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Research Article

ABSORPTION SPECTRA OF SEMICONDUCTING NANOPARTICLES WITH CONDUCTING POLYMER

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A R T I C L E I N F O

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A B S T R A C T

The absorption spectra are produced when ions or molecules absorb electromagnetic radiation in ultra violet or visible region when as organic molecules absorb energies available in UV region. The absorption spectra of molecules are very useful in understanding the oxidation states, analysing and characterizing the conducting polymers. We have studied UV-Visible spectrum of molecules which provides information about structure and stability of materials This work tends to study the conducting polymers in which Poly-aniline (PANI) is a most tenable member which can be used in sensors and electro chromic devices. We have also considered II-VI semiconductor nanomaterials as they possess large variation of band gap as function of particle size which is a consequence of quantum confinement and vast applications in solar cells, fluorescent materials and photonic research. Various kinds of electronic excitations may occur in organic molecules by absorbing the energies available in UV-Vis region. UV-Vis spectrum of PANI, CdS and ZnSnanoparticles and their composites with different weight % have been recorded along with the energy band gap particle size of semiconducting nanoparticles. It is generally noticed that nano particles made of semiconducting elements change their optical properties comparative to their bulk materials and a significant shift in optical absorption spectra towards blue region is noticed. The absorption band observed in the UV-Vis spectra of samples is recorded with corresponding optical band energies. The energy band gap and particle size of CdS and ZnS along with their nano composites are calculated from UV- Vis spectra and recorded simultaneously. On the basis of recorded data it is observed that, there are two absorption maxima, one in the UV region and other in the visible region for PANI as well as their semiconducting nanocomposites. Thus using measured data, fluorescence spectra of PANI, PANI-CdS and PANIZnS have been drawn between wavelength and intensity. The band gap of the synthesized CdS and ZnS confirms the formation of nanosized inorganic semiconductors. The calculated values of particle size and band gap energy of materials reveal the variation of opto-electronic properties. It is also observed that PANI and its CdS and ZnS composites are similar in nature and increase in absorption intensity indicating the interaction of CdS and ZnS with conducting polymer. This work will be fruitful in studying the optoelectronic devices.

INTRODUCTION

The general class of Nano composites organic/inorganic matters is a fast growing area of research. Nano composite materials lead to new and improved properties when compared to their Nano-composite counterparts. Therefore Nano composites promise new applications in many fields such as mechanically reinforced light weight components, non-linear optics, battery cathodes, nano wires, sensors and other systems. In the last years, new fillers have emerged, providing an opportunity for the development of high performance multifunctional Nano composites.

The conductivity of the conducting polymer can be tuned by electrical manipulation of the polymer backbone by the nature of dopant, by the degree of doping, and by making composites with inorganic materials. When conducting polymers are taken in the composite form, their properties are altered from those of basic materials. It has been shown that the conductivity of these heterogeneous systems depends on number of factors such as the concentration of the conducting fillers, their shape, orientation and interaction between filler molecules. The geometrical shape of the dispersant governs the ability of conductive network formation which results in large increase in conductivity. The physical properties of the matrix of concern elements influence the agglomeration of the dispersant phase which affects the properties of composites.

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The size of silicon nanoparticles decreases, the band gap changes and the colour of the particle changes. Another example is single wall carbon nanotubes can exhibit stiffness, strength and strain that statistically exceed that of traditional micrometer diameter carbon fibre. These features of nanoparticles provide an opportunity for creating polymer composites with unique properties.

The semiconductor nanoparticles provides an opportunity to understand the physical properties in low dimensions and to explore their vast potential for various applications. The unique feature of semiconductors is based on the large variation of the band gap as the function of particle size, which is a consequence of quantum confinement. Nanostructured materials especially II-VI semiconductors has been a subject of intensive research for their extra ordinary properties compared to their bulk counterpart. Blue shift of the optical absorption spectrum, size dependent luminescence enhances extra strength. Particularly, semiconducting materials in the nanostructured form offers the possibility of possessing large optical non linear susceptibility and the ultra fast response. They are very attractive for the realization of the thermally stable and frequency selective lasers and photo detectors, whose performance is found to be modulated drastically by the shape and size of the nano-crystals.

We have considered II-VI semi-conductor materials ZnS and CdSto form nano composites with conducting polymer at different weight percentageand reported in this piece of paper. These materials have been attracted considerable interest in recent years due to their vast applications in various fields including solar cells, fluorescent materials, optoelectronic devices, spintronics, photonic research etc. Therefore it is thought worthwhile to synthesize CdS and ZnS Nanoparticles and make their composites with conductingpolyaniline.

Cadmium Sulphide (CdS)

Cadmium sulphide is an important semiconductor of class II-VI group owing to its unique electronics, optical properties and its potential applications in solar energy conversion, non-linear optical, photo-electrochemical cells and heterogeneous photo-catalysis, occurs in nature as the mineral. The physical properties are yellow to orange crystal. Cadmium sulphide is the direct band gap semiconductor having band gap energy 2.82 eV. CdS occurs as two polymorphs, hexagonal alpha form and cubic beta form. CdS compounds are widely used in pigments in making enamels in ceramic plastics. Other applications of these compounds are in photovoltaic solar cells, photoconductors, thin film transistors and diodes, rectifiers, scintillation counters, pyro-techniques and smoke detectors.

Zinc Sulphide (ZnS)

Zinc sulphide (ZnS) is also one of the II-VI group semiconductor compounds which have wide ranging applications in solar cells, infrared window materials, photo-diode and photo cathode ray tube, electroluminescent devices and multiplayer dielectric filters. ZnS occurs in two crystalline forms, one is the hexagonal system and the other in cubic system. The minerals in hexagonal systems are called Wurtzites where as the cubic system as zinc blended. ZnS has unique physical properties such as high refractive index, low optical absorption in the visible and infrared range and wide optical gap. Such film is widely used in many optical and electronic areas. ZnS can be used in fabrication of optoelectronic devices such as blue light emitting diodes, electroluminescent devices, electro optic modulator, optical coating, heterojunction solar cells and photoconductor etc.

Polyaniline (PANI) – Polyaniline is synthesized by chemical oxidation method. The reaction is exothermic, therefore this reaction was not carried out at room temperature. During the polymerisation the colouration of reaction indicates that the product is in conducting phase. The product washed out and finally a greenish black salt of polyaniline is obtained which is used as conducting material.

Experimental Techniques

UV-Vis spectrum of PANI, PANI-CdS and PANI-ZnSnanoparticles and their nano-composites with different weight percentage are recorded on double beam spectrophotometer in the wide range of wavelength to measure band gap and particle size of materials. The absorption band observed in the UV-Vis spectra of samples are recorded and corresponding optical band energies are also noticed .On the basis of recorded data certain plots between wavelength and absorbance have been plotted in figure 1,2,3,4 & 5.

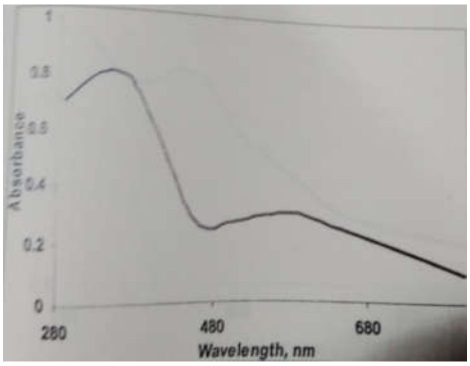

Fig 1 UV-Vis spectra of PANI

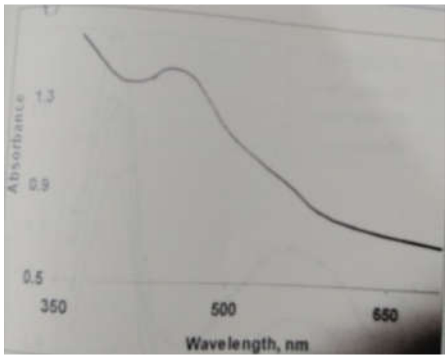

Fig 2 UV-Vis spectra of CdS

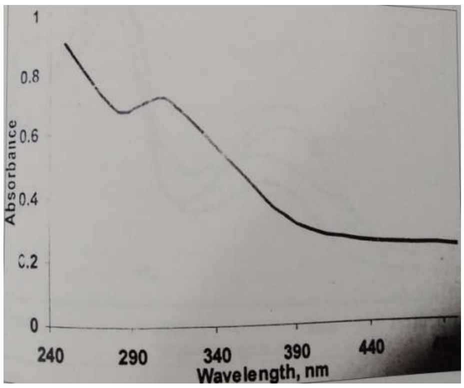

Fig 3 UV-Vis spectra of ZnS

The absorption band observed in the UV-Vis spectra of samples is recorded with corresponding optical band energies. The energy band gap and particle size of CdS and ZnS along with their nano composites are calculated from UV- Vis spectra and recorded simultaneously.

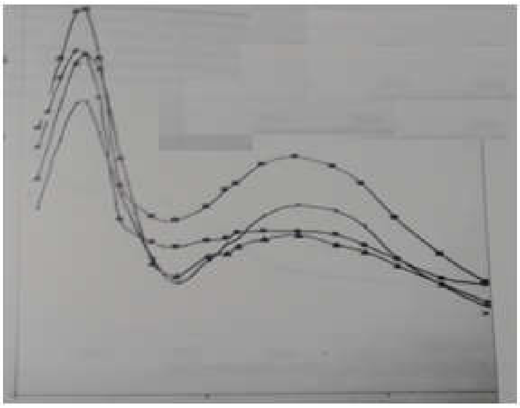

Fig 4 UV-Vis spectra of PANI- CdS

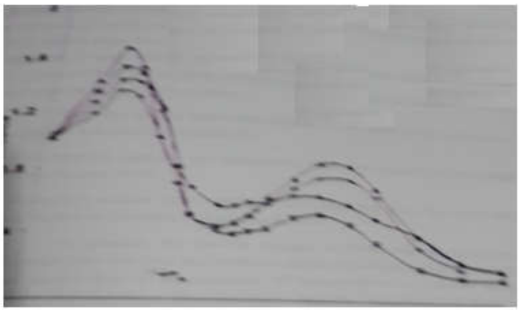

Fig 5 UV Vis spectra of PANI-ZnS nanocomposites

RESULTS AND DISCUSSIONS

On the basis of observations, it is noticed that, there are two absorption maxima, one in the UV region and the other in the visible region. The fine structured absorption in the range 200-300 nm corresponding to absorption peaks and broadens around 480-600nm.The observed peaks thus confirm that prepared PANI is in conducting form doped with SO_4. It is also reported that polymer samples shows the various bands in different positions depending on the nature of the solvents The band gap was calculated to be 2.61eV for CdS which is larger than corresponding bulk material which is reported to be 2.40 eV. It is observed that the maximum in absorption spectra attributable to excitation was observed at 400 nm indicating the blue shift in absorption maxima at 490nm.It is also observed that composites also shows two absorption bands, one in UV and other in visible region similar to pure PANI with slight variation in the wavelength of maximum absorption but a large variation is observed in the intensity of absorption. It is seen that composite containing 10% CdS shows the enhanced absorption as compared to other composites.

Similarly absorption spectra of synthesized ZnS show the maximum absorption band at 300 nmwhis shows the blue shift in absorption maxima as compare to bulk material.

The particle size of ZnS was found to 3.81 nm calculated from the absorption band. In case of PANI-ZnSnanocomposites, two absoption bands at 300 and around 550 nm are observed and coincide with those of pure PANI as shown in adjacent figures. The particle size of CdS nanoparticles was found to be 3.8 nm and that of ZnS was found to be 3.92nm. Conclusively, the blue shift in the absorption maxima and increased band gap of the synthesized ZnS and CdS confirms the formation of nanosized inorganic semiconductors CdS and ZnS. These are inconsistent with TEM images observed in other works,

CONCLUSION

It is noticed that from the adjacent figures that the blue shift in absorption maxima and increased band gap of the synthesized CdS and ZnS confirms the formation of nanosized inorganic semiconductors. The calculated values of particle size and band gap energy of materials reveal the variation of opto-electronic properties. Thus, this property can be employed in optoelectronic devices. The intensity spectra also revealed that absorption increase in composites. The blue shift indicates that the particle size of semiconductor is in nano-size. This work leads to develop the basis of photochromic sensors and solar cell applications.

References

1. Kyazym-zade,G., Mekhtieva, R. N., Akhmedov, A. A. (1992). Photoluminescence spectroscopy of CdS and Ga Se, Jorn. Phys. Semiconductors, 25, 840.
2. Kuhn, A., Chevy, A., Chevalier, R., (1997). Crystal Structure and meter atomic distances in GaSe, Phys. Stat Sol, 31, 469-475.
3. Rossotti, R., Nakahara, S., Brus, L.E., (1983). Quantum size effect in redox potential, resonance Raman spectra, *Jour. Chem. Phys*., 79, 1086.
4. Schroeder, H. K., (2001). Semiconductor Material and Devices Characterization.
5. Tiwari,K. P., Sarkar, K. K., (2006) Quantum Computation of temperature variation of refractive indices for binary ionic crystals and covalent semiconductors. Proc. of NCNMT, Tirupati.
6. Tiwari, K. P., Sarkar, K. K., (2007). Correlation between electronic dielectric and refracting properties of binary solids, *Ind. Journ. Pure and appl. Physics*, 73, 169.
7. Tiwari, K. P., (2017) Dielectric properties of mixed and complex compound, *J. Applicable Chem*, 6(1), 154-159.
8. Tiwari, K.P., (2019) Optoelectronic Properties of ZnS and CdS Nano-Composites and their Applications, *Jour. of Applicable Chem*., 8 (3): 1501-1504.
9. Van-Vachten, J. A., (1969). Quantum Dielectric Theory of Electro-negativity in Covalent Systems, II. Ionization Potentials and Interband Transition Energies, Phys. Rev, 187, 1007.

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