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# Characterization of Polyanilin and Cadmium Sulphide Nano-Composites with Inorganic Compound as Dopant by Different Way of Synthesis

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***Abstract*****—** *The polymer nano composites (PNCs) are those materials in which the nano-sized inorganic or organic materials or particles such as CuO, $CeO_2$, $TiO_2$, ZnO nano particles, CNTs (carbon nanotubes), and graphene oxide and their derivatives etc. are dispersed in an organic polymer matrix. Due to the dispersion of the nano-sized inorganic or organic materials in the organic polymer matrix, the characteristics of the polymer matrix are enhanced dramatically. In fact, the PNCs have represented a new option which can replace the customarily filled polymers. Because of their dimensions at nano-scales, the filler dispersion nano composites demonstrate significant enhanced properties, if these are compared to the pure polymers or their conventional composites. When conducting polymers are taken in the composite from their properties are altered from those of basic materials. The dispersant /matrix interactions and physical properties of the matrix influence the agglomeration of the dispersant phase which affects the properties of the composites. Polymer nano-composites are polymer matrix composites in which the filler is less than 100 nm at least in one dimension. These composites exhibit extraordinary interesting properties. This work emphasized on polymerization of conducting polymer in presence of oxidant using inorganic compound as dopant. The synthesized polymer was characterized using different techniques. These synthesized polymers were studied for their UV-vis spectra and their electrical conductivities has been carried out by four-probe technique. It is observed that results are in comparable with the available results. The results reveals that these materials are ideally suited for the manufacture of optoelectronic devices in the visible wavelength and could also be used to photovoltaic applications such as solar cell fabrication and gas sensors etc.*

***Keywords*****—** *Polymer Nano-composites, UV-vis Spectra, Electrical, Conductivity, Optoelectronic devices, Gas sensors etc.*

## I. INTRODUCTION

The mixing of filler and functional polymers (polar polymers) interacting at atomic level constitute the bases for preparing an important class of inorganic–organic nanostructure materials i.e., polymer nano-composites with a good mechanical strength. Due to the wide applications of optical materials in glass lens, camera lens, optical waveguides, optical reflectors, etc., polymer nano-composites with high-refractive index have been widely studied. The advantages of organic materials are their transparency, light weight, ease of process, cost-efficiency and good mechanical properties but they normally show low refractive index. The conductivity of the conducting polymer as stated earlier can be tuned by electrical manipulation of the polymer backbone by the nature of dopant, by the degree of doping, by blending with other polymers by making composites with inorganic materials. When conducting polymers are taken in the composite form their properties are altered from those of basic materials. The dispersant /matrix interactions and physical properties of the matrix influence the agglomeration of the dispersant phase which affects the properties of the composites. Transparent conducting polymer/ nano tube composites are under development as solar cell electrode nano-particles filled amorphous polymers are being used as scratch resistance, transparent coating in cell phone and compact disc technology. A large number of investigation has been carried out on conducting polymers due to their properties and synthesis. The material used in this work is polyaniline due to its high performance electrical property and low resistivity. The ability of polyaniline in various forms via acid and base treatment and oxidation, reduction has made polyaniline the most tenable member of conducting polymer. The combination of the unique properties of conducting organic polymers makes the material as multi function system with many applications as super capacitor, sensors, photovoltaic cell, photo diodes, solar cell, electromagnetic absorber etc. Thus in this piece of paper, we have selected polyaniline as the efficient material for the industrial need due to their electrical conductivity and molecular behaviour.

## II. MATERIALS AND METHODS

We have used Research grade chemicals obtained from E-Merck Chemical Company. For the commercial production of nano powders, following methods are used for preparation of conducting polymers

1. Polymerization by Electrochemical method
2. Polymerization by oxidation method

We have prepared the samples of poly aniline by both process. For the Synthesis of CdS nano-particles chemical precipitation method is used and DMF is used as capping agent. CdS is one of the compounds which have wide ranging applications in solar cells, infrared window materials, photo-diode and cathode ray tube, electroluminescent devices and multilayer dielectric filters. Thus a sample of Polyaniline and CdS is prepared and used as nano composite in this piece of paper.

Polyaniline is synthesised by chemical oxidation method. In which 100 ml solution of aniline is added in 1 M sulphuric acid and the 0.5M solution of ammonium per sulphate was added drop wise with constant stirring at room temperature at



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normal condition. The resulting solution is filtered, washed with distilled water and sulphuric acid until the filtrate become colourless and finally the removes the impurities. The solution is chemically polymerised and dried in vacuum. Finally grinded and the product is obtain in the form of greenish black salt. The electro Chemical polymerization of polyaniline is carried out in the presence of sulphuric acid in the polymerization vessel at different voltages. We have also prepared the aniline solution by chemical oxidation method for characterization and conductivity measurement.

## III. Characterization

The synthesized powder form material by different techniques is characterized using UV-Vis spectroscopy technique available in our lab which is primarily concerned with structure and stability of the material and the spectrum is shown as figure 1(a) and 1(b) respectively where as electrical resistance measurement is done by four-probe method. It is observed that the electrical resistance (R) is related with the electrical conductivity (C) equal to

$$\frac{1}{\left(\frac{\pi}{ln2}\right).R.D}$$

Where {K.R} is sheet resistance, D is the thickness of pellet and K is a constant [7].

## IV. Results and Discussion

*UV-Vis Spectroscopy:*

The UV-Vis Spectra of synthesised nano composites by different techniques has been given at figure 1 (a) and 1(b). A view of these spectra insists that the absorbance has been observed for the excitation wavelength in the visible region 300nm and 510nm approx. It is also observed that the nano composites have been excited at various wavelengths corresponding to individual wavelength of maximum absorption. Certain peaks in fig (a) spectrum confirms that composites also shows two absorption band one in UV region and other is in visible region. With slight variation in the wavelength of maximum absorption as compared to other spectra by other method. In case of increase in dopant shifting of wavelength towards shorter wavelength is observed. Certain peaks in the spectra reveals that intensity increases due to regular arrangement of monomer in electrochemical polymerization. The enhanced absorption indicates the formation of more polarons and bipolarons. These characteristics are very much favouring the solar cell fabrication. It is also noticed that electrochemical polymerization method is most suited one for selecting the material for photovoltaic applications.

*Electrical Conductivity:*

The electrical conductivity of the synthesized material is measured by four-probe technique at different voltages at room temperature and the conductivity is also computed by different other methods using established relation. It is observed that the electrical conductivity of the synthesized material through electro chemical polymerisation is higher than the materials synthesized by oxidation methods. A view of conductivity values ranging between 0.35 to 1.67 S/Cm at different voltages. It is also noted that the conductivity of the material increases as the voltage of pellets increases. The conductivity of nano composites also varies on mixing of inorganic dopant.

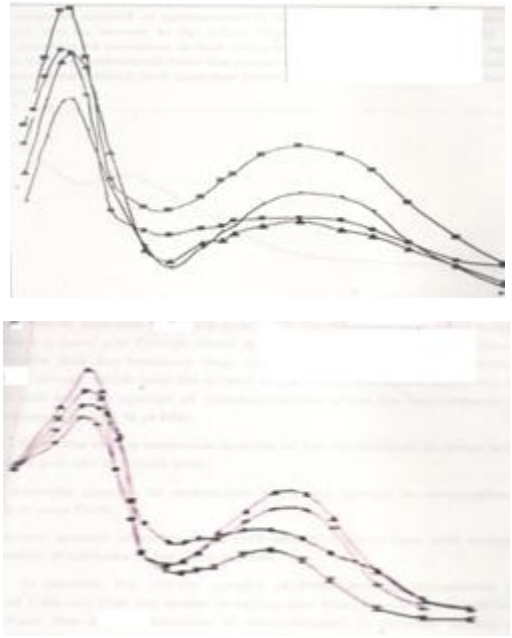

Fig. 1. (a),(b)

## V. Applications

The increase in absorption intensity indicating the interaction of nano-composite chain hence these materials are useful in fabrication of optoelectronic devices. The conducting polymers has the photo voltage applications. Due to high performance of electrical properties the polyaniline synthesized through electro polymerisation has a vast applications in the rechargeable battery, Solar cell techniques and can also be used for materials of LED's as well as transparent coating in cell phones.

## VI. Conclusions

The analysis of UV-Vis Spectra confirms the chemical structure of composite of polyaniline and CdS. It is also observed that there is a change is the corresponding frequencies of polymer but no major change was observed between the composites with the increase of nano fillers. It is also concluded that absorption band occurs in UV region and visible region both. A critical review of these spectra reveals that the spectra broadens around 525-625 nm is due to excitation band and charge transfer associated with the excitation from benzenoid to quinoid structure. A view of these spectra reveals that blue shift in abjection maxima and increase band gap of the synthesized CdS confirms the formation of Nano-sized inorganic semiconductors. It is also noticed that the conductivity measurement of the synthesised nano composites through electro-chemical polymerization is higher than the conductivity of sample by oxidation process and it is noticed that the conductivity increases by increasing



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voltage. Thus these materials are most useful for optoelectronic devices, solar cell fabrication and photo voltaic applications etc.

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