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COMPARATIVE STUDY OF STRUCTURAL AND MORPHOLOGY OF UNDOPED AND TIO2, V2O5 AND MN DOPED POLYTHIOPHENE THIN FILMS.

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Abstract:

Undoped polythiophene and with dopant TiO_2, V_2O_5 and Mn thin film synthesized with on glass slide surface using $FeCl_3$ as an oxidant at room temperature by chemical bath deposition technique. Effect of dopant TiO_2 ,V_2O_5 and Mn on properties of polythiophene thin film was then studied. The synthesized polythiophene were characterised by electrochemica technigues.Fourier transform infrared spectroscopy (FTIR), SEM analysis and XRD analysis. Chemical composition of polythiophene film was investigated by FTIR spectroscopy. Surface morphology was influence by dopant ,SEM analysis of PTh/TiO_2 image seems to be uniform microporous on the surface and the particles were in nanometer scale. PTh/ V_2O_5 shows agglomerated nanoparticles of different shape and PTh/Mn shows nanoparticles agglomerated with micropores in between ,the size of the agglomeration is found to be increased. In a tube like structure formed by the nanoparticles and seems like random network of interconnected bundles. XRD analysis showed modification from fully amorphous to well developed crystalline structure after doping with TiO_2 and V_2O_5 and Mn shows little modification.

Keywords: *Polythiophene, TiO_2,V_2O_5,Mn chemical bath deposition, ,Morphology.*

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INTRODUCTION:

Polymer nanoparticles have received attention due to their diverse nanometer size particles and a series of special performance ,polymer nanoparticle composites may posses the unique property superior to that of either the polymer or nanoparticles. In polymer science, owing to interesting chemical and physical properties, conducting polymers have been studied extensively during the last two decades as an important semiconductor material [1-3]. Metal containing polymer composites have attracted the attention of scientific community over a last few decades. Insertion of metal ions into polymer backbone may improve the mechanic, electronic and magnetic properties of polymer [4]. Among the conducting polymers, polythiohene (PTh) and its derivatives have attracted much consideration because of their easy preparation, environmental stability,higher conductivity and photoconduction [5,6]. Stability of polythiophene in air comes from its lower oxidation potential thus polythiophene thin films have been studied by many workers, because of their special electrical properties, considerable thermal stability and oxidation resistance. It has also shown that composite material always has advantages over homogeneous material. Few researchers reported doping of derivatives of polythiophene by FeCl3 [7,8] and fabrication of devices using $FeCl_3$ doped derivatives of polythiophene [9,10]. An optical and electronics properties of polythiophene are useful for various device applications such as LED, field effect transistors, optical waveguides [11] in optoelectronic devices [12], photovoltaic and photoconductive devices and optical modulator devices [13]. Polythiophenes have also been exploited in sensor applications [14].

EXPERIMENTAL:

Materials and Methodology

Chemicals: Thiophene (AR grade Merck), Iron chloride (Sd-Fine), Methanol (CH_3OH), TiO_2 Mn, V_2O_5 and chloroform are used for the synthesis.

FTIR: Bruker Germany spectrometer with a resolution of 4 cm^{-1} in the range 450-4000 cm^{-1} of SAIF IIT Mumbai.

XRD: Rikagu Mini Flex 300/600 instrument at Vidyabharti College, Amravati.

SEM: JSM-6380 Instrument VNIT College, Nagpur.

METHODOLOGY:

1-Preparation of undoped polythiophene thin film

For Synthesis of polythiophene thin film by chemical bath deposition method, primarily substrate were washed with deionized water, boiled in chromic acid and washed with detergent, rinsed in acetone before deposition of thin film.Thiophene is used as monomer for preparation of polythiophene thin films. Monomer solution was prepared by dissolving 0.1 M of thiophene in chloroform, oxidant solution was prepared in a glass beaker with 0.5 M concentration of $FeCl_3$ in chloroform the ratio of monomer to oxidant was kept 1:5.Substrates were immersed in bath at room temperature at constant stirring. Monomer solution was added drop wise in an oxidant solution reaction being carried out at room temperature. During precipitation, heterogeneous reaction occurred and deposition of polythiophene took place on substrate. The substrates coated with polythiophene thin films were removed after a time interval of 1 h from the bath, washed with methanol followed by chloroform and acetone repeatedly to remove residual oxidant and unreacted monomers. Dried in air and preserved in an airtight container.

2-Preparation of PTh /TiO_2,PTh/ V_2O_5, PTh/Mn thin film.

The composites thin films were prepared by same procedure only 0.5% w/v TiO_2 V_2O_5 , Mn added in oxidant solution. The substrates coated with doped polythiophene thin films were removed after a time interval of 1 h from the bath, washed with methanol followed by chloroform and acetone repeatedly to remove residual oxidant and unreacted monomers. Dried in air and preserved in an airtight container.

RESULTS AND DISCUSSION:

1. Fourier Transform Infrared (FTIR) investigation

The IR studies of undoped polythiophene and 0.5% w/v TiO_2,V_2O_5, Mn PTh composites synthesized in present research work are given in Figures- 1, 2, 3,4 .

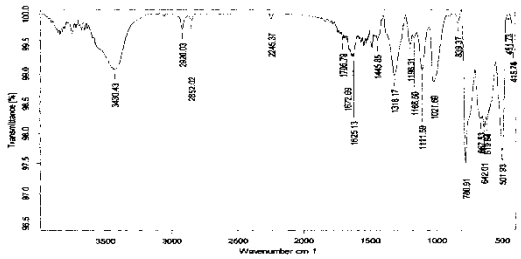

Fig1 : FTIR spectra of undoped Ph thin film.

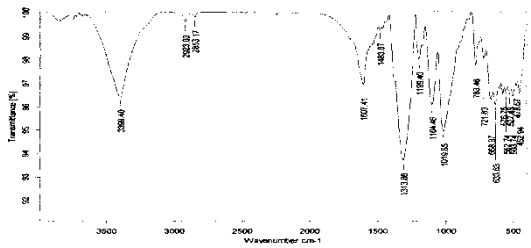

Fig2: FTIR spectra of PTh/0.5%w/v TiO_2 thin film.

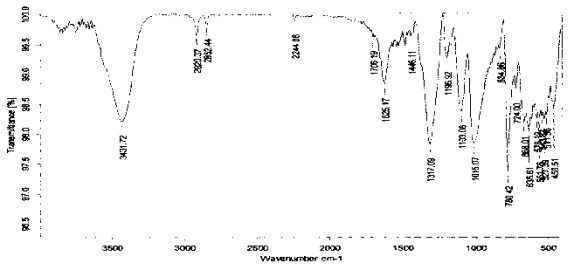

Fig 3: FTIR spectra of PTh/0.5w%V_20_5 thin film .

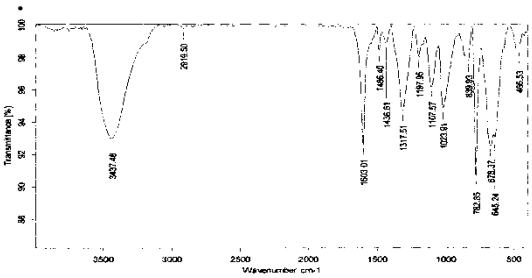

Fig 4: FTIR spectra of PTh /0.5w% Mn film.

The absorption band in region 2920.03 cm^{-1} is due to aromatic C=C-H stretching frequency of undoped polythiophene which is shifted to the ranges 2923.03 cm^{-1} , 2920.37 cm^{-1} and 2919.50 cm^{-1} in PTh/TiO_2 composite , PTh/ V_2O_5 composite and PTh/Mn . The absorption band in region 1625.13 cm-1 is due to aromatic C=C stretching frequency of undoped polythiophene which is shifted to ranges 1607.41 cm^{-1}, for TiO_2 doped and 1625.17 cm^{-1} for V_2O_5, 1603.01 $cm^{-1}$for Mn doped PTh and Peak at 1313.17 cm^{-1} for Polythiophene is assign for C-C stretching frequency are shifted to 1313.86 cm^{-1} in TiO_2 and 1317.90 cm^{-1} for V_2O_5 doped thin film and 1317.51 $cm^{-1}$for Mn doped film.The absorption band in the region 780.91 cm^{-1} is due to the C-S stretching frequency of undoped polythiophene which is shifted to the ranges 783.46 cm^{-1} in PTh/TiO_2 composites.The absorption peak at lower frequency 721.83 cm^{-1} assigned for Ti-O stretching and 552.74 cm^{-1} for Ti-O bending of PTh thin film. TiO_2 composite. .In case of V_2O_5 doped polythiophene V-O-V stretching vibration observe at 578.19 cm^{-1},579.58 cm^{-1} In PTh/Mn composite the absorption peak at lower frequency 466.53 observed for co-ordination of Mn with Sulphur which is absent in undoped polythiophene.film .

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2. XRD analysis

A typical XRD pattern obtained for undoped polythiophene and TiO_2,V_2O_5,, Mn doped Polythiophene composite are shown in Figure 5, 6,7,8,.In case of undoped polythiophene no sharp peak observed,this indicates the polymer under investigation is nanocrystalline in nature .XRD analysis 0.5%w TiO_2 doped polythiophene shows 5 peaks at 2 theta 25.507,38.00,48.199,55.36,69.01 In XRD analysis of 0.5% w V_2O_5 doped polythiophene shows one peak at 2q =26.27. In Mn composite only one intense peak observed at 2 theta =35.07 showing little change in crystallinity of the polythiophene after addition of Mn.

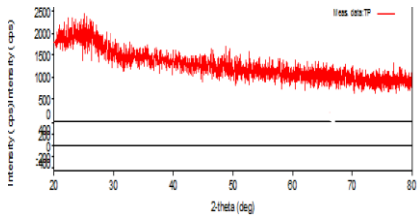

Fig.-5: XRD of undoped polythiophene.

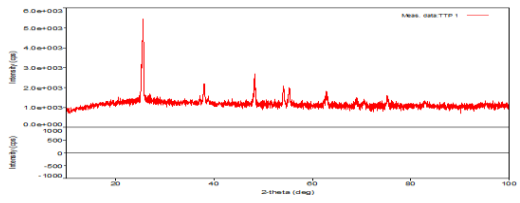

Fig-6: XRD of 0.5% w/v TiO_2 doped polythiophene

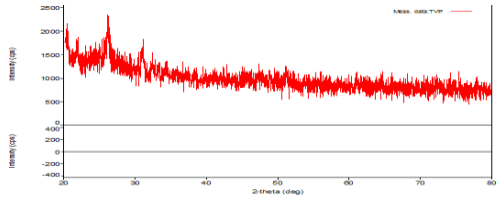

Fig-7: XRD patterns of 0.5% V_2O_5.

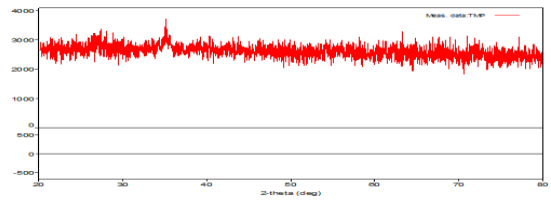

Fig 8 : XRD diffractogram of PTh/0.5%w Mn composites.

3.Scanning Electron Microscopy

The SEM images of undoped and TiO2, V_2O_5, Mn doped polythiophene composites thin film are shown in figures-9,10,11,12. TiO_2 doped image seems to be uniform microporous on the surface and the particles were in nanometer scale. Nanoparticles agglomerated grain structure observed. The grains are highly agglomerated shape but they are well interconnected each other. PTh/ V_2O_5 The grains are highly agglomerated highly irregular shape some grains are irregular in structure some of them are elongated and some are spherical in shape. SEM photographs of Mn doped polythiophene thin films shows nanoparticles agglomerated with micropores in between .the size of the agglomeration is found to be increased. A tube like structure formed by the nanoparticles and seems like random network of interconnected bundles.

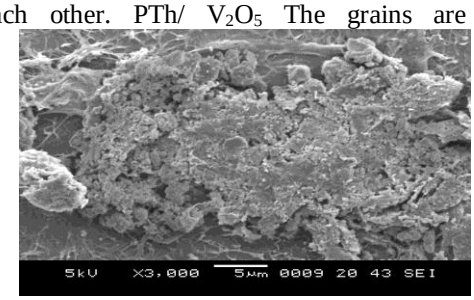

Fig 9 : SEM image of undoped PTh thin film.

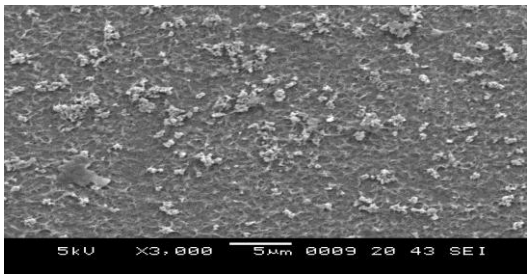

Fig 10 : SEM image of 0.5 % w/v TiO_2 thin film.

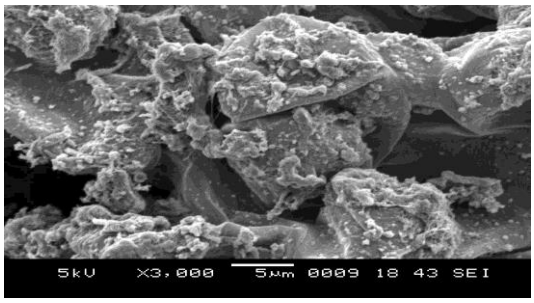

Fig. 11: SEM image of 0.5%w/v V_2O_5

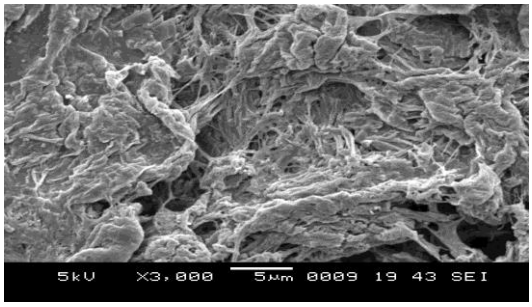

Fig- 12 : SEM of PTh with 0.5% Mn thin film.

CONCLUSION:

Polythophene thin films has been synthesised at room tempreture by chemical bath deposition method. polythiophene can be doped by TiO_2 ,V_2O_5, Mn in chloroform with formation of complex Polythiophene TiO_2 and Polythiophene V2O5 and Polythiophene Mn composites thin films were prepared by in situ doping .The result of FTIR proved the formation of polythiophene and PTh/ TiO_2 and PTh/ V_2O_5 Polythiophene Mn complex. The amorphous nature of PTh has been confirmed by XRD. XRD patterns of the composites exhibited peaks corresponding to TiO_2 and V_2O_5 and shows modification from amorphous to the well-developed crystalline structure after doping and Mn composite shoes little change in structure . Morphology of thin film were analysed by SEM it shows change in morphology after doping.

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REFERENCES:

1.Karim, M. R, K. T. Lim, C. J. Lee, and M.S. Lee (**2007)** *Synthetic metal* 157: 1008.

2.Ahn , S.H, M. Z Czae, E. R. Kim, and H. Lee**(2001**) *Macromolecules* 34: 2522, 2527.

3.Daik , R. and S. Maniam, (**2007)** *Malaysian Journal of Chemistry* 9: 16.

4. *American Chemical society, International Symposium on Inorganic and metal-containing Polymeric Materials* held on September 11- 14, **1989**, in Miami Beach, Florida edited by Plenum Press, 1990, Network.

5.Guo Xian-zhi, Kang Yan-fei, Yang Tai-li, Wang Shu-rong, Low-temperature NO2 sensors based on polythiophene/WO3 organic-inorganic hybrids, *Trans. Nonferrous Met. Soc. China*, 22, 380-385 **(2012**).

6.Mohd. Hanief Najar. Kowsar Majid, Synthesis, characterization, electrical and thermal properties of nanocomposite of polythiophene with nanophotoadduct: a potent composite for electronic use, *J Mater Sci:Mater Electron* DOI 10. 1007/s 10854-013-1407-8(**2013).**

7.Kitao S., SetoM., Maeda Y., Matsuyama T. et al.*J. Phys. Soc.Jpn*., 66, 1195**,(1997).**

8. Qiao X., Wang X. andMo Z.*Synth. Met.*, 122, 449**,(2001).**

9. Kuo C., Wakim F., Sengupta S. and Tripathy S.: Jpn. *J. Appl.Phys*., 33, 2629**,(1994).**

10.Tada K., Wada M. and Onada M.: J. Phys. D, *Appl. Phys*., 36, L70**,(2003**).

11.Jahia, M., *Journal of Nonlinear Optical Physics &Maerialst*,19, 269,280,(**2010**).

12.Fichou, D.*Journal of MaterialChemistry*, 10, 571,588**,(2000**).

13.Bloisi, F., A. Cassinese, R. Papa, L. Vicari, and V. Califano,*Thin Solid Films*, 516, 1594,1598, **(2008).**

14.Ma, X., G. Li, H. Xu, M. Wang, and H. Chen, *Thin Solid Films*,515, 2700, 2704**,(2006).**