reflectivity.

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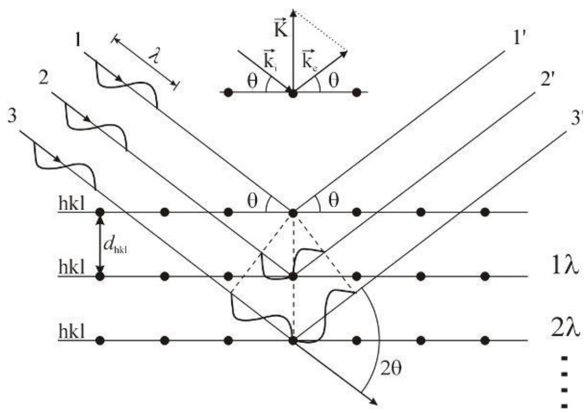
The mathematic formula :

A) When a beam of X-rays (wavelength λ) strikes a crystal surface in which the layers of atoms or ions are separated by a distance *d*, the maximum intensity of the reflected ray occurs when n λ=2d sin(θ)

where θ (known as the Bragg angle) is the complement of the angle of reflection and *n* is other of diffraction. The law enables the structure of many crystals to be determined. It was discovered in 1912 by Sir William Lawrence Bragg.$d^2=a^2/h^2+k^2+l^2$



B) In order to obtain more structural information and evaluate the mean grain size (D) of the films, we adopted the Scherrer formula [7].

D = (0/9λ) /B cos (θ)

λ=wave length, θ=the bragg diffraction , B = FWHM of diffraction peak, respectively [8].

C) you will find that various different symbols are given for some of the terms in the equation –particularly for the concentration and the solution length. The concentration of the solution is "c" and the length of solution the light passes is "L" .

Log $I_{ï}$ / I = Ɛ L C

You should recognize the expression on the left of this equation as what we have just defined as the absorbance, A. you might also find the equation written in terms of A:

A= Ɛ L C

That's obviously easier to remember than the first one

A= Log $I_{ï}$ / I = Ɛ L C

Ɛ=A / L C

aim of this work is to produced multilayer, and investigate about optical and structural properties of these layers and their communication.

RESULT AND DISCUSSION

The Atomic Force Microscopy (AFM), spectrophotometer and XRD analyses are perfectly accomplished for this multilayer and the results are mentioned in detail.

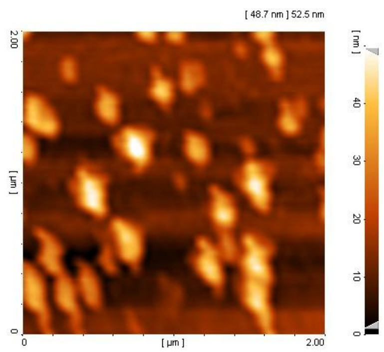


Fig. 1:

Figure.1.shows AFM tow dimensional image of Tio_2 /glass multilayer in 2µm×2µm dimensions as it is shown, the surface is full of domed peak and empty space is completely visible.

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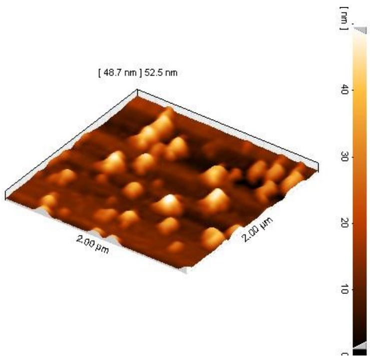

Fig. 2:

Figure.2.shows AFM three dimensional image of Tio_2 /glass multilayer in 2µm×2µm dimensions as it is shown, the surface is full of domed peak. The black holes are visible on the image.

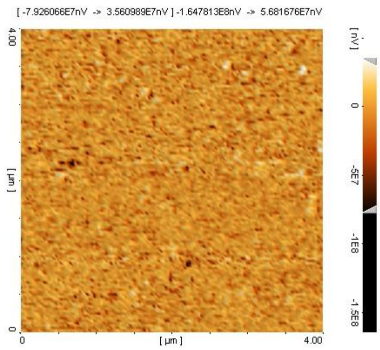

Fig. 3:

Figure.3. shows two dimensional phase image of Tio_2 /glass multilayer in 4µm×4µm dimensions uniform color of image shows purity .The Oxygen impurities along grain titanium metal shows.

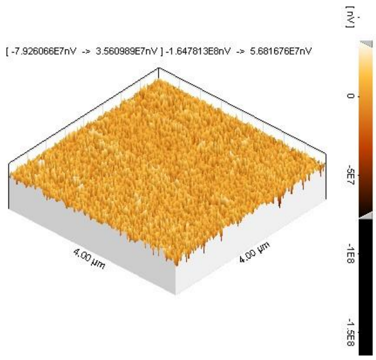

Fig. 4:

Figure.4. shows three dimensional phase image of Tio_2 /glass multilayer in 4µm×4µm dimensions. The Oxygen impurities shows.

Figure.5. shows transmission diagram of Tio_2 /glass multilayer in the model according to productive radiance wave length. As it is determined, we have about 82% transition and transmission. The layer is transparent. Diagram exactly is consistent to Titanium dioxide standard.

Figure.6. shows diagram of X-ray diffraction of Tio_2 /glass multilayer . Extended peak related to shapeless substratum of glass is visible in 20 to 30 and in addition, in general condition XRD is noisy. Tio_2 is shapeless.

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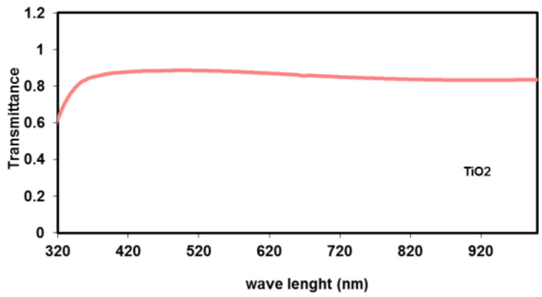

Fig. 5:

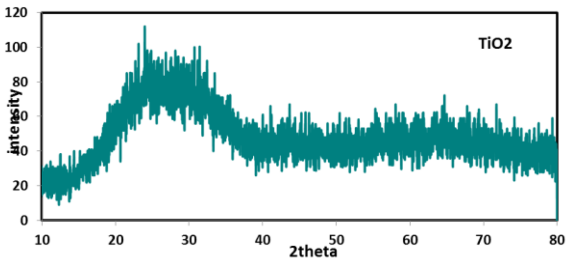

Fig.6:

Summery:

multilayer of TiO2/glass were prepared by resistance evaporated method under UHV conditions, morphology of multilayer showed shapeless as we can see from XRD pattern. This multi layer has a good transmittance and there was a good agreement between nano structure and optical property of produced multi layer.

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