ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(7): 07-20
www.allresearchjournal.com
Received: 05-04-2015
Accepted: 04-05-2015

A Philomin Freeda
Assistant professor, Department of Physics, Dhanalakshmi Srinivasan Engineering College, Perambalur – 621 212, Tamilnadu.

S Rajivgandhi
Assistant professor, Department of Physics, Dhanalakshmi Srinivasan Engineering College, Perambalur – 621 212, Tamilnadu.

A Dinesh Kumar
Assistant professor, Department of Mathematics, Dhanalakshmi Srinivasan Engineering College, Perambalur – 621 212, Tamilnadu.

Correspondence:
A. Philomin freeda
M.Sc., M. Phil., Assistant professor, Department of Physics, Dhanalakshmi Srinivasan Engineering College, Perambalur – 621 212, Tamilnadu.

Preparation and study of polyethylene oxide and its derivative thin films

A Philomin Freeda, S Rajivgandhi, A Dinesh Kumar

Abstract
In recent years, studies on the electrical and optical properties of polymers have much attention in view of their application in electronic and optical devices. In this work polymer material Polyethylene oxide complexes with sodium bicarbonate have been taken, and the solution was prepared with the solvent (Methanol and Water) for different concentration. The film has been fabricated on glass substrates by solution route spin coating technique. The optical and the electrical behavior of the film have been studied and the optical constants were determined.

Keywords: Polyethylene Oxide, Thin film, Polymers, Spin Coting.

1. Introduction
Thin film science and technology plays an important role in the high-tech industries. Thin film technology has been developed primarily for the need of the integrated circuit industry. The demand for development of smaller and smaller devices with higher speed especially in new generation of integrated circuits requires advanced materials and new processing techniques suitable for future Giga Scale Integration (GSI) technology. Polymers are playing important role than silicon because they are cheaper and more biocompatible. Sabiha Sultana *et al.* [1] presented a paper on Preparation, morphology, and thermal and optical properties of thin films of ferric chloride/polyethylene oxide composites by solution cast technique. U. Sasikala *et al.* [2] presented a paper on structural, electrical and parametric studies of PEO based polymer electrolyte battery applications. Jibril Al-Hawarin *et al.* [3] presented a paper on Dielectric and thermal properties of PEO doped with Cadmium Chloride salt. They investigate the effect of salt concentration on the dielectric properties and melting behaviour of PEO/CdCl2 complexes. The dielectric study was carried out over a frequency range 10-335 kHz and a temperature range 25 °C-450 °C.
Presently, rapidly changing needs for thin film materials and devices are creating new opportunities for the development of new processes, materials and technologies. Therefore, basic research activities will be necessary in the future, to increase knowledge, understanding, and to develop predictive capabilities for relating fundamental physical and chemical properties to the microstructure and performance of thin films in various applications. In basic research, special model systems are needed for quantitative investigations of the relevant and fundamental processes in thin film materials science.

2.1 Material and Methods
We are interested in fabricating a film that is both optically transparent and electrically conducting. Here we take Polyethylene oxide as a base material and Water and also Methanol as a solvent. We take Sodium bicarbonate as a derivative material to prepare the derivative thin film of Polyethylene oxide.

2.1.1 Fabrication of Thin Film
The fabrication of thin film involves the following steps
- Solution preparation
- Substrate cleaning
- Spin coating technique

2.1.2 Solution preparation

The solution of Polyethylene oxide is prepared by using Water and Methanol as solvent at different concentrations. The different weight percentage solutions are prepared by dissolving a known quantity of polymer in Water and Methanol. The weight of the solute is measured by using the digital balance.

2.1.3 Cleaning of substrate

The substrate must be cleaned well before coating the prepared solution. The glass substrate is used for studying optical properties of thin film. The glass substrate was cleaned using the soap solution, and then rinsed with distilled water. Finally, the glass substrate is cleaned with acetone using filter paper.

2.1.4 Spin coating technique

The polymer solution is deposited onto the substrate surface. Then the substrate is rotated to a very high speed step to thin the polymer solution. Then the substrate is dried well, so that Methanol evaporates, leaving the polymer film over the surface of the substrate.

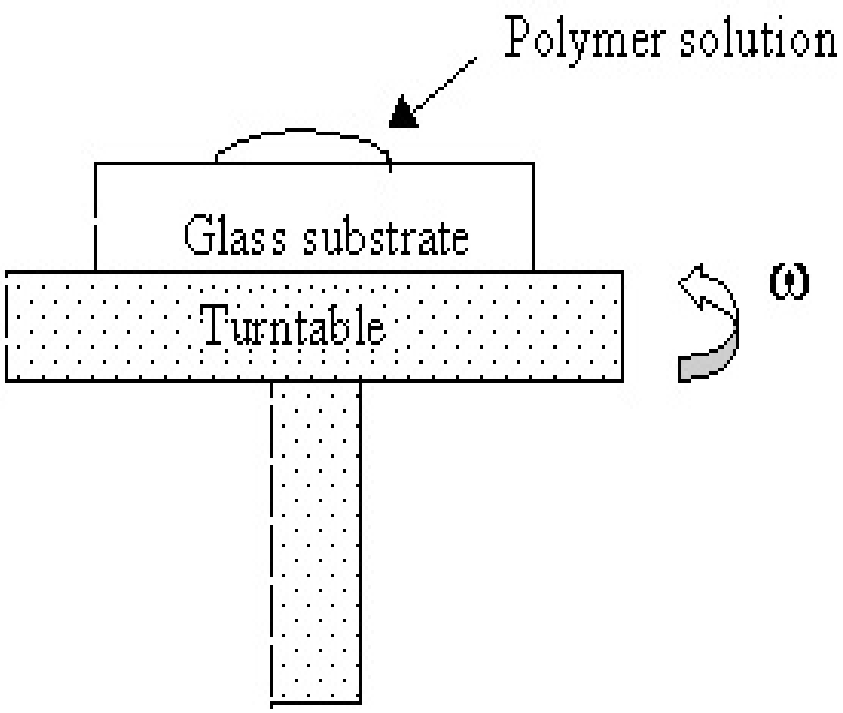

Fig 2.1: Schematic diagram of the Spin -Coating Process

3.1 Results and Discussion

3.1.1 Optical Behavior

The experimental and theoretical investigations on the optical characterization of thin films deal with reflection, transmission and absorption studies. These studies will give the optical parameters of the thin films.

3.1.1.1Transmittance of Thin Film

Figs (3.1A, 3.1B, 3.1C, 3.1D) explain the transmission spectrum of PEO and PEO complexes with Sodium Bicarbonate thin films for different solvents as s function of wavelength. From the tables (3.1A, 3.1B), it is clear that the transmittance of film increases rapidly in the range 300 – 600 nm and reaching the maximum value beyond 600nm. After the maximum value the transmission approximately remains constant at near infrared wavelength. The film exhibits transparency in visible and infrared region nearly 90% for PEO dissolved in Water, 75% for PEO dissolved in Methanol, 98% for PEO complexes with $NaHCO_3$ dissolved in Water and 95% for PEO complexes with $NaHCO_3$ dissolved in Methanol.

PEO in Water

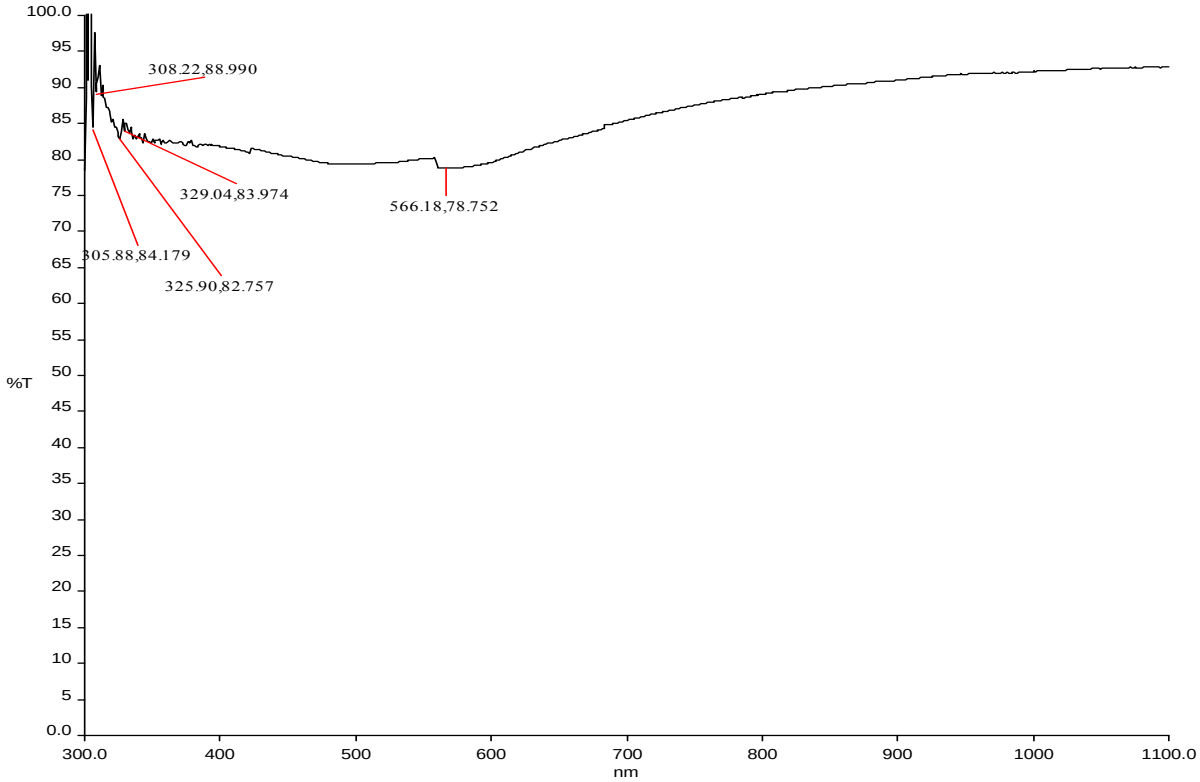

Fig 3.1A: Transmittance Spectrum from UV-Vis Spectrometer

PEO in Methanol

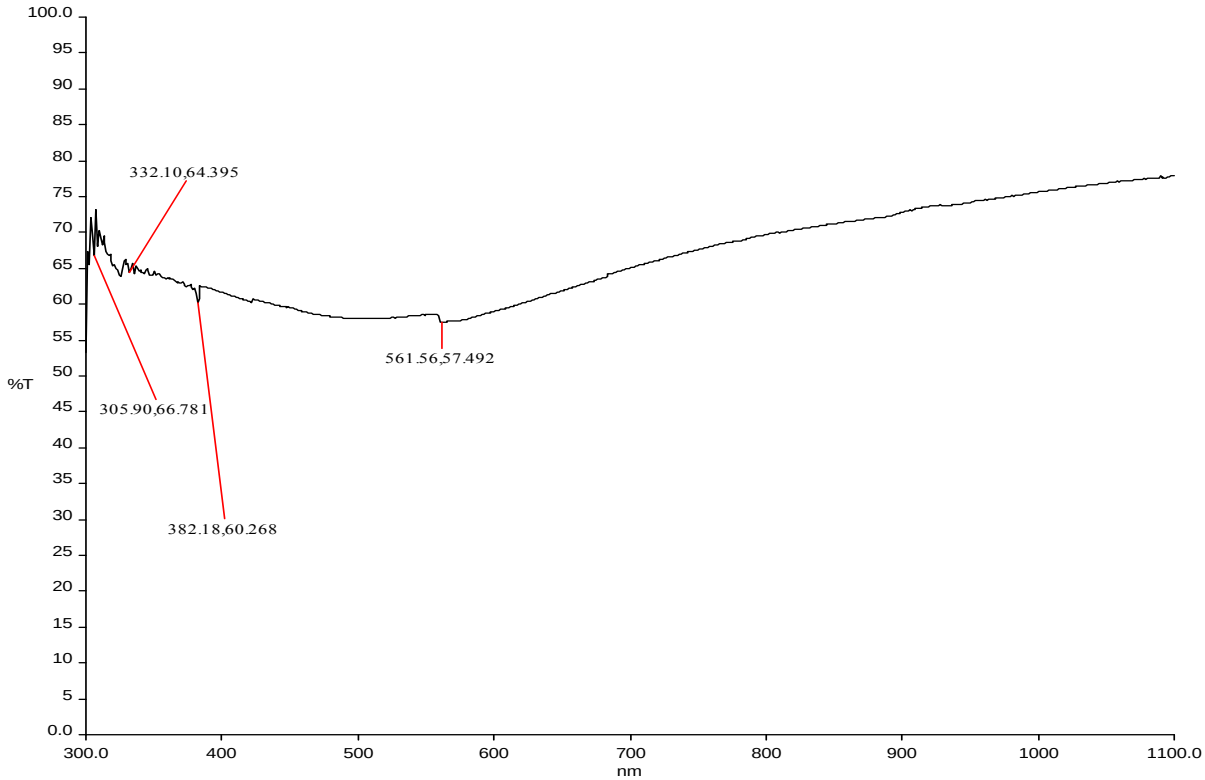

Fig 3.1B: Transmittance Spectrum from UV-Vis Spectrometer

PEO+ $NaHCO_3$ in Water

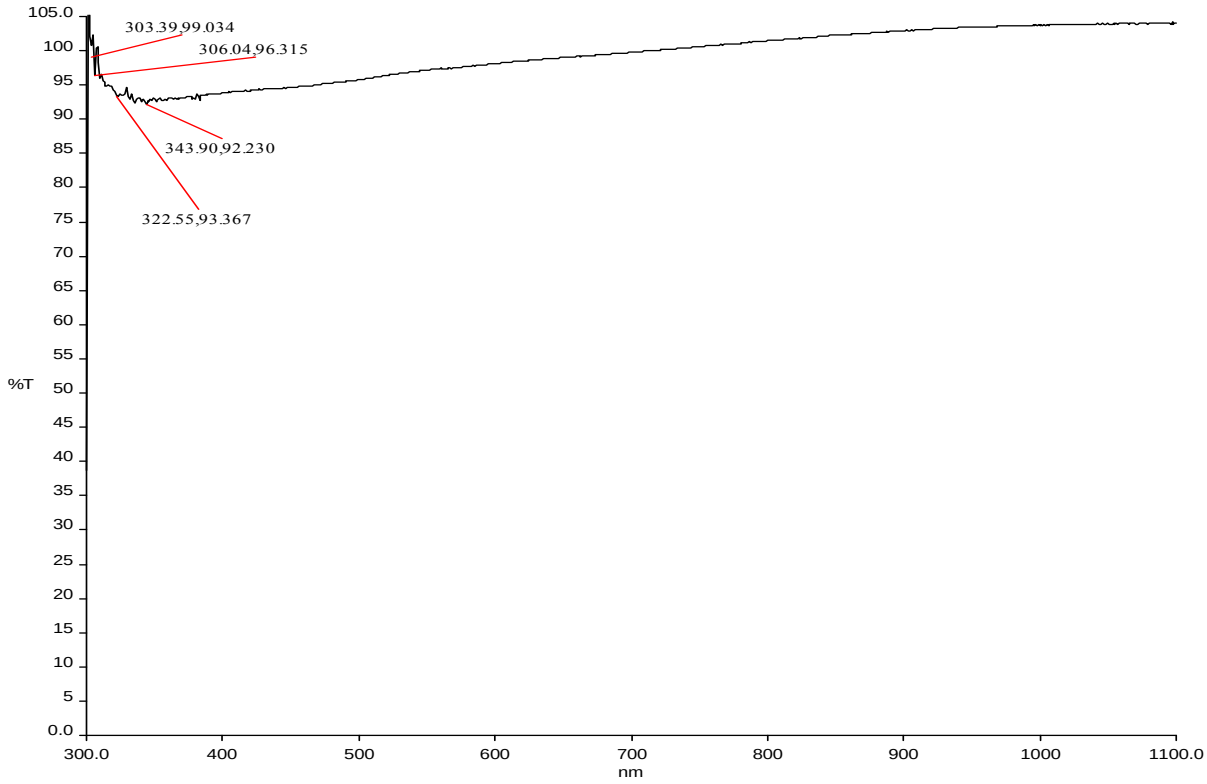

Fig 3.1C: Transmittance Spectrum from UV-Vis Spectrometer

PEO+ $NaHCO_3$ in Methanol

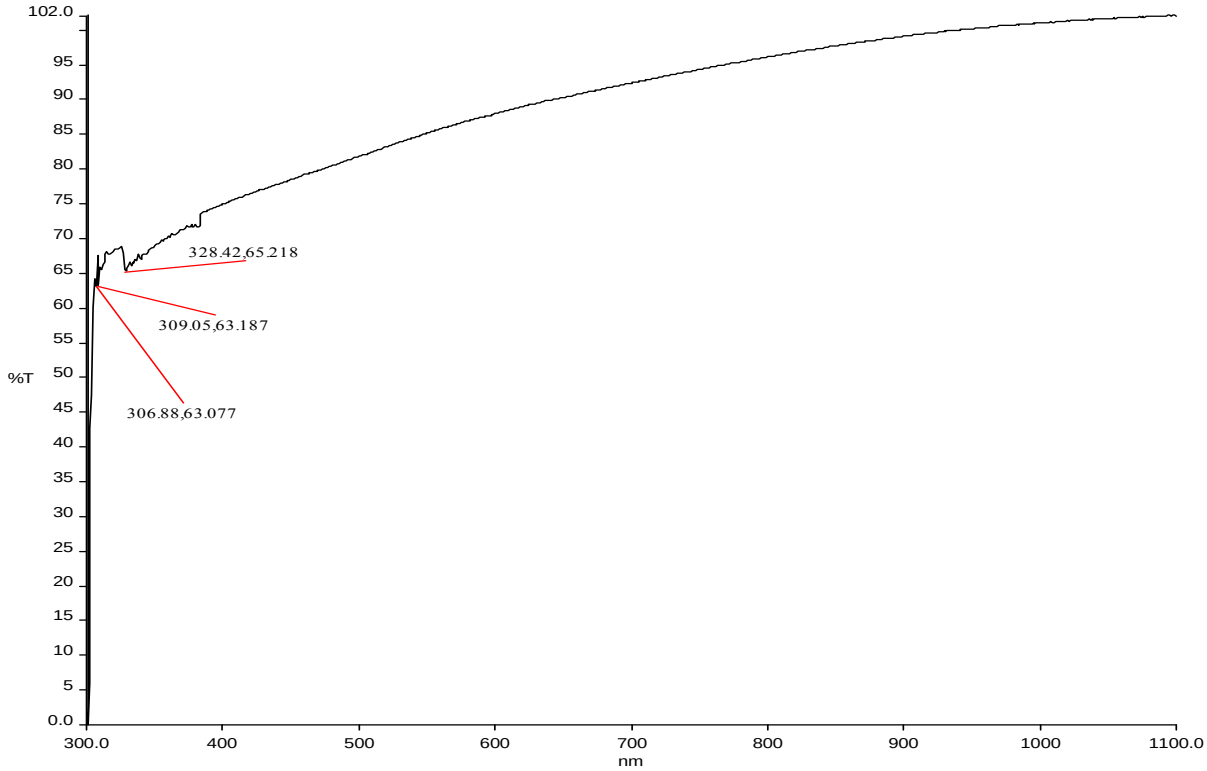

Fig 3.1 D: Transmittance Spectrums from UV-Vis Spectrometer

Table 3.1A: Determination of Transmittance (% T)

Material	Wavelength(nm)	Frequency(THz)	Transmittance	
			Dissolved In Water	Dissolved In Methanol
PEO	300	1000	78.41	53.19
	350	857	82.93	64.57
	400	750	81.82	61.65
	450	667	80.46	59.52
	500	600	79.32	58.01
	550	545	80.11	58.50
	600	500	79.62	59.01
	650	462	82.59	61.87
	700	429	85.42	65.05
	750	400	87.50	67.59
	800	375	89.07	69.69
	850	353	90.17	71.20
	900	333	91.03	72.82
	950	316	91.76	74.05
	1000	300	92.19	75.65
	1050	286	92.59	76.87
	1100	273	92.92	77.93

Table 3.1B: Determination of Transmittance (% T)

Material	Wavelength(nm)	Frequency(THz)	Transmittance	
			Dissolved In Water	Dissolved In Methanol
PEO+ $NaHCO_3$	330	909	94.96	65.71
	360	833	93.12	70.29
	390	769	93.67	74.13
	420	714	94.13	76.43
	450	667	94.60	78.48
	480	625	95.26	80.47
	510	588	96.05	82.46
	540	556	96.93	84.55
	570	526	97.51	86.38
	600	500	98.13	87.98
	630	476	98.67	89.47
	660	455	99.18	90.74
	690	435	99.61	91.98

The comparative study of PEO dissolved in different solvents and the PEO complexes with dopant $NaHCO_3$ are shown in the table (3.1A, 3.1B). The percentage of transmittance is varied with solvents. The percentage of transmittance of PEO dissolved in water was higher percentage of transmittance of PEO dissolved in Methanol was smaller than the PEO dissolved in Water. This trend remains the same even after the addition of$NaHCO_3$ to PEO.

According to Swanepoel's method [4] the envelope of interference maxima and minima can be utilized for obtaining optical parameters. According to PEO and PEO+$NaHCO_3$ transmittance spectrum both are having above 75% transmittance. So they have least number of the maxima and minima. Using this maxima and minima only few number of thickness values are obtained and tabulated in Table (3.2) for corresponding wavelengths.

Table 3.2: Determination of the Refractive Index, Thickness of the Thin Film by Swanepoel's Method

Material	Solvent	Transmittance		Wavelength (nm)	Refractive Index	Thickness (m)
PEO	Water	89.45	89.39	812	1.502	6.24x105
		89.49	89.44	817	1.502	
	Methanol	70.90	70.86	839	1.502	4.44 x105
		72.01	71.96	880	1.503	
PEO + $NaHCO_3$	Water	98.87	98.81	640	1.502	4.67 x105
		99.18	99.13	660	1.502	
	Methanol	95.04	94.99	769	1.502	1.21 x104
		96.30	96.23	805	1.502	

The presence of maxima and minima of the transmittance spectrum of the same wavelength position confirmed the optical homogeneity of the deposited film and that no scattering or absorption occurs at long wavelength.

3.1.1.2 Refractive Index

The refractive index was calculated by using the formula $n = \left[N + \left(N^2 - S^2\right)^{1/2}\right]^{1/2}$,

where $N = 2s\frac{T_M - T_m}{T_M T_m} + \frac{s^2 + 1}{2}$, from the formula [5] the refractive index is the function of T_{max} and T_{min}. In case of PEO and PEO complexes with $NaHCO_3$films few peaks and valleys were obtained. Hence only few number of refractive index for corresponding wave length were obtained and tabulated in the table (3.2).

From the table (3.3) the comparative study of refractive index of PEO and PEO complexes with $NaHCO_3$filmsprepared by different solvents has been made. It is observed that the refractive index of PEO dissolved in Water was smaller than the refractive index of PEO dissolved in Methanol. And also the refractive index of PEO complexes with $NaHCO_3$ film dissolved in Water was smaller than the refractive index of PEO complexes with $NaHCO_3$ film dissolved in Methanol.

Table 3.3: Determination of Refractive index from %T

Material	Solvent	Refractive Index
PEO	Water	1.512
PEO + $NaHCO_3$		1.505
PEO	Methanol	1.518
PEO + $NaHCO_3$		1.515

3.1.1.3 Thickness of the Film

The thickness of the PEO and PEO complexes with $NaHCO_3$films measured by Michelson interferometer method and Swanepoel's method for various concentrations were tabulated in table (3.4) and (3.2) respectively. The difference in thickness values for the same samples by two different methods can be explained as follows.

The thickness of the film by Michelson Interferometer was calculated by using the following formula,

$$t = \frac{AB - NB}{2A(1-n)}$$

Where A=1- cosθ is angle of the film,

B=Nλ is number of fringes and λ is wavelength of light, n is refractive index of the glass.

Using these values, we can obtain the thickness of the film. In this case thickness of the film depends on the angle of incidence of light ray on the film and the number of fringes. It fails to take into account of some of the thickness determining factors such as the homogeneity of the film, deposition conditions etc.

Table 3.4: Thickness of the Film :(Glass Substrate) - Michelson Interferometer Method

Material	Solvent	Angle	No Of Fringes	1- COS θ	Nλ	Thickness (m)	Thickness – wanepoel's Method(m)
PEO	Methanol	10^0	11	0.01519	7.15×10^{-6}	6.820×10^{-4}	4.79×10^{-4}
		20^0	41	0.06031	2.665×10^{-5}	6.211×10^{-4}	
		30^0	95	0.13397	6.175×10^{-5}	7.956×10^{-5}	
		40^0	156	0.23395	1.014×10^{-4}	5.366×10^{-4}	
PEO + $NaHCO_3$	Water	10^0	13	0.01519	8.45×10^{-6}	8.198×10^{-4}	9.93×10^{-4}
		20^0	68	0.06031	4.42×10^{-5}	1.047×10^{-3}	
		30^0	151	0.13397	9.815×10^{-5}	9.937×10^{-4}	
		40^0	336	0.23395	2.184×10^{-4}	1.111×10^{-3}	
PEO + $NaHCO_3$	Methanol	10^0	16	0.01519	1.04×10^{-5}	9.964×10^{-4}	1.08×10^{-3}
		20^0	74	0.06031	4.81×10^{-5}	1.125×10^{-3}	
		30^0	176	0.13397	1.144×10^{-4}	1.144×10^{-3}	
		40^0	310	0.23395	2.015×10^{-4}	1.070×10^{-3}	

The thickness obtained by Swanepoel's method is more reliable than the Michelson interferometer method because it depends entirely upon the transmittance of the film. The transmittance spectrum of the thin film exhibits only least number of peaks and valleys in the region 300-600nm, which are associates with interference effects. The few number of thickness values for corresponding maxima and minima have been tabulated in the Table (3.2).

3.1.1.4 Absorption Coefficient

The graph drew between the absorption co-efficient of PEO and PEO complexes with $NaHCO_3$films and wavelength of the incident light as shown in fig (3.2A, 3.2B, 3.2C, 3.2D). From the table (3.5A, 3.5B) the value of absorption co-efficient decreases slowly due to increase in wavelength. This behavior supports the assumption of using these thin films as total reflectors while they are used for fabrication of photo detectors, solar cells, semiconductor laser and light emitting diodes [6].

3.1.1.5 Extinction Coefficient

Fig (3.3A, 3.3B, and 3.3C, 3.3D) shows that the relation between the extinction coefficient (k) of PEO and PEO complexes with $NaHCO_3$films with the wavelength of the incident light. The behavior of extinction coefficient is similar to the absorption coefficient as they are proportional to each other. Hence the extinction coefficient decreases rapidly with wave length like absorption coefficient. The variation of extinction coefficient with wavelength is as shown in table (3.6A, 3.6B).

PEO in Water

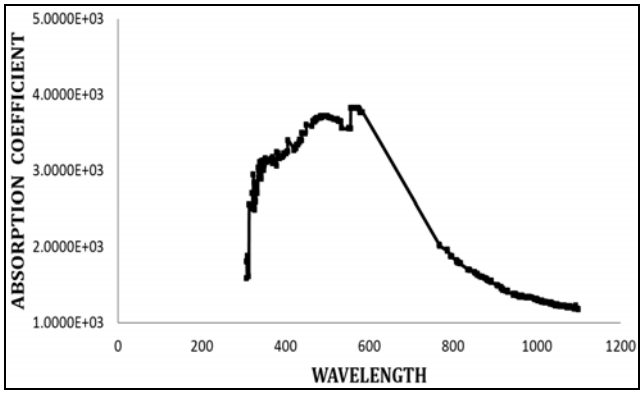

Fig 3.2A: Variation of Absorption Coefficient with Wavelength

PEO+ $NaHCO_3$ in Water

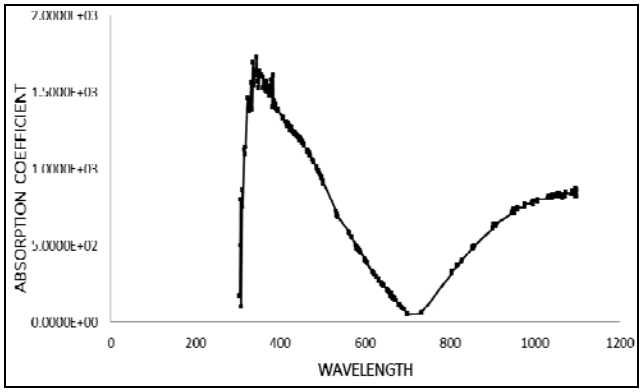

Fig 3.2C: Variation of Absorption Coefficient with Wavelength

PEO in Methanol

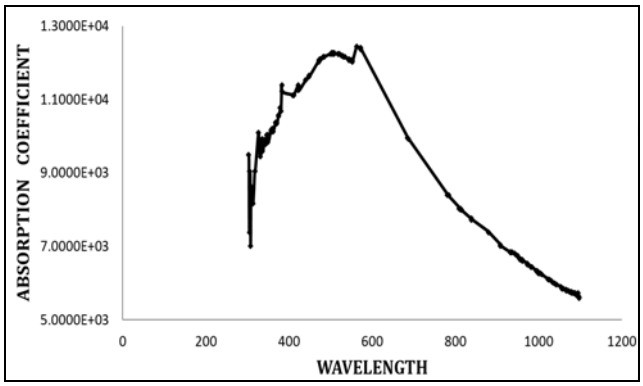

Fig 3.2B: Variation of Absorption Coefficient with Wavelength

PEO+ $NaHCO_3$ in Methanol

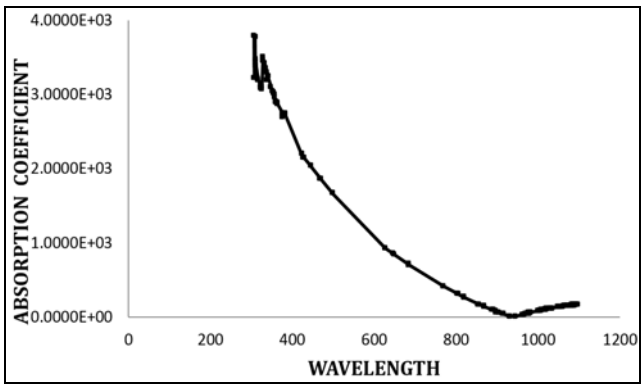

Fig 3.2D: Variation of Absorption Coefficient with Wavelength

Table 3.5A: Determination of Absorption Coefficient

Material	Wavelength(nm)	Frequency(THz)	Absorption Coefficient(10^3)	
			Dissolved In Water	Dissolved In Methanol
PEO	300	1000	3.896	14.194
	350	857	2.997	9.836
	400	750	3.214	10.875
	450	667	3.482	11.664
	500	600	3.711	12.247
	550	545	3.552	12.054
	600	500	3.658	11.865
	650	462	3.063	10.796
	700	429	2.523	9.667
	750	400	2.137	8.807
	800	375	1.853	8.117
	850	353	1.656	7.635
	900	333	1.504	7.131
	950	316	1.376	6.754
	1000	300	1.301	6.274
	1050	286	1.232	5.915
	1100	273	1.175	5.605

Table 3.5B: Determination of Absorption Coefficient

Material	Wavelength(nm)	Frequency(THz)	Absorption Coefficient(10^3)	
			Dissolved In Water	Dissolved In Methanol
PEO + $NaHCO_3$	350	857	1.584	30.534
	400	750	1.357	23.779
	450	667	1.187	19.987
	500	600	0.919	16.560
	550	545	0.612	13.215
	600	500	0.402	10.556
	650	462	0.211	8.404
	700	429	0.051	6.530
	750	400	0.128	4.790
	800	375	0.312	3.225
	850	353	0.489	1.866
	900	333	0.620	0.712
	950	316	0.740	0.173
	1000	300	0.773	0.820
	1050	286	0.835	1.382
	1100	273	0.839	1.698

PEO in Water

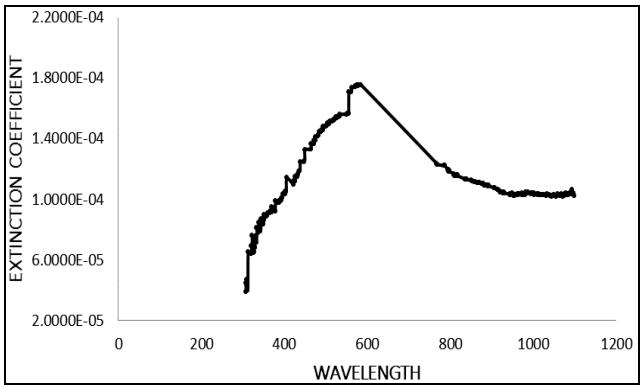

Fig 3.3A: The Plot between Extinction Coefficient and Wavelenth

PEO+ $NaHCO_3$ in Water

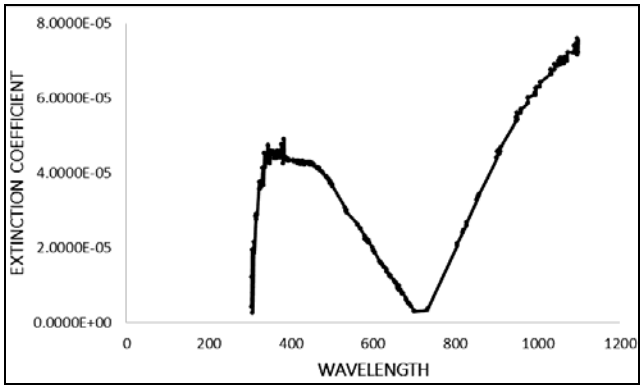

Fig 3.3C: The Plot between Extinction Coefficient and Wavelenth

PEO in Methanol

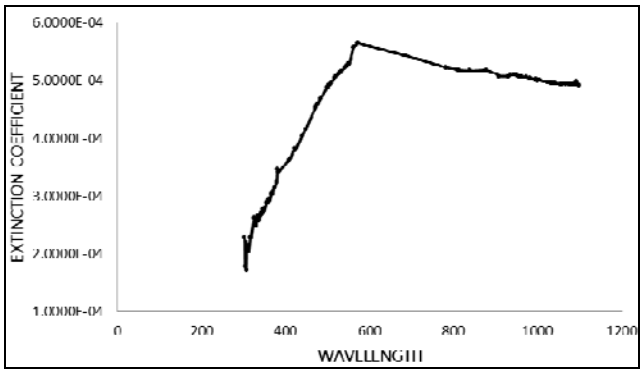

Fig 3.3B: The Plot between Extinction Coefficient and Wavelenth

PEO+ $NaHCO_3$ in Methanol

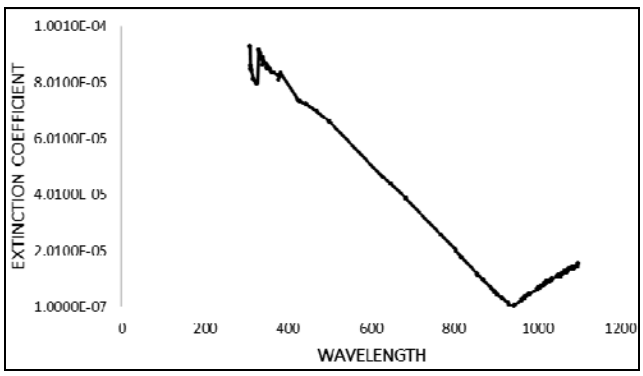

Fig 3.3D: The Plot between Extinction Coefficient and Wavelenth

Table 3.6A: Determination of Extinction Coefficient

Material	Wavelength(nm)	Frequency(THZ)	Extinction Coefficient (10^{-5})	
			Dissolved In Water	Dissolved In Methanol
PEO	300	1000	9.305	33.903
	350	857	8.353	27.410
	400	750	10.236	34.635
	450	667	12.478	41.790
	500	600	14.773	48.755
	550	545	15.554	52.784
	600	500	17.477	56.680
	650	462	15.855	55.872
	700	429	14.064	53.880
	750	400	12.765	52.594
	800	375	11.807	51.704
	850	353	11.212	51.673
	900	333	10.778	51.102
	950	316	10.412	51.087
	1000	300	10.361	49.958
	1050	286	10.302	49.451
	1100	273	10.297	49.089

Table 3.6B: Determination of Extinction Coefficient

Material	Wavelength(nm)	Frequency(THZ)	Extinction Coefficient (10^{-5})	
			Dissolved In Water	Dissolved In Methanol
PEO + $NaHCO_3$	350	857	4.416	85.087
	400	750	4.322	75.729
	450	667	4.255	71.611
	500	600	3.661	65.923
	550	545	2.684	57.867
	600	500	1.922	50.427
	650	462	1.094	43.496
	700	429	0.286	36.395
	750	400	0.764	28.603
	800	375	1.990	20.544
	850	353	3.309	12.634
	900	333	4.446	5.104
	950	316	5.603	1.308
	1000	300	6.161	6.534
	1050	286	6.986	11.556
	1100	273	7.355	14.871

3.1.1.6 Optical Band Gap Energy

In order to determine the value and type of energy gap as well as the dominant absorption processes in such material, the graph is drawn between $(\alpha h\upsilon)^2$(in y axis) and the incident photon energy($h\upsilon$)(in x axis) is explained in fig (3.4A, 3.4B, 3.4C, 3.4D) for PEO and PEO complexes with $NaHCO_3$ films dissolved in different solvents. The obtained value of optical band gap for each concentration is tabulated in table (3.7).

The decreasing optical band gap with increasing dopant concentration may be explained on the basis of the fact that the incorporation of small amounts of dopant forms charge transfer complexes. It increases the electrical conductivity by providing additional charges in the lattice. This results in the decrease of optical band gap energy.

PEO in Water

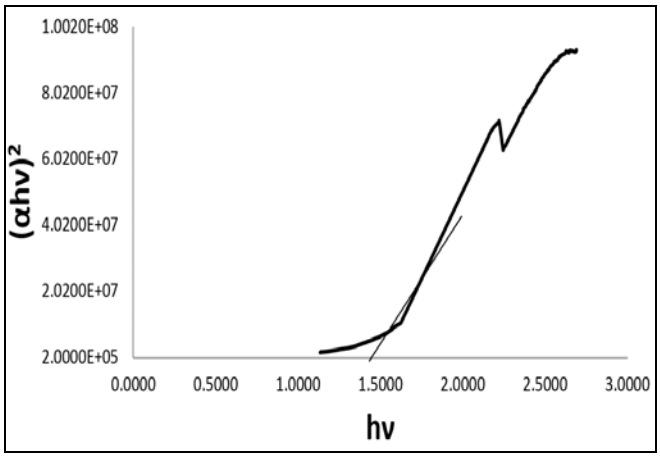

Fig 3.4A: Determination of Band Gap Energy from the Graph

PEO in Methanol

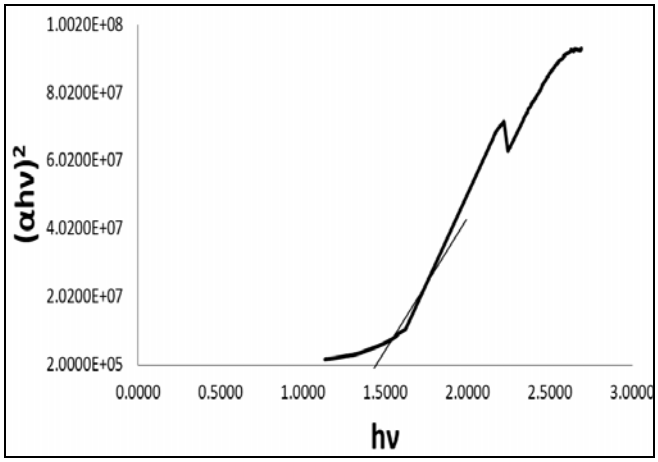

Fig 3.4B: Determination of Band Gap Energy from the Graph

PEO+ $NaHCO_3$ in Water

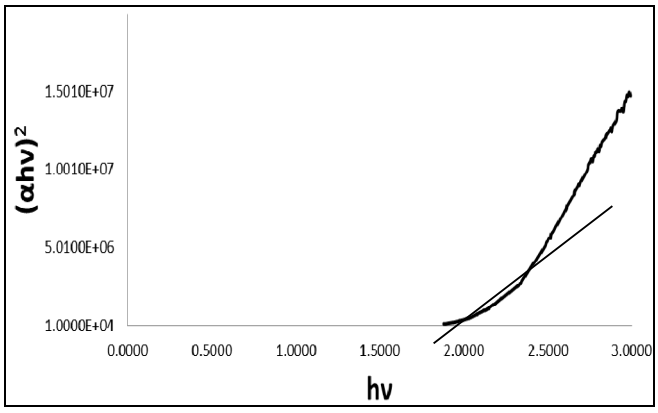

Fig 3.4C: Determination of Band Gap Energy from the Graph

PEO+ $NaHCO_3$ in Methanol

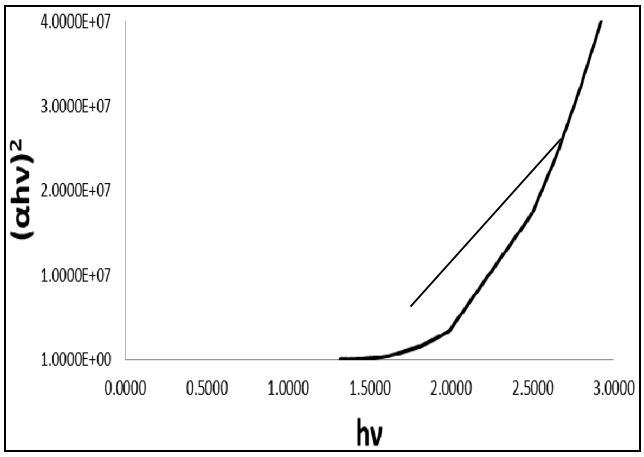

Fig 3.4D: Determination of Band Gap Energy from the Graph

Table 3.7: Optical Band Gap Energy

Material	Solvent	Energy Band Gap (eV)
PEO	Water	1.42
	Methanol	1.39
PEO + $NaHCO_3$	Water	1.94
	Methanol	1.89

The band gap of PEO thin films for different solvents are 1.42eV (water) and 1.39eV (methanol) and the band gap of PEO complexes with NaHCO3 thin films for different solvents are 1.94eV (water) and 1.89eV (methanol). The optical band gap of the material was decreased after the dopant added to the material in both the cases. The observed activation levels with increase of concentration indicate inclusion of impurity levels within the band gap of the material.

3.1.2 Electrical Behavior

3.1.2.1 Dielectric Constant

The variation of dielectric constant with frequency has been tabulated in the table (3.8A, 3.8B, 3.8C, 3.8D). According to this table we can say that the PEO and PEO complexes with NaHCO3 thin films have low dielectric constant at higher frequency. The dielectric behavior of PEO and PEO complexes with $NaHCO_3$films swere shown in figure (3.5A, 3.5B, 3.5C, 3.5D).

Table 3.8A: Variation of Dielectric Constant with Frequency

Material	Frequency(Hz)	Dielectric Constant
PEO Dissolved In Water	$1.00x10^6$	4.27
	$7.94 x10^5$	9.49
	$3.16 x10^5$	3.77
	$1.26 x10^4$	3.28
	63.1	2.57
	39.8	55.8
	1.58	36.1

Table 3.8B: Variation of Dielectric Constant with Frequency

Material	Frequency(Hz)	Dielectric Constant
PEO Dissolved In Methanol	1.00×10^6	13.8
	5.01×10^5	8.92
	1.00×10^5	15.2
	79.4	8.31
	12.6	7.90
	3.98	20.5
	3.16	5.58

Table 3.8C: Variation of Dielectric Constant with Frequency

Material	Frequency(Hz)	Dielectric Constant
PEO + $NaHCO_3$ Dissolved In Water	1.00×10^6	5.75
	3.98×10^5	4.25
	1.26×10^3	5.70
	50.1	44.7
	25.1	12.1
	20	148
	3.16	9.14

Table 3.8D: Variation of Dielectric Constant with Frequency

Material	Frequency(Hz)	Dielectric Constant
PEO + $NaHCO_3$ Dissolved In Methanol	1.00×10^6	11.3
	3.98×10^5	31.7
	39.8	24.1
	31.6	23.7
	15.8	15.1
	3.98	113
	1.58	94.0

PEO in Water

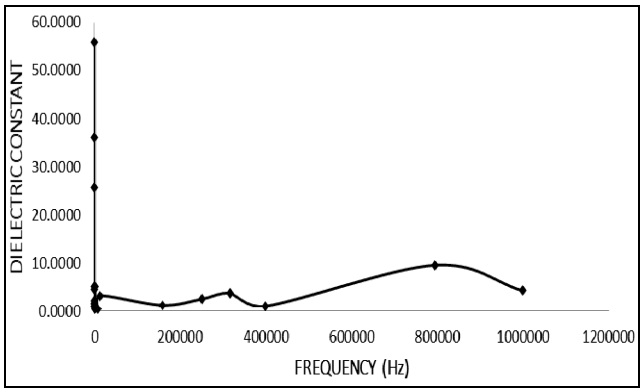

Fig 3.5A: Variation of Dielectric Constant with Frequency

PEO in Methanol

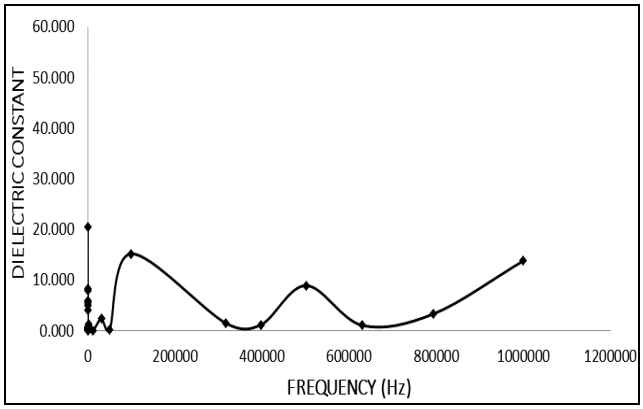

Fig 3.5B: Variation of Dielectric Constant with Frequency

PEO+ $NaHCO_3$ in Water

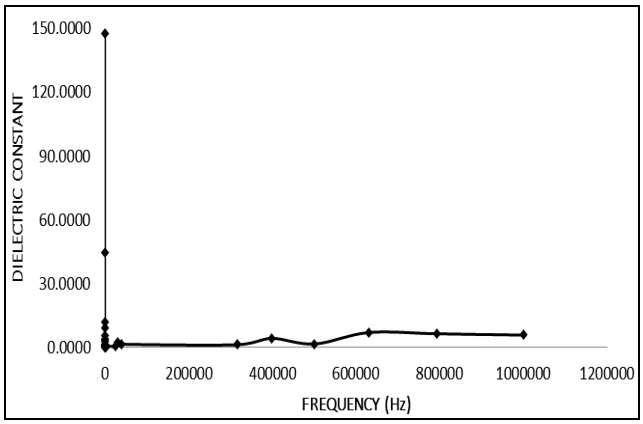

Fig 3.5C: Variation of Dielectric Constant with Frequency

PEO+ $NaHCO_3$ in Methanol

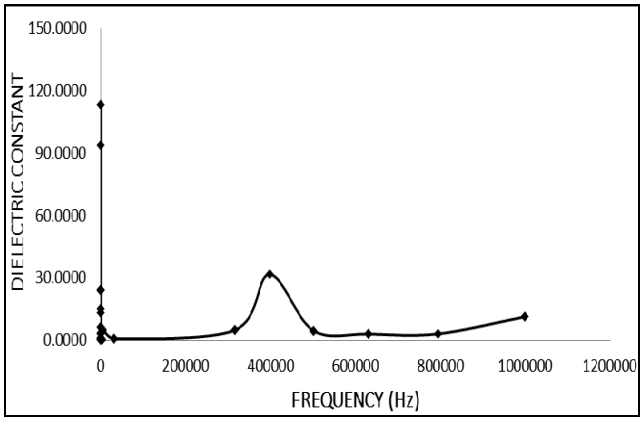

Fig 3.5D: Variation of Dielectric Constant with Frequency

3.1.2.2 Impedance Measurement

The graph is drawn between the impedance with frequency of PEO and PEO complexes with $NaHCO_3$ thin films were shown in the figure (3.6A, 3.6B, 3.6C, 3.6D), the values of impedance with corresponding frequency is tabulated in table (3.9A, 3.9B, 3.9C, 3.9D). According to the table, the value of impedance decreases with increasing the frequency. From this impedance value the dielectric constant were measured with corresponding frequency. The value of dielectric constant is tabulated in the table (3.8A, 3.8B, 3.8C, 3.8D).

PEO in Water

Table 3.9A: Variation of Impedance with Frequency

Frequency(Hz)	Impedance(Ω)
1.00×10^6	9.88×10^2
3.16×10^5	3.54×10^3
1.26×10^4	1.02×10^5
3.16×10^3	1.65×10^6
1.00×10^3	8.57×10^6
3.16×10^2	1.41×10^7
31.6	2.90×10^7
5.01	4.93×10^8
1.58	7.38×10^7

PEO in Methanol

Table 3.9B: Variation of Impedance with Frequency

Frequency(Hz)	Impedance(Ω)
1.00×10^6	1.76×10^2
3.16×10^5	5.05×10^3
1.00×10^5	1.59×10^3
3.16×10^4	3.22×10^4
3.16×10^3	1.37×10^6
3.16×10^2	4.78×10^7
1.58×10^2	2.63×10^7
25.1	2.23×10^8
3.16	1.37×10^8

PEO+ $NaHCO_3$ in Water

Table 3.9C: Variation of Impedance with Frequency

Frequency(Hz)	Impedance(Ω)
1.00×10^6	4.17×10^2
3.16×10^5	6.14×10^3
3.16×10^4	3.25×10^4
3.16×10^3	1.28×10^6
1.00×10^3	6.76×10^6
1.00×10^2	2.14×10^7
10	2.18×10^8
3.16	8.30×10^7
1.00	1.08×10^7

PEO+ $NaHCO_3$IN METHANOL

Table 3.9D: Variation of Impedance with Frequency

Frequency(Hz)	Impedance(Ω)
1.00×10^6	4.07×10^2
3.16×10^5	3.00×10^3
3.16×10^4	1.99×10^5
3.16×10^3	4.15×10^6
1.00×10^3	8.07×10^6
3.16×10^2	1.18×10^7
1.00×10^2	7.32×10^6
31.6	6.13×10^6
3.16	1.11×10^8

PEO in Water

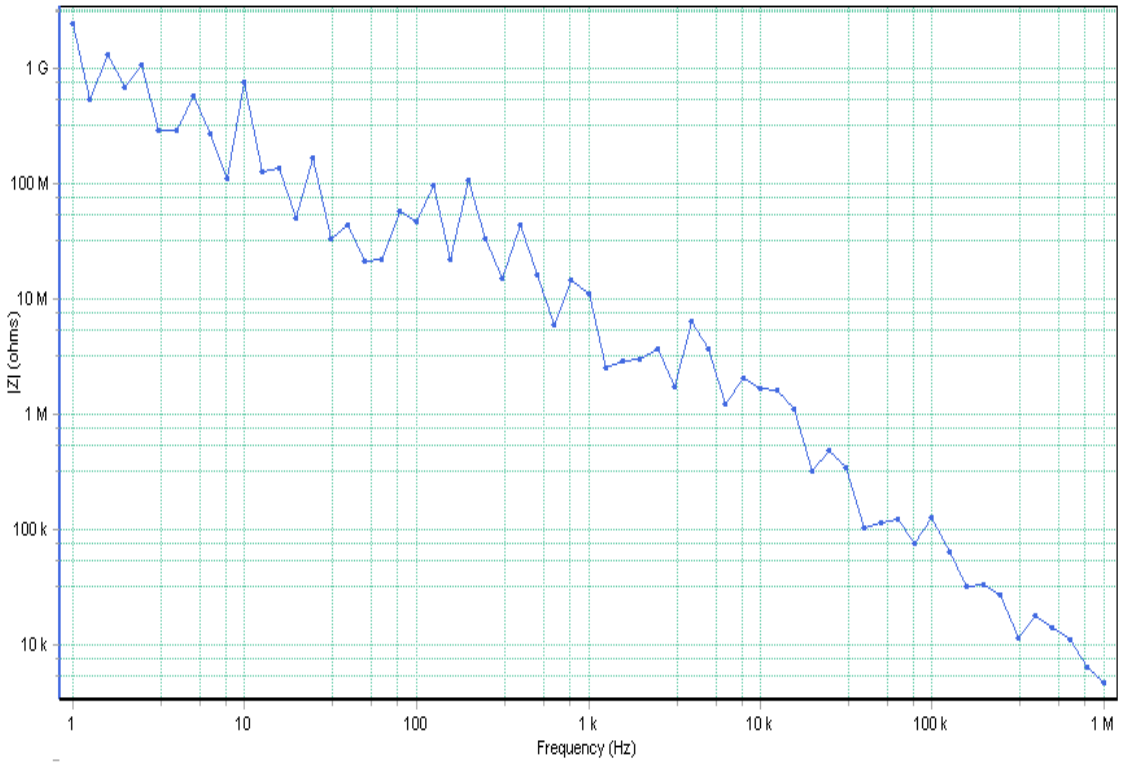

Fig 3.6A: Variation of Impedance with Frequency

PEO in Methanol

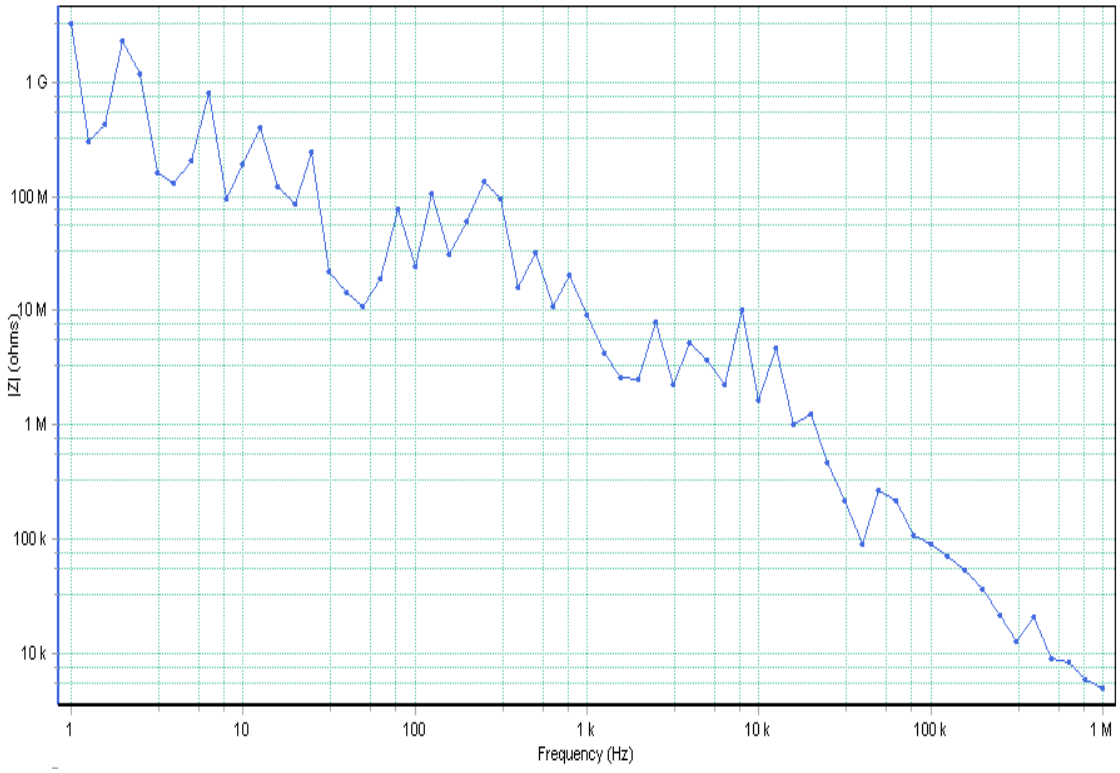

Fig 3.6B: Variation of Impedance with Frequency

PEO+ $NaHCO_3$ in Water

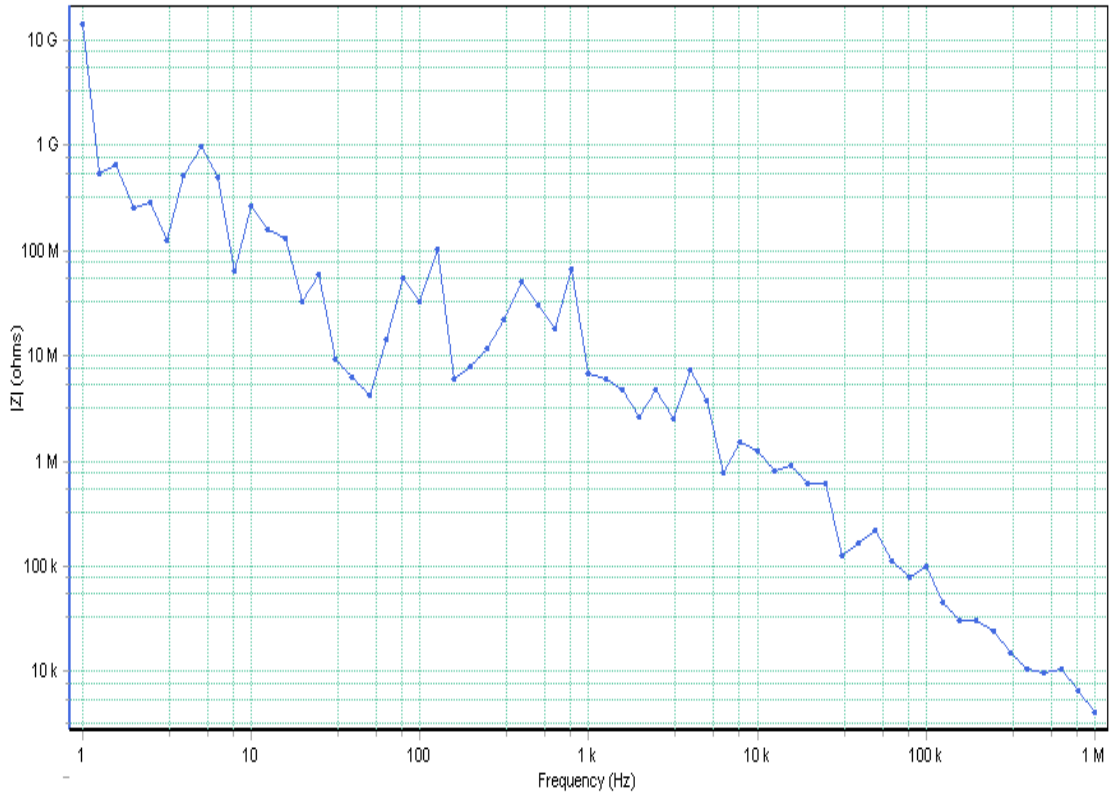

Fig 3.6C: Variation of Impedance with Frequency

PEO+ $NaHCO_3$ in Methanol

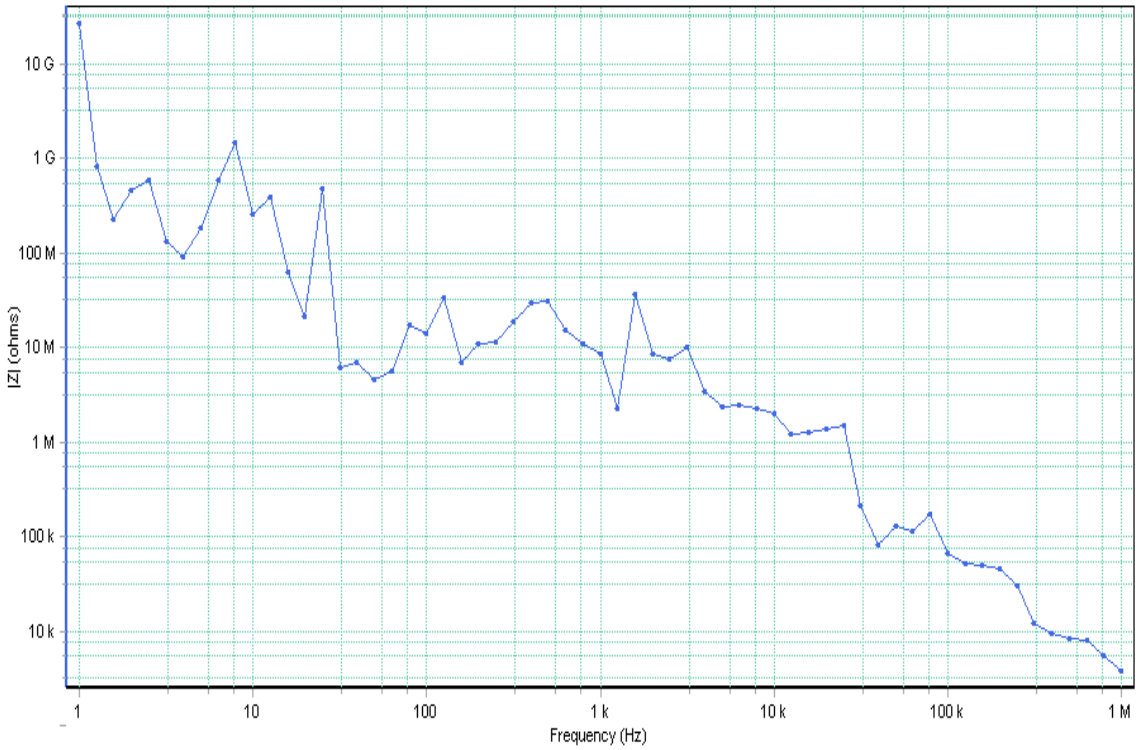

Fig 3.6D: Variation of Impedance with Frequency

4.1 Conclusion

The Polyethylene Oxide is a material of interest in a variety of applications including electrochemical devices, electro chromic display devices, photo electro chemical solar cells, etc. In the present case, the PEO and PEO complexes with $NaHCO_3$ film has been successfully prepared by spin coating technique using solution casting method.

Optical studies were done using UV-Visible Spectrometer. From the transmission spectrum the optical constants were obtained, such as absorption co-efficient, extinction coefficient and optical band gap were evaluated using Swanepoel's method. The obtained data reveals that the film has high transparency and posses low optical band gap energy (1.39-1.94eV). These transparent films can be used as optical filters polarizer, total reflectors etc.

Impedance measurements were done using impedance Spectroscopy. In this study we obtained the impedance values for various frequencies. From this study we got, the value of impedance decreases as the frequency increased. So the conductivity increases when the frequency is increased. The dispersion of dielectric constant with frequency was examined and tabulated. The PEO and PEO complexes with $NaHCO_3$films have large dielectric constant.

5.1 References

1. Sabiha Sultana, Muhammad Saleem Khan *et al.*, "Preparation, morphology, and thermal and optical properties of thin films of ferric chloride/polyethylene oxide composites", National Centre of Excellence in Physical Chemistry, University of Peshawar, 2012.
2. Sasikala U, Naveen Kumar P *et al.*, "Structural, electrical and parametric studies of PEO based polymer electrolyte battery applications", International Journal of Engineering Science and Advanced Technology, 2012, 2.
3. Jibril Al-Hawarin, Ayman S Ayesh, "Dielectric and thermal properties of PEO doped with Cadmium Chloride salt", Chinese journal of polymer science, 2012, 30.
4. Naser M Ahamed, Zaliman Sauli, "Investigation of Absorption co-efficient refractive index, energy band gap and thin film thickness for Al0.4Ga0.89N, Al0.03Ga0.97 Nand GaN by optical transmission method", International Journal for Nano electronic and materials, 2009, 2.
5. Sankar S, Gopichandran KG. "Effect of Growth parameters on structural, electrical and optical properties of titanium Oxide thin film". Indian Journal of pure and Applied Physics, 2008, 46.
6. B Colin Pratt - Kingston University London, "Conducting Polymers", 1996.