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Dye Doped Nanoparticles for Solar Cell Applications

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Abstract—*Titanium dioxide and Cadmium sulphide nanoparticles were synthesised by sol-gel method by using glacial acetic acid and sodium sulphide as capping agents. The nanocomposite formed from these two was characterised with X-Ray diffraction, Nonlinear optical properties, SEM and FTIR.Each study confirmed the presence of its constituents. A dye Rhodamine-B was doped into this nanocomposite such that material will be applied in dye doped solar cell fabrication. Cadmium sulphide was blended with titanium oxide using PMMA to increase its optical strength and absorption properties, which are required features of a solar cell.Nanoparticle solar cell is a promising material in future due to its low cost and high efficiency. These materials can be also used from satellite to cell phone applications.*

Key words*: Dye, TiO2, Cadmium Sulfide, Solar cell*

1. INTRODUCTION

Titanium dioxide as such does not exist in nature . It is derived from ilmenite and leuxocene ores. In recent years nanoparticles which are strongly size dependent focused attention on the preparation of semiconductors. TiO2 is a promising material as semiconductor having photochemical stability and low cost.TiO2 nanoparticle are synthesised to increase its application[1]. Cadmium Sulfide which has a very good refractive index is chosen for its application in solar cell.This is also used as nanosized particle.

2. SYNTHESIS

In this paper we have synthesised optically suitable material for solar cell application. A nanocomposite of TiO2 and Cadmium Sulfide is synthesised and is coated with a dye Rhodamine B in order to improve solar cell efficiency. As Rhodamine-B has very high range of absorption this dye is chosen.

2.1 Synthesis of TiO_2/CdS nanocomposite

TiO2 nanoparticle were synthesised from titanium butoxide, glacial acetic acid and distilled water using sol-gel method. After titanium butoxide , acetic acid was added and is maintained at 40^0C for 6 Hrs. Gel was filtered and dried in oven for 12 hrs at 80^0C.

Cadmium sulphide nanoparticles[2] were synthesised by using cadmium nitrate and sodium sulphide .This mixture was kept in oven at 70^0C for about 8 hrs.

These synthesised nanoparticles using sol-gel[3] method taken as per their molar composition, were mixed together, along with Rhodamine B dye it is heated for 8 hrs and maintained from 100^0C to 120^0C . Then finally dried to obtain powdered nanocomposites.

Thin film was prepared from the nanocomposte by using PMMA . Characterisation of TiO_2[4], CdS nanoparticles was done by XRD and Scanning electron microscope.The Rhodamine B dye doped nanocomposte with PMMA and TiO2/CdS nanocoposites were characterised by FTIR, XRD, SEM and nonlinearity. The characterisation data infers the presence of all the functional groups in it.

3. RESULTS AND DISCUSSIONS

XRD [5] of TiO2 ,CdS nanoparticles and TiO2/CdS nanocomposite Fig.1,2,3 infers that their inter-lattice spacing is $3.7A^0$, $3.703A^0$ and $3.44A^0$ respectively.The lattice spacing decreased for nanocomposte when compared to individual nanoparticle , which confirms that the size is reduced to nano.XRD of nanocomposite with Dye using PMMA shows that there is a slight change in 2theta angle.This concludes the nanoparticles have mixed well indicating a change when moved from nanocomposite.SEM analysis of nanoparticles

Fig.4,5 shows that the size of these particle varies from micron range to nanometre range.Fig.6 shows the SEM analysis of Nanocomposite doped with dye using PMMA . This figure indicates a good dispersion of sample.

FTIR analysis of nanocomposite indicates the presence of CdS/TiO2 stretching. FTIR of dye doped nanocomposite shows the presence of OH group,aromatic unsaturated double bond with carbonyl group,C-O stretching and metal coordinate with PMMA.

Nonlinearity of dye doped nanocomposite thin film was performed by Z scan experiment [6] , which concluded that it has a negative nonlinear refractive index. Such materials can act as optical limiter [7] and can be used in solar cell.

4. FIGURE AND TABLE CAPTIONS

Fig. 1 XRD of TiO_2 nanoparticles
Fig. 2 XRD of CdS Nanoparticles
Fig. 3 XRD of TiO2/CdS nanocomposite
Figure .4 SEM of TiO2 nanoparticle
Fig. 5 SEM of CdS nanoparticle
Fig. 6 SEM of TiO2/CdS nanocomposite with Dye

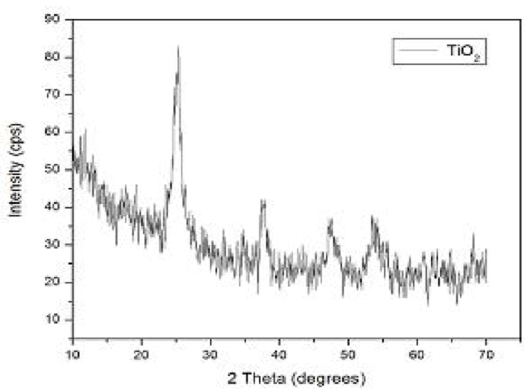

Fig. 1

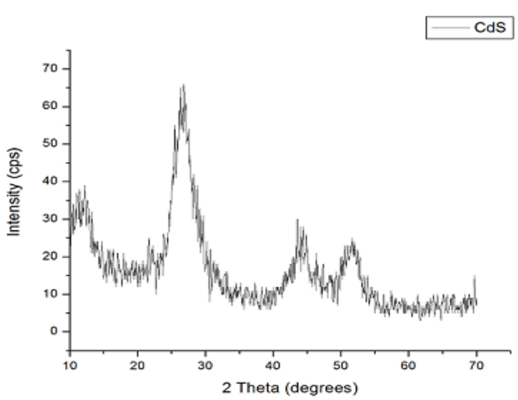

Fig. 2

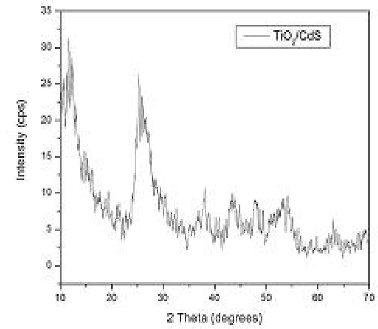

Fig. 3

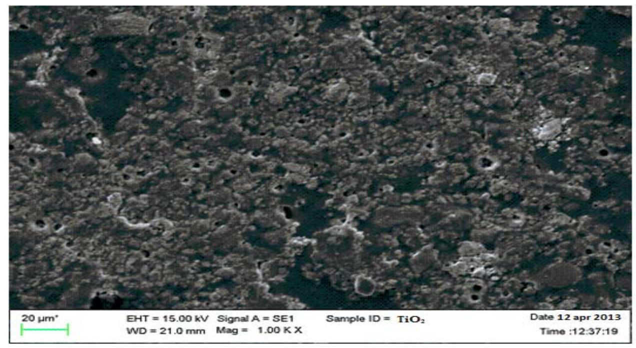

Fig. 4

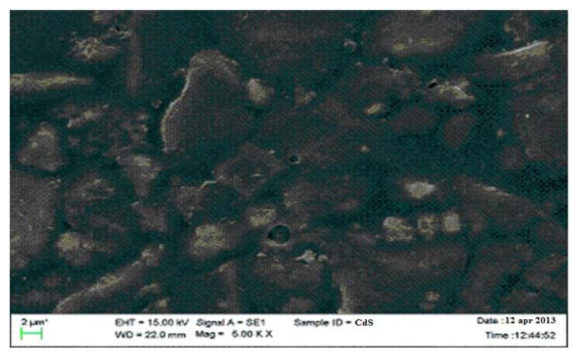

Fig. 5

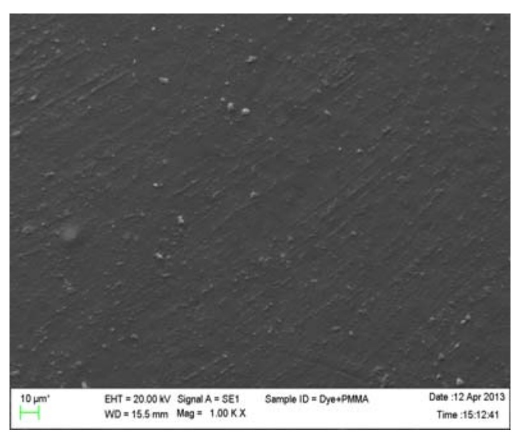

Fig. 6

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