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Preparation And Characterization Of Tio2 -Pvabased Nanocomposite Using Solar Cell Application

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ABSTRACT:

A thin flim of poly vinyl alcohol (PVA) and nanocomposite of PVA/TIO2 have been prepared by solvent casting method ,to be used as UV for various application an as anti-reflection coatings in solar cell. This method precursors ,a membrane was formed with the solvent evaporation technique (solution casting method) .There are several methods for the preparation of polymer blends, but among them solution blending is very simple and rapid method. PVA is a semicrystalline and water soluble polymer with non toxic,better than forming excellent chemical resistance ,biocompatible and good mechanical properties . TIO2 nanoparticles confirms crystaline nature of polymer nanocomposite films. Melting point temperature of TIO2/PVA nanocomposites was incresed in compare to PVA .The prepared sample were investigated by XRD ,FTIR, SEM, UV techniques. The structaral properties were evaluated using X-ray diffraction .The specific functional groups responsible for the reduction of TIO2 nanoparticles were anaylsed using FTIR . The UV has been used to find the wavelength of TIO2 nanoparticles. The SEM with the energy dispersive X-ray studies provided the size of TIO2 nanoparticles.

KEYWORDS :

Poly vinyl alcohol (PVA) , TIO2 Nanoparticle ,Solution casting method.

INTRODUCTION :

Solar cells are widely regarded as one of the most promising candidate technologies for low-cost photovoltaic power production and have demonstrated solar –to electric conversion . The increase in worldwide energy demand is principally driving by the increase of population , the industrialisation and the globallization . Beside the other renewable energies sources: biomass,wind, hydroelecticity, the solar energy source has many advantages: is ready available ,secure from geopolitical tension, available everywhere, even on isolated sites and less polluting . Solar cells are still most popular , due to the low cost they have been challenged by new promising materials such as polymers ,copolymers and new generation organic and hybrid photovoltaic devices . Transparent oxide thin films are widely used materials in new generation solar cells . Another intensively studied oxide is TIO2 , which is the most promising candidate for relatively low cost , simple manufacture and high –performance solar cells . Here the TIO2 film dosen't act as electrode but it contributes as active layer in a process similar to the photosynthesis.Different methods could be employed for TIO2 thin film deposition such as : sol-gel,supptering ,thermal oxidation or spray. Poly vinyl alcohol (PVA) has been used in recent years as a simple polymer ,with specific properties including high stability , biodegradable, environmentally stable ,electric ,and optical properties . The key feature of PVA semi crystalline nature is the presence of both amorphous and crystalline regions that cause interfacial crystal –amorphous effects to increase physical characteristics. These amorphous crystal regions are quite well separated by an intermediate order that induces several crystalline and amorphous PVA \TIO2 macromolecule phases. PVA\TIO2 composite materials have drawn greater interest in solar cell system applications .An organic solar cell of architecture was used to investigate the effect of incorporating self developed TIO2\PVA . Nanocomposite films on its efficiency.

MATERIALS AND METHODOLOGY:

MATERIALS:

Titanium dioxide (TIO2) high quality specialist manufacture . TIO2 was purchased from Madurai scientific shop. All the chemicals were of analytical grade and they were used without further purification . Deionized water was used throughout the experiment . Titanium dioxide (TIO2) nanoparticles was prepared by using ball milling method with the help of our college PG and research center of physics. Poly vinyl alcohol (PVA) was purchased from Madurai scientific shop. All the solution were prepared by using double distilled water .

PREPARATION OF TIO2 NANOPARTICLE:

The appropriate amount of TIO2 nanoparticle was prepared by 0.5m of salt was dissolved in 100ml of distilled water in a beaker . Which was stirred at 220rpm\sec for 1hr without heating .The solution was mixed with 50ml catharanthus roseus leaf extract as precipitating agent.The Erlenmeyer flask containing two components was stirred at 220rpm\sec for about 2hrs without heating .Then the formed TIO2 solution were allowed to stay within a refrigerator overnight at the end, the formed TIO2 nanoparticles were collected using a crucible ceramic dish and placed into a drying oven overnight . The precipitate obtained was stored in beaker for further characterization.

PREPARATION OF PURE PVA:

Poly vinyl alcohol (PVA) aqueous solution was prepared by mixing of 1gm PVA was dissolved in 10ml of deionized water in a beaker . which was stirred at 110rpm\sec for about 2hrs without heating using magnetic stirrer.

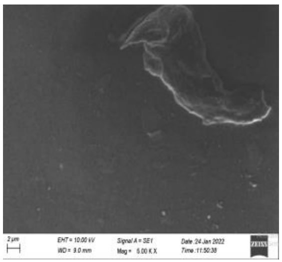
TIO2-PVA COMPOSITE :

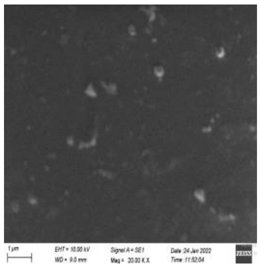
Followed by, 0.5mol of TIO2 nanoparticle was added into the PVA aqueous solution. The components were stirred continuously at 120 rpm/ sec for about 2 hrs without heating (ratio : 9:1). The above procedure was repeated to get another ratios. Finally, the resulting mixtures were casting into dry clean glass Petri dish at 60℃ and were kept at room temperature until dried. The polymer film was formed by solution casting method.

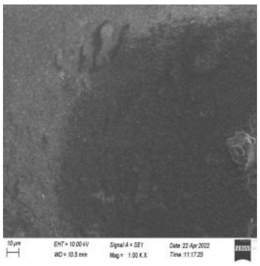
RESULT AND DISCUSSION :

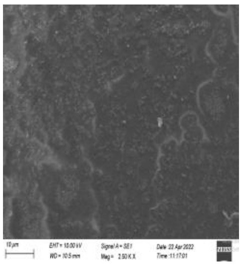
SCANNING ELECTRON MICROSCOPY: (SEM)

Scanning electron microscopy techniques, provides information on the size, shape ,location of the individual nanocomposite . Scanning electron microscope analysis was employed to study the morphology of the nanocomposite . the SEM image are shown in the fig6.1 &6.2 . It can be seen from the fig shows that PVA were exclusively spherical shape .



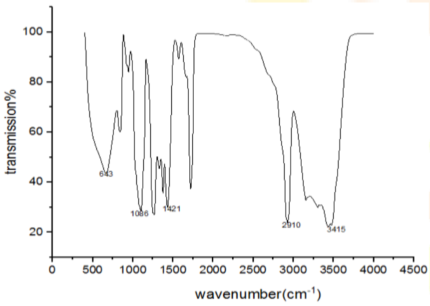


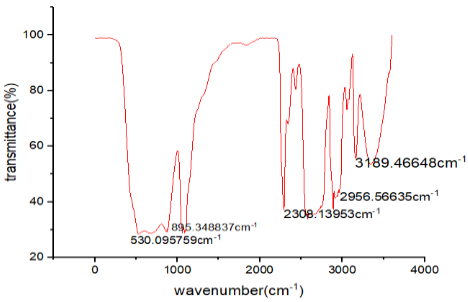




FOURIER TRANSFORM INFRA RED SPECTROSCOPY (FTIR)

FTIR Spectra for Tio2: PVA nanoparticles : the absorption peak at 3415cm^{-1}Indicates the presence of (O-H) stretching of alcohol and also the peak at 2910 cm^{-1} indicates the presence of (C-H) stretching. The band around 1421cm^{-1} represent (C-H) stretching of alkenes and 1086cm^{-1}Represent (C-H) bonding (C-H) bonding of amine .The band around 643cm^{-1} is a strong bond.





The FTIR spectroscopy is used to study the change in chemical composition impurity content, and interaction between different species. FTIR spectrum is used to calculate various functional groups which are present in PVA which were synthesized by solution casting method. The wave number 2308 of(C=C)variable the wave number 2956 (C-H) Bend in Alkenes and also 3189 (O-H) stretch in strong and broad .The wave number 895 (C-H) Bend in strong, and also wave number 530(C=Br) stretch in strong.

ULTRA VISIBLE SPECTROSCOPY :

TIO_2:PVA(C_2H_4O(X))nanocomposite have been extensively investigated because of its high chemical sustainability, optic properties and adaption to the environment. In this present work, we plan to prepare and UV visible spectroscopic study of Tio_2: PVA(C_2H_4O(X)):TIO_2 Nanocomposite solution casting method. UV vis spectroscopic technique is a sensitive to the electromagnetic fields or the particle surfaces, thus providing important challenged to study UV spectroscopic technique .

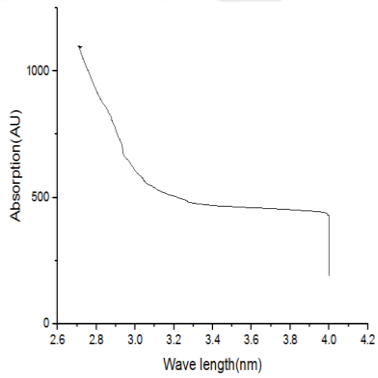
The sample absorption peaks in UV region 200 to 400nm

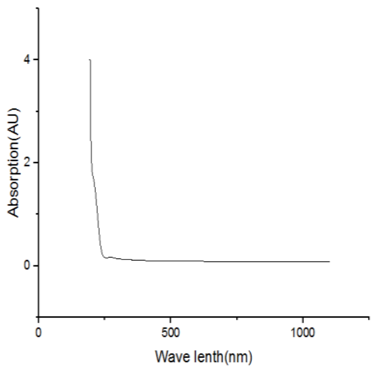
$$E = hc/\lambda_{max}$$

λ_{max} – Maximum absorbance wavelength

h- Planks constant (6.6×10^{-34}Js)

c - Speed of light (3×10^{8} m\s^{2})





X-RAY DIFFRACTION (XRD):

Using X-ray diffraction phase analysis was studied .The average crystalline size of the nanocomposite were calculated based on Debye's equation .

$$D = k\lambda/\beta \cos\theta$$

Where

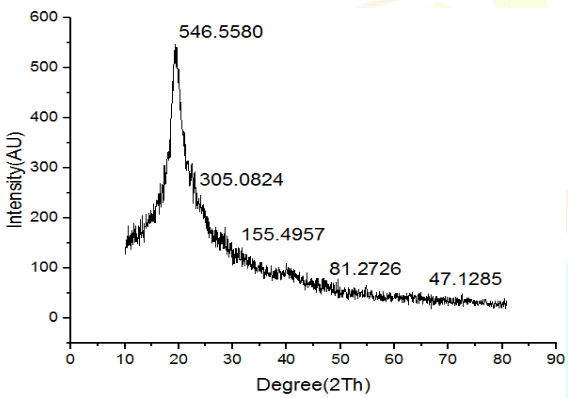
D – Mean crystalline size

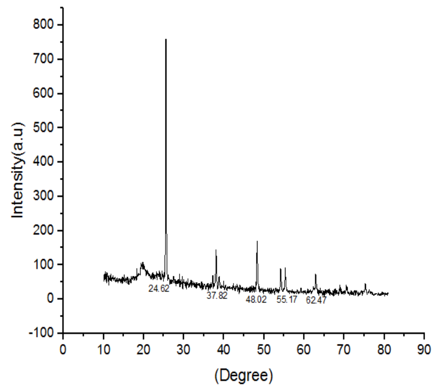
K – Shape factors

λ - Wavelength of the incident beam

θ – Bragg's angle

The C2H4O(X) sample shows 2 major peaks 19.3315,40.3315 respectively ,the below table shows the interplanar distance and FWHM of corresponding values of C2H4O(X) .The average crystalline size is about 29.8315. The TIO2 –PVA nanocomposite sample shows 5 major peaks 19.6535,25.5433,37.2111,38.0460,38.8225respectively.The below table shows the interplanar distance and FWHM of corresponding value of TIO2 –C2H4O(X) nanocomposites.





CONCLUSION:

PVA based nanocomposite polymer prepared by solution casting method .The membranes properties were analyzed by various characterization techniques. The complication and functional group were examined by FTIR spectroscopy. The structural analysis by XRD revealed the amorphous domains of the polymer. The light absorption coefficient of the sample are obtained from UV-visible spectroscopy. Polymer offered tunable properties , improved process ability. SEM reveals the enhancement in amorphous region. We believe that titanium dioxide will play more and more important roles in solar cells and other fields ,such as energy storage, optoelectronics ,electrics and sensing ,in the near future.

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