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One Step Galvanostatical Synthesis and Characterization of Acid Doped Pani Thin Films

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Abstract :

In the present investigation , electrochemical behavior of polyaniline (PANI) thin films which is synthesized by chronopotentiometry on platinum substrate as working electrode in three electrode system. During deposition of PANI thin film, various process parameters Viz. time of deposition, concentration of dopant and applied current density were optimized. Surface morphology was characterized by Scanning probe technique Viz. Atomic Force Microscopy (AFM) which confirms the deposition of 50 nm PANI thin films due to the roughness of the topographic surface of the substrate.

Keywords: Polyaniline Thin films, Chronopotentiometry, surface modification. Atomic Force Microscopy,.

Introduction:

Due to the enormous advanced development in the liberalization, Privatization and globalization which can produce adverse effect on flora and fauna. So it is very essential to monitor our environment for our better tomorrow. Therefore scientists were fascinated towards the Conducting polymers i.e. Polyaniline [1 - 2], polypyrrole [3 - 4], polythiophene [5] which can play an important role to nurture the environment due to its ease of synthesis, low power consumption, tunable conductivity [6 - 10]. conducting polymer synthesized by chemical oxidative polymerization techniques [11, 12] 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 complex to carry out [13]. PANI films synthesize by electrochemical polymerization techniques [14, 15].

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 of 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 * 5 *0.5 mm^3 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 perchloric acid ($HClO_4$) of laboratory grade. In the electrolyte preparation 1 M of $HClO_4$ is added drop wise with continuous stirring in 0.5 M of aniline for half an hour. This solution was 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 1.5 mA/cm^2 for 20 minutes which introduced PANI nuclei on to the platinum working electrode and effective potential at this current density on the working electrode at which anodic peak potential remains at 1.14 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. During the process of deposition, the small size oligomers were first deposited on the working electrode which acts as a seeds based to deposits PANI polymers on the platinum working electrode. The modification in the topographic surface of the deposited PANI thin film substrate of platinum working electrode were confirmed by Atomic Force Microscopy (AFM).

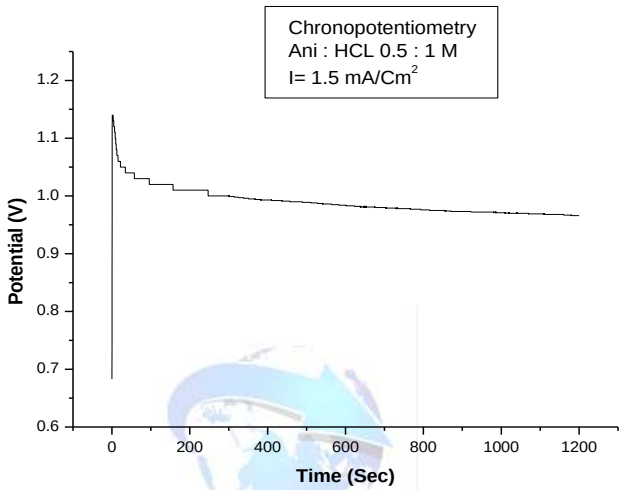


Fig.1: Chronopotentiogram of polyaniline thin film.

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

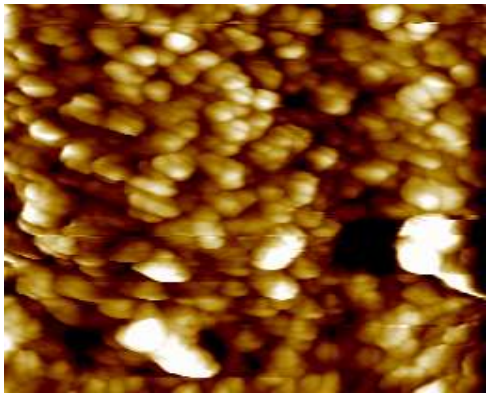
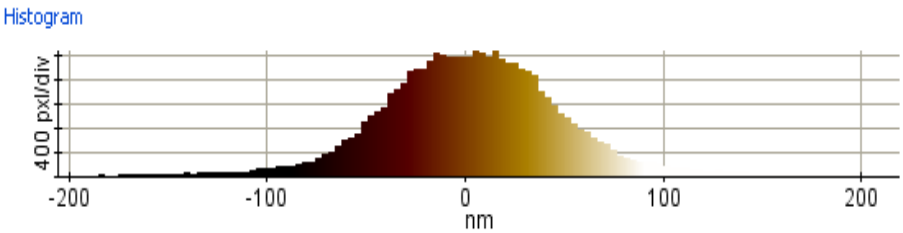


Fig. 2: Surface morphology of PANI thin film by AFM.



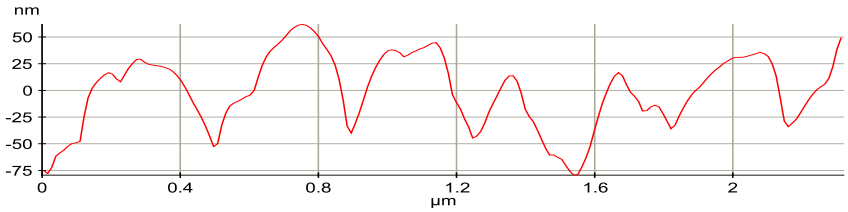


Fig. 2: Histogram of PANI thin film by AFM.

Conclusion:

One step galvanostatic 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. The surface morphology of deposited acid doped PANI thin film was studied by Atomic Force Microscopy, which confirms that more than 50 nm PANI thin film deposited on the working electrode due to roughness of topographic image.

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References:

1. P. Pawar, A.B. Gaikawad, P.P. Patil, Electrochemical synthesis of corrosion protective coating on mild steel from aqueous salicylate medium, Sci. Technol. Adv. Mat. 7 (2006) 732–744.
2. A.H. El- Shazly, H.A. Al-Turaif, Improving the corrosion resistance of buried steel by using polyaniline coating, Int. J. Electrochem. Sci. 7 (2012) 211–221.
3. P. Herrasti, P. Ocon, Polypyrrole layers for steel protection, Appl. Surf. Sci. 172 (2001) 276–284.
4. J.I. Martins, T.C. Reis, M. Bazzaoui, E.A. Bazzaoui, L.I. Martins, Polypyrrole coatings as a treatment for zinc-coated steel surfaces against corrosion, Corros. Sci. 46 (2004) 2361–2381
5. Stelian Lupu, In situ electrochemical preparation and characterization of PEDOT–Prussian blue
   composite materials Synthetic Metals 161 (2011) 384–390
6. Heeger Alan J. " Semiconducting and polymers: the fourth generation of polymeric materials " Synth. Met. **125** 23, 2002.
7. MacDiarmid G " Synthetic metals : a novel role for organic polymers"2002 Synth. Met. **125** 11
8. R.K. Paul, C.K.S. Pillai, B.R. Mattes.(2000) Melt/solution processable conducting polyaniline with novel sulpfonic acid dopants and its thermoplastics blends. Synth. Met. 114 , pp 27- 35.
9. M.T. Nguyen, P. Kasai, J.L. Miller, A.F. Diaz, (1994). Synthesis and properties of novel water soluble conducting polyaniline copolymers. ACS, Macromolecules. volume 27 pp 3625 – 3631.

10. Shirakawa H " The discovery of polyacetylene film : the dawning of an era of conducting polymers"2002 Synth. Met. **125** 3

11. S. Adhikari, P. Banerjee (2010). Enhanced conductivity in iodine doped polyaniline thin film form by thermal evaporation, Thin films volume 518, issue 19,pp 5421 – 5425.

12. Joshi Rajesh A (2016). Preperation and characterization of polyaniline thin films for sensor applications. Int. Res. J. of Science & Engineering, **vo**lune 4 (2) ,pp 51 – 55.

13. M. Jain, S. Annapoorni, Raman study of polyaniline nanofibers prepared by interfacial polymerization, Synt. Met 160 (2010) 1727–1732.

14. O.Kazume , M Bobby Kannan (2013). Galvanostatic polymerization of aniline on steel : improving the coating performance in choride – containing environment. Synthetic metal Vol. 180, pp 54 – 58.

15. P D Gaikwad, D. J. Shirale, V. K. Gade, P. A. Sawale, K. P. Kakade, H. J. Kharat and M. D. Shirsat (2006). Potentiometric study of polyaniline films synthesized with various dopants and composite-dopants : a comparative study Jurnal Bull. Mater. Sci. Vol 29, No. 4, pp 417 – 420.