SYNTHESIS, CHARACTERIZATION AND SPECTROSCOPIC STUDIES OF ZNS-POLYANILINE NANOCOMPOSITE

K P TIWARI
Department of Physics
Agra College, Agra- 282002
(Affl. to: Dr.B.R.Ambedkar University, Agra- 282002, India)
E-mail: drkptiwari@rediffmail.com

Abstract:

Nano-composites are the materials having unique properties which can be used for wider applications. We have prepared a nano-composite of II-IV semiconducting nano-material and a conducting polymer by precipitation method at room temperature. The synthesized nano-composites with different weight percentage (5%, 10%) of semiconducting nano-particles. These materials have characterized by FTIR and UV-Vis spectroscopy. The parameters of these composites are compared with certain values available with other studies. It is concluded that the measured values are in better agreement with the available experimental values. On the basis of observations, we can conclude that nano-composites can be more useful with designed optical band gap energy which can be obtained by controlling size and shape of the semiconducting materials. Certain technological applications in nano-electronic devices, gas sensors, solar cells etc. have been suggested.

Keywords:

Multifunctional nano-composites, Semiconducting crystal, Polymer, FTIR, UV-Vis spectroscopy, Activation energy, Gas sensors, Solar cell etc.

Introduction:

Conducting polymers are taken in the composite form and their properties are altered from those of basic materials. It has been shown that the conductivity of these heterogeneous systems depends upon number of factors such as the concentrations of the conducting fillers, their shape, orientation and interaction between filler molecules and the host matrix. Polymer Nano-composites are polymer matrix composites in which the filler is less than 100 nm in at least in one dimension [1]. These composites exhibit extraordinary interesting properties. A defining feature of polymer Nano-composites is that the small size of the filler leads to a dramatic increase in the interfacial area creates a significant volume fraction of interfacial polymer with properties different from the bulk polymer even at low loadings. The nano-composites promise new applications in many fields such as mechanically reinforced light weight components, non-linear optics, battery cathodes and ionics, nano wires, sensors and other systems. New fillers have emerged, providing an opportunity for the development of high performance multifunctional nano-composites. Nano-particles are being considered for enhancing matrix properties of traditional composites to increase out of plane properties and add conductivity and sensing capabilities [2].

Experimental Techniques

Synthesis of ZnS nano-particles is one of the II-VI semiconductor compounds which have wide ranging applications in solar cells, infrared window materials, photo-diode and cathode ray tube, electroluminescent devices and multiplayer dielectric filters. ZnS occurs in two crystalline forms, one in the hexagonal system and the other in cubic system. Zinc sulphide (ZnS) has unique physical properties, such as high refractive index, low optical absorption in the visible and infrared light range and wide optical gap, such film is widely used in many optical and electronic areas. In the area of optics, Zns can be used as reflectors and dielectric filters because of its high refractive index and high transmittance in visible range. ZnS can be used for fabrication of optoelectronic devices such as blue emitting diodes, electroluminescent devices, electro optic modulator, optical coating, hetero junction solar cells etc.

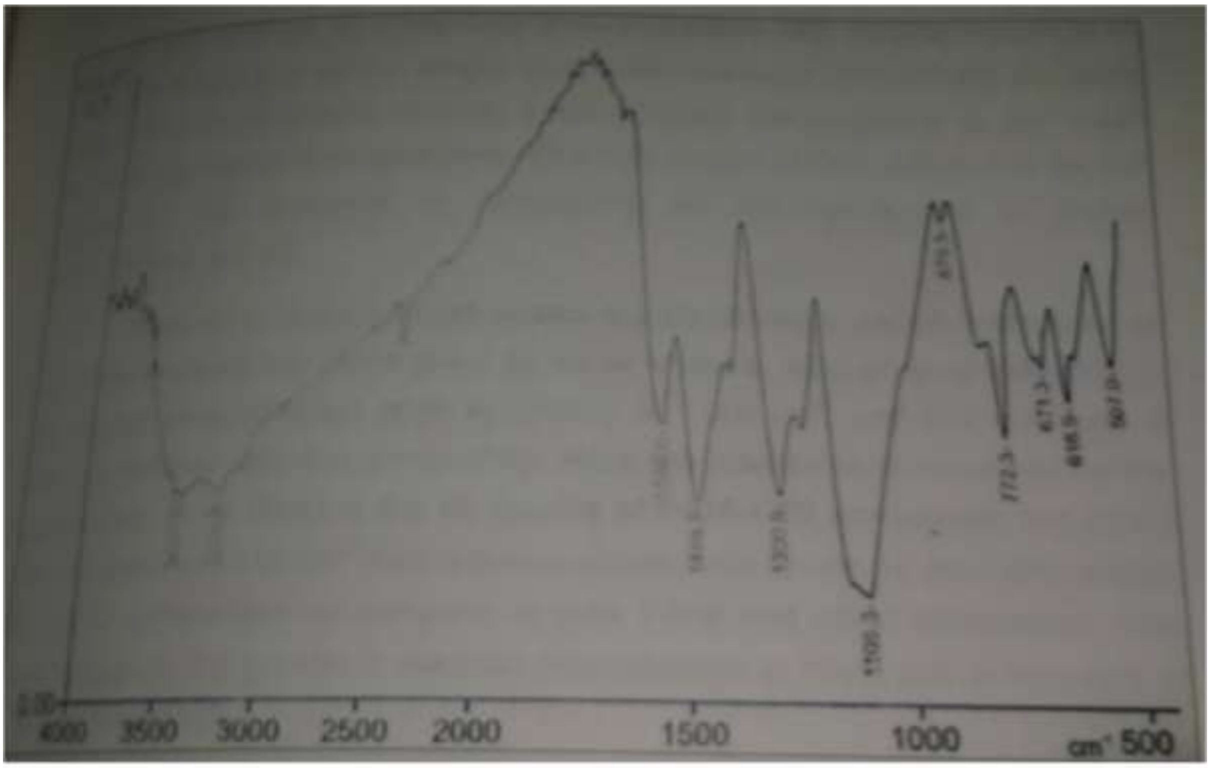
0.1M Zinc salt solution was made by dissolving Zinc Acetate in double distilled water and 0.1 M Na_2S solution was also made in double distilled water. From these stock solutions, 100ml of solution of Zinc acetate solution was mixed with 100 ml of DMF and stirred for 10 minutes. Then to above mixture 100 ml Na_2S solution was added drop wise with constant stirring. The stirring was continued for 1 hour.The solution was kept over night. The same procedure was repeated for the washing of resultant solution. Dry white powder of ZnS was obtained by this process which was used to synthesis PANI-ZnS nano composites. Nanoparticles of ZnS have been synthesized successfully by chemical precipitation method. Polyaniline and its nano-composites with ZnS under investigation have been synthesized by chemical oxidation polymerization method. Thus, we successfully synthesized the nanomaterials by simple precipitation method and conducting polymer and composites by chemical oxidation polymerization at room temperature

Characterization:

The synthesized PANI-ZnS is characterized by using UV-Vis and FTIR spectroscopy.

UV-Vis spectroscopy:

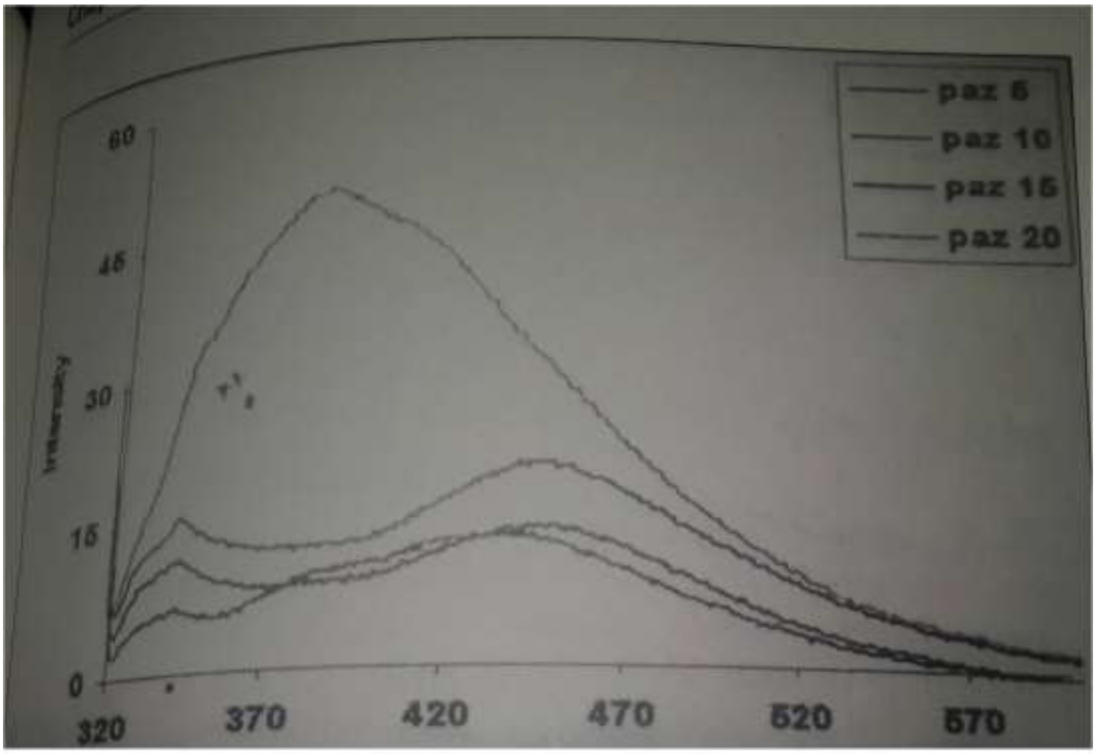
By comparing the UV-Vis spectra of PANI and PANI ZnS, it is observed that there is a shift in the absorption maxima. The shift in the absorption bands is due to addition of ZnS which changes the delocalisation in the polymer chain. This has been verified by the conductivity measurement which shows the highest value of composites. By increasing the weight percentage of ZnS nanofiller the peak centred of PANI becomes substantially broadened and shifts towards higher wavelength side since the absorption of colloidal ZnS overlap with that of PANI.



FTIR Spectra of PANI ZnS Nano-composites

FTIR spectroscopy The IR-spectra of PANI shows the characteristic vibration bands. All these bands are well matches with the earlier reported values of polyanniline.By comparing the IR spectra of pure PANI – ZnS, it is observed that composites of PANI-ZnS are built up of repeating units as that of pure PANI indicating the formation of conducting polymer nano composites. IR study also reveals that peak intensities and conductivity variation in the polymer sample are in tight interaction with each other.

formation of nanosized inorganic semiconductor of ZnS..Such materials can be used in optoelectronic devices. The conductivity increases only for the composites containing 5% and 10% ZnS. For higher concentrations the conductivity decreases.



Fluorescent spectra of PANI-ZnS

UV-Vis spectra of PANI and composites shows two bands, one in UV and other in visible region. The enhanced intensity of these bands indicates the formation of large number of charge carriers, indicating the increase in electrical conductivity. Change in band intensities and shifting in band positions for different % of filler indicates strong interfacial interaction between PANI and ZnS nanoparticles.

From the above findings we conclude that the new polymer nanocomposites can be synthesized with desired thermal stability, optical band gap energy and tunable electrical conductivity.

Results and Discussion:

. It is observed that PANI –ZnS enhanced poloronic and bipoloronic bands are observed for the 5%, and10% composites . The hypsochromic shift was seen with the increase in ZnS content. The blue shift in absorption maxima and increased band gap of the synthesized ZnS confirms the shifting of band position.

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