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INFLUENCE OF CoOEP ON REDOX ACTIVITY OF PANI

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ABSTRACT: In the present investigation Electrochemical polymerization of polyaniline (PANI) was carried out in the presence of cobalt octaethylporphyrin (CoOEP). Morphological changes in PANI/CoOEP were noticeable. Electrochemically deposited PANI film was confirmed and redox activity studied by electrochemical technique (cyclic voltammetry). The chemical composition of the film was confirmed by Fourier Transform Infrared Spectroscopy (FTIR).

KEYWORDS: Polyaniline, electrochemical polymerization, I/V, Fourier Transform Infrared Spectroscopy (FTIR).

1. INTRODUCTION

Conducting polymers are also known as 'Synthetic Metals'. In this class, polyaniline and its derivatives are the interesting compounds for the researchers worldwide. Synthesis and doping of PANI and its derivatives can be done by chemical and electrochemical method. Both methods are relatively cost effective. PANI has been used for the various applications like in electrochemical sensors, gas sensors, microelectronics, etc [1-5]. PANI has different oxidation states which have different colour and conductivities. Among which conducting form of PANI is green emeraldine which is half oxidized and can be synthesized in strong acidic electrolyte [6].

Porphyrins contain four pyrrole units which are linked by four methane bridges in the basic structure and in metalloporphyrins it consists of central metal ion. This follows Huckel's rule, so the porphyrin ring is aromatic having 18 π-electrons. The porphyrins have stability towards concentrated acids and bases also possess thermal and chemical stability [7]. Porphyrins have wide range of applications in solar cells, volatile organic compounds sensors, gas sensors, etc. [8]. In the class of porphyrins 2,3,7,8,13,17,18 – octaethyl – 21H, 23H porphyrin cobalt (II) (CoOEP) is the interesting compound having cobalt as central metal atom.

2. RESULTS AND DISCUSSION

The synthesis of PANI film was carried out using 0.2M sulphuric acid (H_2SO_4) as dopant and 0.1M aniline (sigma Aldrich) as monomer. The electrochemical polymerization was carried out with CHI 660C instrument having Ag/AgCl, platinum plate as reference and counter electrode and Indium Tin Oxide (ITO) coated glass as working electrode by cyclic voltammetry (CV) technique at potential range -0.2 V to 1 V at scan rate 0.1 V/s.

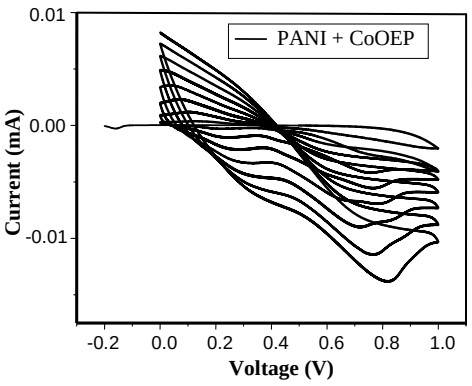

Fig. 1. Electrochemical synthesis of PANI/CoOEP composite

Composite of PANI/CoOEP was synthesized electrochemically in aqueous media in presence of 0.2M sulphuric acid (H_2SO_4) having 0.1 M monomer i.e. aniline (sigma Aldrich) and 8 µmole of CoOEP (Sigma Aldrich). The Solution of CoOEP

was prepared in deionised water after sonication for 1 h at room temperature. Aniline and H_2SO_4 solution prepared in distilled water having constant stirring of ½ h. Then the prepared solution of CoOEP was slowly added in the above solution and stirred for 15 min. The electrochemical polymerization was carried out as above configuration. The CV for the synthesis of PANI/CoOEP composite is as shown in Fig. 1.

The comparative CV in 1 M KCl solution of PANI and PANI/CoOEP is as shown in Fig. 2. Oxidation peaks for PANI observed at 0.2 V and 0.8 V and reduction peaks at 0.1 V and 0.7 V respectively. For PANI/CoOEP configuration oxidation peaks at 0.2 V and 0.75 V and reduction peaks can be observed at 0.1 V and 0.6 V with the decrease in the peak current for the PANI/CoCEP composite. This suggests the decrease in the redox activity of the PANI due to presence of CoOEP.

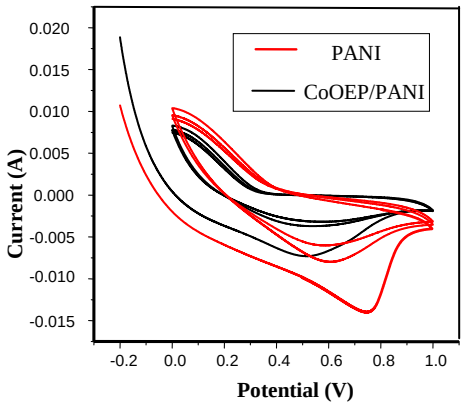

Fig. 2. Comparative CV of PANI and PANI/CoOEP in KCl

The FTIR spectra (Fig.3) confirm peaks at 1464 cm^{-1} for (Cα-Cβ, Cβ-CH2) bond, 1652 cm^{-1} for aromatic ring and 3401 cm^{-1} confirms the amine group (N-H stretching) present in the PANI/CoOEP composite. The FTIR spectra, confirms the formation of PANI/CoOEP composite.

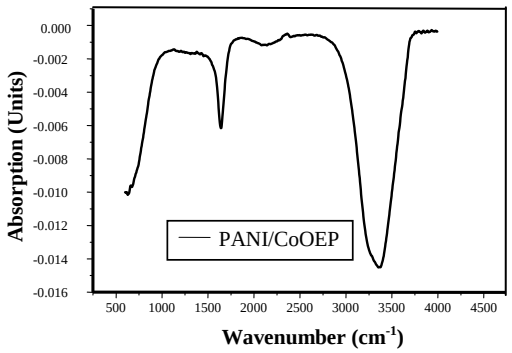

Fig. 3.FTIR of PANI/CoOEP

3. CONCLUSIONS

The electrochemical synthesis of the PANI/CoOEP on ITO coated glass is described in this paper. The influence of CoOEP increases the stability and decreases the redox activity of the PANI. The synthesized composite would be useful for the sensitive and selective detection of volatile organic compounds and gas sensing applications.

REFERENCES

[1] M. K. Ram, O. Yang, V. Lahsangarh and M. Aldissi, "*CO Gas Sensing from Ultrathin Nano-Composite Conducting Polymer Films,"* Sensors and Actuators B, Vol. 106, 2005, pp. 750-757. doi:10.1016/j.snb.2004.09.027

[2] G. Liu and M. S. Freund, *"New Approach for the Controlled Cross-Linking of Polyaniline: Synthesis and Characterization,"* Macromolecule, Vol. 30, No. 19, 1997, pp. 5660-5665. doi:10.1021/ma970469n.

[3] S. Koul, R. Chandra and S. K. Dhawan, *"Conducting Polyaniline Composite: a Reusable Sensor Material for Aqueous Ammonia,"* Sensors and Actuators B: Chemical, Vol. 75, No. 3, 2001, pp. 151-159. doi:10.1016/S0925-4005(00)00685-7

[4] N. Takami, A. Satoh, M. Hara and T. Ohsaki, *"Structural and Kinetic Characterization of Lithium Intercalation into Carbon Anodes for Secondary Lithium Batteries,"* Journal Electrochemical Socience, Vol. 142, 1995, pp. 371- 379. doi:10.1149/1.2044017

[5] J. Stejskal, P. Kratochvil and A. D. Jenkins, *"The Forma-tion of Polyaniline and the Nature of Its Structures,"* Po-lymer, Vol. 37, No. 2, 1996, pp. 367-369. doi:1016/0032-3861(96)81113-X

[6] Milica M. Gvozdenović,*, Branimir Z. Jugović, Jasmina S. Stevanović, Tomislav Lj. Trišović and Branimir N. Grgur; "*Electrochemical Polymerization of Aniline"* www.intechopen.com

[7] Karolien De Wael, Philippe Westbroek, Peter Vandenabeele, Annemie Andriaens, Eduard Temmerman; "*Study of deposition and characterization of a 5,10,15,20 – tetrakis-(4-sulphonatophenyl)porphyrin Co (II) layer at gold surfaces in alkaline solution"* Electrochimica Acta 50 (2005) 4269-4274.

[8] Michael G. Walter and Carl C. Wamser; "*Synthesis and characterization of Electropolymerized Porphyrin Nanofibers"* Mater.Res. Soc. Symp. Proc. Vol. 1013(c) 2007.