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POLYANILINE THIN FILM SYNTHESIS AND CHARACTERIZATION BY A NOVEL ELECTROCHEMICAL POLYMERIZATION TECHNIQUE.

Gedam, P.*[1, 2] & Shirsat, M.[2,3]
*1 Shri R.L.T.College of Science, Akola (M.S.) India
2RUSA – Centre For Advanced Sensor Technology, Aurangabad (M.S.), India
3Dept. of Physics Dr. BAMU, Aurangabad (M.S.) India
mr.gprashant@gmail.com, mdshirsat@gmail.com

ABSTRACT

In the present work electrochemical behavior of polyaniline (PANI) thin films which is synthesized by galvanostatic technique on platinum substrate as working electrode in three electrode system. During deposition of PANI, various process parameters Viz. concentration of dopant, time of deposition and applied current density were optimized. Surface morphology was characterized by Scanning probe technique Viz. Atomic Force Microscopy (AFM) which confirms the deposition of thin films and chemical composition verified by Fourier Infra Red (FTIR) Spectroscopy.

Keywords: *Polyaniline Thin films, galvanostatic technique, surface modification, Atomic Force Microscopy, Fourier Infra Red Spectroscopy.*

INTRODUCTION

In this era world is going to developed due to liberalization, Privatization and globalization which can produce adverse effect on flora and fauna. So it is very important to nurture the nature for our future. Therefore scientists were attracted towards the Conducting polymers which can play a vital role to monitor the environment due to its ease of synthesis, low power consumption, tunable conductivity [1 - 5] conducting polymer synthesized by chemical oxidative polymerization techniques [6, 7] which require large amount of times to carry out the reaction with the help of oxidizing agent but it is helpful to synthesize the thick film as well as an interfacial polymerization technique is utilize to produced composite film of polyaniline with the help of oxidizing agent which is quite tedious to carry out [8]. PANI films synthesize by electrochemical polymerization techniques [9, 10].

In present work, keeping the idea of one step electrochemical polymerization technique by lower applied current density. PANI thin film synthesize and deposited on platinum working electrode (vs Ag/AgCl reference electrode) and topographical image PANI thin film is recorded by Atomic Force Microscopy (Park XE 7). The electrochemical characterization performed by utilizing CH 600C electrochemical work station. A three electrode cell containing platinum plates of dimensions 20 * 10 *0.5 mm3 were used as working & counter electrodes and saturated Ag AgCl used as reference electrode. In the preparation of electrolyte, aniline monomer distilled once prior to used and stored in cold environment were purchase from Sigma Aldrich. The reagent used as hydrochloric acid (HCl) of laboratory grade. In the electrolyte preparation 1 M of HCl is added drop wise with continuous stirring in 0.1 M of aniline for half an hour. This solution is used for electrochemical deposition of PANI thin films on platinum working electrode at room temperature.

RESULT AND DISCUSSION

PANI thin films synthesized by galvanostatic electrochemical polymerization technique by applying constant current density of 0.0417 mA cm2 for 20 minutes to introduced PANI nuclei on to the platinum working electrode, at this current density effective potential at working electrode at which anodic peak potential remains at 0.77 v (vs Ag/AgCl reference electrode). After anodic peak there is a decrease in potential which confirms a uniform polymerized mass of PANI deposited on platinum working electrode. In the process of deposition, first the oligomers with smaller in size are deposited on the working electrode which acts as a seeds and help to deposited PANI polymers on the platinum working electrode. The modification in the topographic surface of the substrate after deposition of PANI thin film on working electrode is confirmed by Atomic Force Microscopy (AFM).

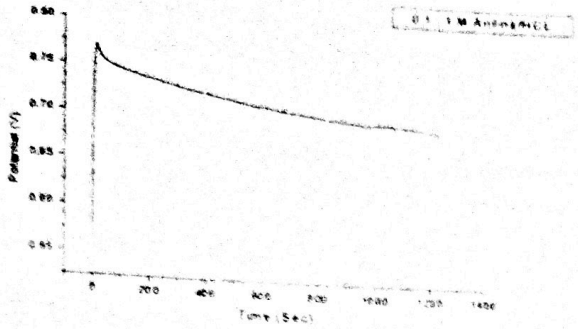

Fig.1: Chronopotentiogram of 0.1 : 1 M aniline/HCL thin film.

The modification in the topographic surface of the substrate after deposition of PANI thin film on working electrode was confirmed by Atomic Force Microscopy (AFM).

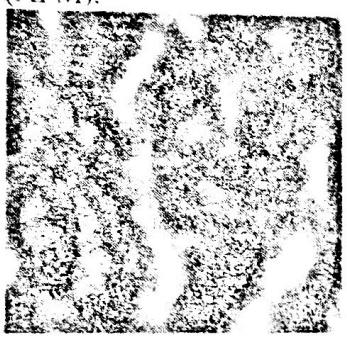

Fig. 2: Surface morphology of PANI thin film by AFM.

The chemical compositions of polyaniline were analyzed by FTIR Spectroscopy. The peak near 3500 cm^{-1} is attributed to stretching mode N-H band. The peak near 3000 cm-1 and 1500 cm^{-1} attributed to C-H sp^3 stretch and C=C stretch for benzenoid group and the peak near 1250 cm^{-1} attributed for stretch quinonoid unit of polyaniline and below 1000 cm^{-1} attributed C-H band

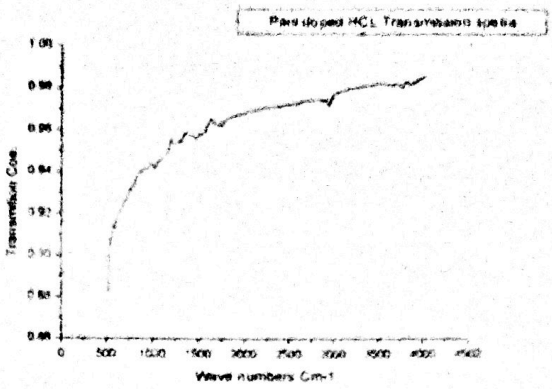

Fig.3 : FTIR spectrum of polyaniline.

CONCLUSION

One step novel electrochemical polymerization technique is utilized to synthesis and characterization of PANI thin film on platinum working electrode at room temperature. A chronopotentiogram is recorded which required less reaction time with lower applied current density as well as do not require any oxidant compare to the chemical oxidative polymerization technique. Surface morphology of deposited PANI thin film was studied by Atomic Force Microscopy, which confirms the deposition of PANI thin film on the working electrode due to roughness of topographic image. Chemical composition of PANI thin film is verified by FTIR Spectroscopy.

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