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FTIR-Reflectance Study of PEDOT: PSS/Ge Nano-Composite Thin Films

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Abstract

PEDOT:PSS films coated on quartz glass by spin coating technique. Thin films of germanium (Ge) of thickness 50 nm, 75 nm and 100 nm were deposited on PEDOT: PSS by electron beam gun evaporation system. The prepared composite thin films were implanted with 200 keV Ar^{++} ions with various fluences varying from 1 x 10^{13} to 1 x 10^{15} ions cm^{-2} and characterized by using Fourier Transform Infrared Spectroscopy. FTIR reflectance spectra of Ge / PEDOT: PSS composite films showed a strong peak at 1110 cm^{-1} for as deposited sample. After implantation of the samples a shift of 6.0 cm^{-1} was observed toward the higher wave number and additional peak with lesser intensity appeared at 1254 cm^{-1} .The results of FTIR reflectance studies indicated the increase in carrier mobility and better conduction in ion-implanted samples as compared to non implanted samples.

Keywords*: - Polymer-PEDOT: PSS, germanium (Ge), Ar^{++} ion, implantation, FTIR spectroscopy*

INTRODUCTION

The literature survey was done on previous works as follows; polymer films are examined in several solvents of varying volatility over a broad range of polymer solution concentrations and spin speeds. Synthesis of nanoparticles on the surface and embedded in the matrix by thermal annealing (leading to diffusion of nanoparticles into polymer matrix) and ion beam irradiation is a promising method as reported in the literature [1, 2].The

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formation of spherical and uniform Pt nanoparticles on SiO_2 surface have been reported as a result of 800 keV Kr ions irradiation of thin Pt film [3]. As compared to the thermal annealing for nanoparticles formation, ion beam irradiation provides a unique tool for the synthesis and engineering of nanostructures by depositing highly localized energy both in space (nanometers) and time (picoseconds) [4,5].

However, a very limited data is available for the modification of optical properties by ion beam irradiation. The optical energy band gap and crystalline size of polymer nano composite can be controlled by ion beam treatment by controlling beam parameters (current, energy, fluences etc.). The main objective of this work was to study the optical properties of Cadmium Sulphide nano crystalline films on poly (3,4ethylenedioxythiophene): polystyrene sulfonate (PEDOT:PSS) irradiated by Ar ions at various fluences.

EXPERIMENTAL DETAILS

The samples for the present work were prepared on quartz glass substrates of dimensions: 15 mm x 15 mm x 1mm. Slides were first cleaned in de-ionized (DI) water and acetone to remove the impurities from the surface of the slides. A programmable spin coater (Model No. Spin NXG-P1, Apex Equipment, Kolkata, India) was used to prepare the PEDOT: PSS films on quartz glass substrates. The Electron Beam Gun Evaporation system (HINDHIVAC VACUUM COATING UNIT MODEL "12A4D" and an Electron Beam Power Supply Model "EGC-3kW" has been used in the present work to deposit a thin films of germanium (Ge) of different thickness 50 nm, 75 nm and 100 nm on the spin coated surface of PEDOT: PSS. The thickness of the germanium (Ge) film was measured by quartz digital thickness monitor. The samples prepared by electron beam gun system were implanted with 200 keV Ar^{++} ions using Electron Cyclotron Resonance Ion Sources (ECRIS) at T.I.F.R., Mumbai, India. Their characterizations are done by using Fourier Transform Infrared Spectroscopy (FTIR).

RESULTS AND DISCUSSION

FTIR reflection spectra were recorded on JASCO FT/IR 610 spectrophotometer in the Spectral region of 6000 to 400 cm^{-1}. All the measurements were taken at a scan rate of 16 cm^{-1} /sec. at room temperature. FTIR reflectance spectra of PEDOT: PSS film of 100 nm thickness and PEDOT: PSS/Ge composite films of germanium thickness 50 nm, 75 nm and 100 nm on PEDOT: PSS layer are shown in Figure 1

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(a), (b), (c), (d) respectively. It is observed from FTIR reflectance spectra that the PEDOT:PSS peak at 1123 cm^{-1} in Figure 1 (a) is shifted to ~ 1097 cm^{-1} in Figure 1 (b), (c) and (d) .This is due to the deposition of germanium and its subsequent bonding with PEDOT:PSS. FTIR reflectance spectra of samples implanted with 200 keV Ar^{++} ions at fluences 1 x 10^{13}, 1 x 10^{14} and 1 x 10^{15} ions cm^{-2} are shown in Figure 2 (a), (b), and (c) respectively. It is observed that the peak at 1097 cm^{-1} is shifted towards higher wave number after implantation in the samples. This shift is 14 cm^{-1} for the ion implantation fluence of 1 x 10^{13} ions cm^{-2} and 20 cm^{-1} for the ion implantation fluences of 1 x 10^{14} and 1 x 10^{15} ions cm^{-2}. The shifting of peak towards higher wave numbers is due to ion beam mixing of germanium into PEDOT: PSS.

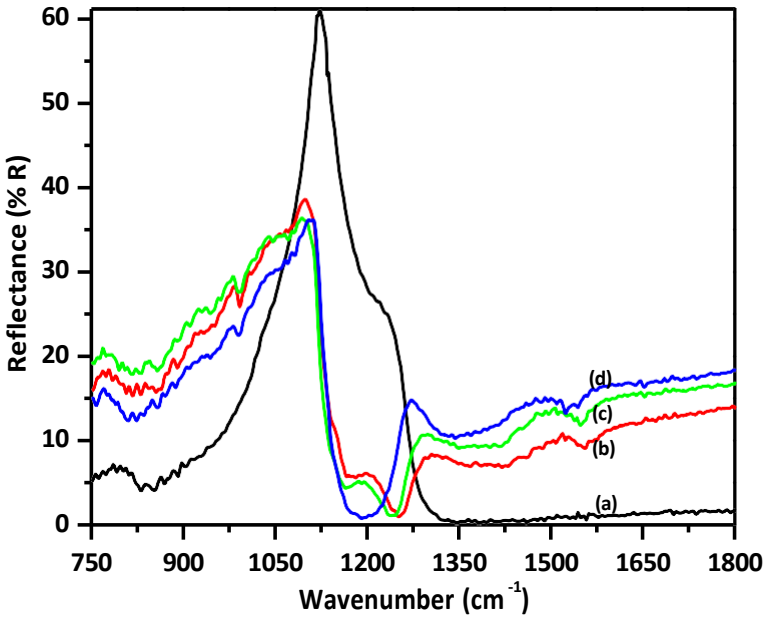


Figure 1 FTIR Reflectance (% R) spectra of (a) PEDOT: PSS and PEDOT: PSS/ Ge composites films of thickness (b) 50 nm (c) 75 nm and (d) 100 nm.

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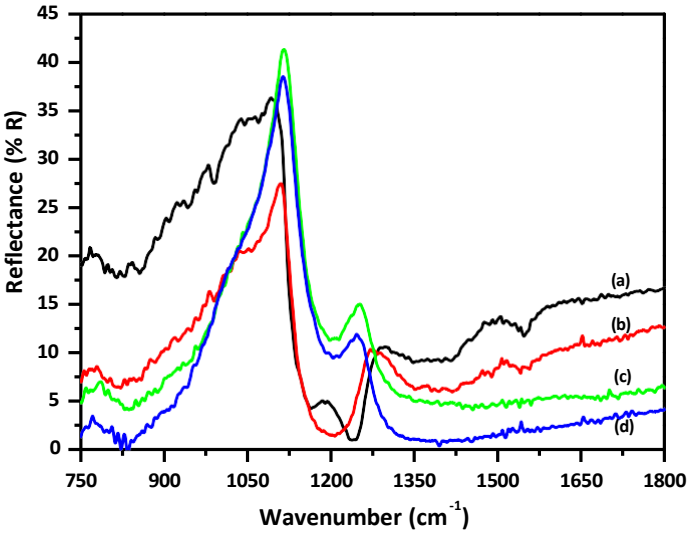


Figure 2 FTIR Reflectance (% R) spectra of Ge/PEDOT: PSS composites films (a) as prepared and implanted with 200 keV argon ions with fluence of (b) 1 x 10^{13} (c) 1 x 10^{14} and (d) 1 x 10^{15} ions cm^{-2}.

CONCLUSION

One strong peak at 1110 cm-1 was found in Ge / PEDOT: PSS composite films. After implantation of the samples a shift of 6.0 cm-1 was recorded toward the higher values of wave number and one more additional peak with lesser intensity reflected at 1254 cm-1. The increase in carrier mobility and better conduction in ion-implanted samples were observed in FTIR reflectance spectra**.**

REFERENCES

I. Martin N., Serruys Y., *Nucl. Inst. And meth*. B, 105,175, (1995).

II. Pasti Z., Peto G., Horvath Z.E., *et. al. Nucl. Inst. And meth.* B, 178,131, (2001).

III. Jai Prakash, Tripathi A., Rigato V., Pivin J. C.Tripathi1 Jala et al, *J.Physics D:Appl. Phys*.,44,125302 (2011)

IV. Hu X., Cahill D.G., Averback R.S., *J. Appl. Phys*. , 89,7777, (2001)

V. Jai Prakash, Tripathi A., Pivin J. C. Tripathi1 Jalaj et al, Adv. Mat. Lett. 2,71,(2011)

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