COMPARATIVE STUDY OF TiO_2 THIN FILMS DEPOSITION AT 0.05 AND 0.1 MOLARITIES BY SPRAY PYROLYSIS

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Abstract

In this present work TiO_2 thin films were deposited employing the simple and economic experimental set up known as spray pyrolysis method. The TiO_2film is prepared for the molarity of 0.1M at constant temperature on glass substrate. The structural and morphological properties were studied with **UV, XRD** and **SEM** analysis.TiO_2 thin films deposited on a glass substrate observed to be good in appearance and the analysis with the XRD spectra shows the gradual uniform formation of the film. The SEM analysis for the sample shows that continuous and smooth film is attained.

Key words: Film, , Scanning electron Microscope, XRD, UV

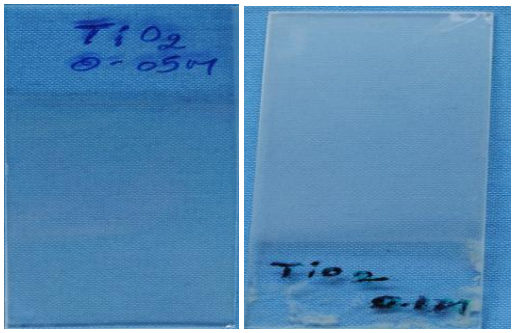
Introduction:

Thin films are very thin structural layers of different materials The size of layer variesfrom several microns to nano level. Thin film technology initially developed to meet the needs of ic industry Breakthrough in micro electronics, optics and nano technology Their material costs are very small compared to bulk material. Titanium dioxide has gained extensive interest because of its important role in various applications, namely photo-induced water splitting [1], dye-sensitized solar cell [2] and environmental purification [3]. Also, TiO2 is used as a white pigment, gas sensor, for corrosive-protective and optical coating. Recently, excellent review of the TiO2 was reported by Diebold [4]. Various methods are available for the synthesis of the TiO2

Materials and methods:

In the present study theTiO_2thin films were deposited on a glass substrate at various molarities 0.05 and 0.1 by spray pyrolysis method. The structural and morphological properties were studied with **XRD** and **SEM** analysis and the results are presented in the following section. Using the SEM images, the dimension of the assembly of nanostructures in the thin films has

been estimated. The effects of substrates, substrate temperature and surface morphology have been discussed.



Photograph of Tio_2thin film at 0.1M and 0.2M

SEM

The surface morphology of TiO2thin films deposited at various moralities 0.05 and 0.1M is examined (10 μm) and the results are shown in fig 1&2 respectively.

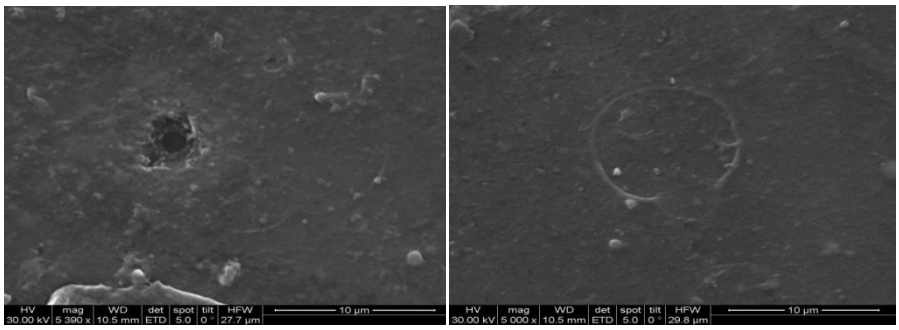


Fig.1SEM Micrography of TiO2 Film at 0.05M & 0.1M

The SEM analysis of two (0.1 and.0.05M) samples is carried out and the film morphology also compared between the samples. Finally, the SEM image shows that the continuous and smooth film is attained with increase of molarities of the solution.

The SEM image of the film 0.05M shows that the formed pattern is not much regular and clear**"River-pattern"** of nucleation crossed down in the film. The SEM image of the film 0.1M shows that the film surface is homogeneous. The overall film formation is smooth.Analyzing the two images, it is inferred that, with increasing of molarities, the film formation is much continuous and smooth.

OPTICAL TRANSMITTANCE SPECTRA

Fig2 gives the optical transmittance spectrum of TiO_2 thin film which is deposited at 0.05molarity. In this spectrum, the minimum transmittance of 3% has occurred at

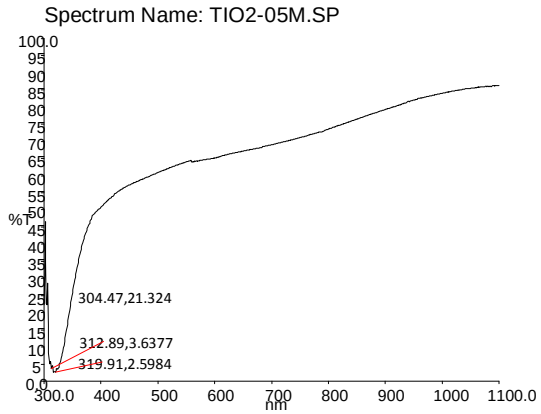


Fig 2 Optical Transmittance Spectra of TiO_2at 0.05M

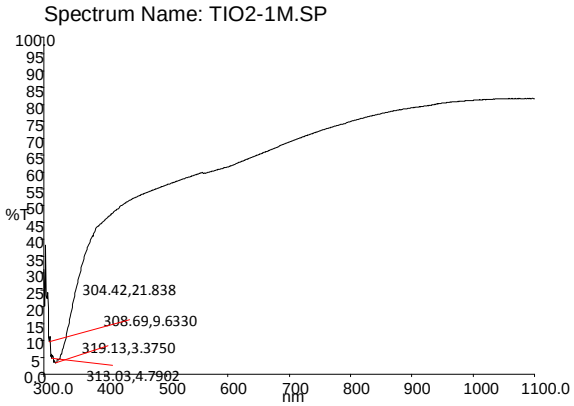


Fig 3 Optical Transmittance Spectra of TiO_2at 0.1M

i) 319.12nm in the UV region, the maximum transmittance of 22% has occurred at 304.47nm in the UV region.

Angle 2-Theta °	d value Angstrom	Intensity Angstrom	Intensity % Count %

ii) Fig3 gives the optical transmittance spectrum of TiO_2 thin film which is deposited at 0.1 Molarity. In this spectrum, the minimum transmittance of 4% occurred at 319.13nm in the UV region, the maximum transmittance of 21% occurred at 304.42nm in the UV region.

From the spectra it is seen that there is decrease in transmittance as the molarities increases. t can be observed that in general, the decrease in transmission rate is due to decreasing grain size as the molarity increases. Thus, it is understood that the increase in the molarity resulted with decrease in transmittance.

X-RAY DIFFRACTION ANALYSIS

The fig (4)shows XRD spectra for the two samples deposited at various molarity 0.05and 0.1M respectively.

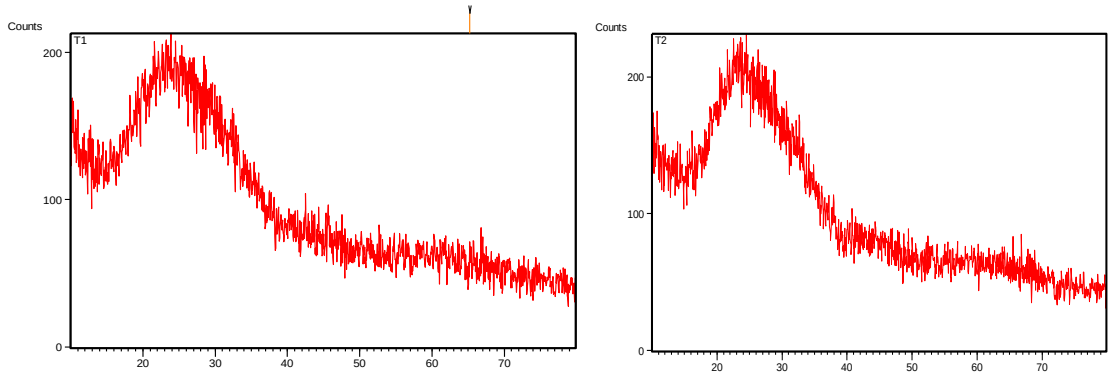


Fig 4. XRD spectrum of TiO_2 Thin film (0.05M) and(0.1M)

Table No. 1XRD Analysis of TiO_2Thin film (0.05M)

26.790	3.32513	398	95.3
34.224	2.61793	418	100.0
37.820	2.37686	228	54.7
52.088	1.75443	305	73.0

Table: 2 XRD Analysis of TiO_2Thinfilm (0.1M)

Angle 2-Theta °	**d value Angstrom**	**Intensity Angstrom**	**Intensity % Count %**
26.790	3.32513	398	95.3
34.228	2.62534	414	100.0
37.820	2.37686	228	54.7

52.084	1.75443	301	72.0

X-RAY DIFFRACTION SPECTRA

TWO samples are taken for analysis by the method of X-Ray diffraction.The first and foremost observation from the XRD pattern is the crystal formation of thin film structure. As we obtain prominent peaks in every spectrum, it is understood that the film formation is achieved.Fig () and table (1), represents XRD spectrum and the crystallography data in the TiO2 thin film deposited for 0.05M solution. At 0.05M grain size value is 72.81168nm.

Fig) and table (2) represents XRD spectrum and the crystallography data of TiO_2 thin film deposited at 0.1M and grain size value is 80.235nm.

Comparing the grain size at two different molarities concerned, we observed that, as molarities increases the grain size increases. This may be due to the nucleation and cleavage properties of these samples at different molarity states.

CONCLUSION

In the present work TiO_2 thin films were deposited employing the simple and economic experimental set up known as spray pyrolysis method. The TiO_2film was prepared at different molarities, 0.05 and 0.1M in a same temperature. TiO_2 thin films thus deposited on a glass substrate was observed to be good in appearance and hence the analysis with the XRD spectra is found that if the deposition molarity increases there is a gradual uniformity attained. In X-ray diffraction spectra, it is learnt that at both molarities thin film formation is achieved. From the calculation as molarity increases the grain size increases. The SEM analysis for the two samples was carried out and the thin film morphology is compared between the samples. Analyzing the SEM image it is found that it is much continuous and smooth film is attained with the increase of

molarity of the solutions. The EDAX analysis is in good agreement with the TiO_2 molecule analysis reported earlier.

TGA and DSC will be much useful tool in the surface characterization and the analysis of the elements present in the film, which could be suggested for future studies.

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