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Synthesis of Polyaniline for Environmental Monitoring

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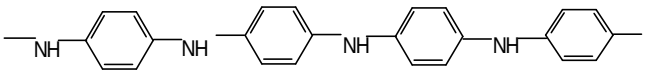
Abstract: ***The branch of science and technology known as sensors has permeated virtually all professional science and engineering organizations. Polyaniline (PANI) receives greater attention as a conducting organic material due to its good environmental stability and suitable for number of practical application. Polyaniline is synthesized electrochemical method were characterized by using electrochemical technique, conductivity measurement, UV-visible spectroscopy, Fourier transform infrared spectroscopy and scanning electron microscopy . Polyaniline having amine functional group can be utilized for environmental monitoring.***

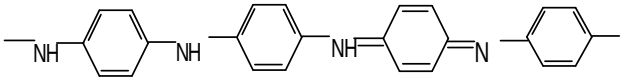
Keywords: Polyaniline, Electrochemical Method, UV-visible spectroscopy, FTIR and SEM.

I. INTRODUCTION

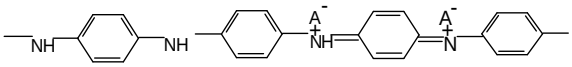
Polyaniline was first known in 1835 as “aniline black”, a term used for anyproduct obtained by the oxidation of aniline. Polyaniline can exist in three isolable oxidation states as “salts” or“bases”, leucoemeraldine (LEB-white/clear or LES-colorless), emeraldine (EB-greenor ES-blue), and pernigraniline (PB-blue or PS-violet), among which emeraldine salt(ES) is partially oxidized form of polyaniline and is the only electrically conductive form[1-2]. The base structure (see Figure 1) of polyaniline consists of a reduced unit or benzenoid attached to an amine (-NH-), and an oxidized unit or quinoid attached to an imine (-N=). The amines and imines are the nitrogenous centers of polyaniline and the ratio of amines to imines dictates the oxidation state. Moreover, the imine sites act as centers for electroactive reactions. Transformations between oxidation states are reversible and controlled using reducing and oxidizing mechanisms. During oxidation polymerization of aniline, pernigraniline (PB) is initially produced. Leucoemeraldine (LEB)



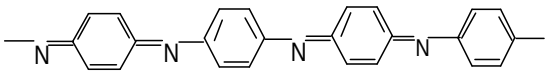
Leucoemeraldine



Emeraldine base



Emeraldine salt



Pernigraniline

Fig.1. (a) Base structure of Polyaniline, (b) for y = 1 the oxidation state is leucoemeraldine, (c) for y = 0 the polymer is in the pernigraniline oxidation state and (d) for y = 0.5 the polymer is in the emeraldine oxidation state.)

Polyaniline attracted much attention because of its physical and chemical properties which make it interesting material for applications in different areas conductive coatings, bio-sensing, molecular electronics, sensors and conducting molecular wires. [3-7].

In this work, synthesized polyaniline matrix obtains an improved interaction with molecules and evaluates the effect of doping PANI on the sensing performance for environmental monitoring.

II. ELECTROCHEMICAL SYNTHESIS SET-UP

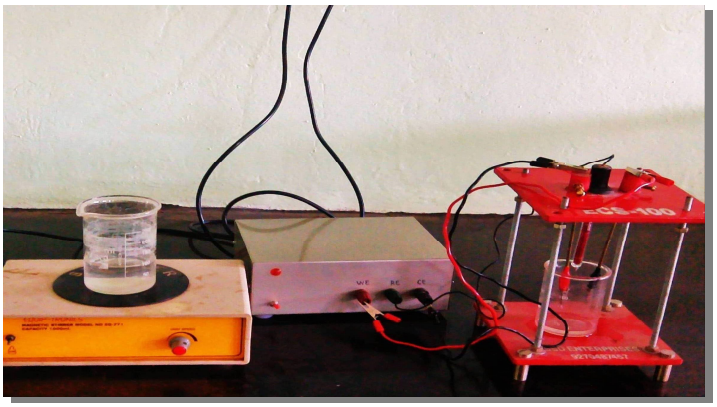


Fig. 2. Schematic of electrochemical synthesis setup along with electrochemical polymerization system

A. Synthesis of PANI-HCl Matrix

The electro polymerization of aniline was carried out by Galvanostatic technique, The Polyaniline Matrix was synthesized from an aqueous solution of distilled water containing 0.2 M aniline and 1 M of Hydrochloric acid (HCl) . After synthesis, polymer coated electrodes were rinsed thoroughly in distilled water and dried in cold air and then used for subsequent characterization.

III. RESULTS AND DISCUSSION

A. Potentionetric studies of PANI-HCl matrix

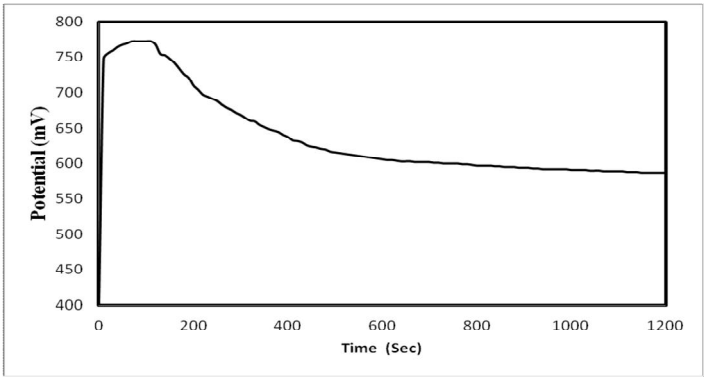


Fig.3. Potentiometric of PANI-HCl matrix

The behavior of the potentiometric synthesis overshoot during first few second probably indicates difficult formation of dimmers and oligomers. After this, potential remain constant suggesting that building up of the films proceeds according to the same reaction along the full thickness of the polymer.

B. UV-Visible characterization of synthesized PANI-Hcl Matrix

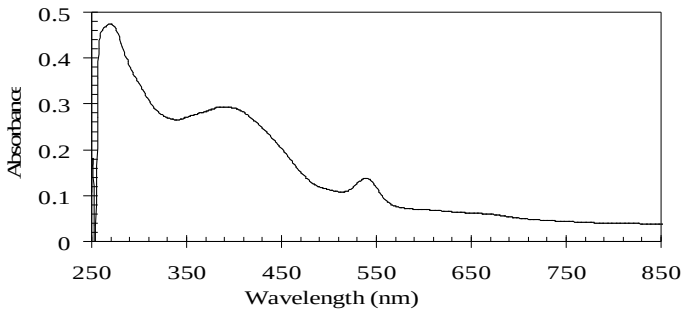


Fig.4. UV-Visible spectrum of synthesized PANI-HCl matrix .

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The UV-Visible absorption spectrum of the synthesized PANI film doped with HCl is shown in Fig.4. The spectra show the presence of three peaks at 300,420 and 800 nm together with a shoulder at 600 nm in DMSO (dimethyl sulfoxide) as a solvent. The peak at 300 nm corresponds to the π-π* transition of the benzenoid rings, while the peak at 400 nm can be assigned to the localized polarons that are characteristic of the protonated polyaniline, together with an extended tail at 800 nm representing the conducting emeraldine salt phase of the polymer. The shoulder at 600 nm represents the insulating pernigraniline phase of the polymer.

C. FTIR Analysis of synthesized PANI matrix

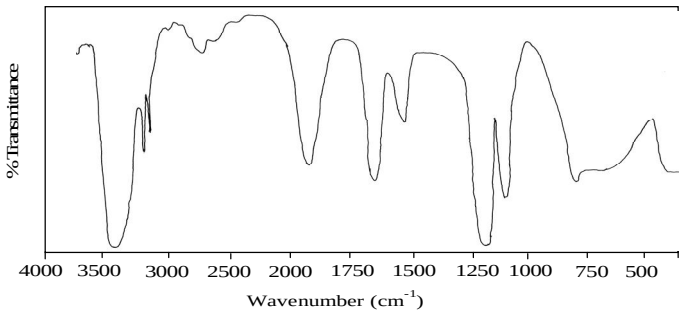

Fig.5. FTIR spectrum of synthesized PANI-HCl matrix.

The molecular structure of synthesized PANI-HCl film was studied using FTIR spectroscopy. The FTIR spectrum of synthesized PANI-HCl matrix is shown in Fig.5. It can be seen that quinoid and benzenoid ring stretching bands are present at 1561 cm^{-1} and 1480cm^{-1}. The C-H in plane and C-H out of plane bending vibrations appears at 1106 cm^{-1} and 704 cm^{-1}. The peak at 1295cm^{-1} is assigned to C–N stretching of secondary aromatic amine. Band at 3440 cm^{-1} is assigned to the N-H stretching band of ES phase of the polyaniline

D. SEM studies of PANI- HCl Matrix

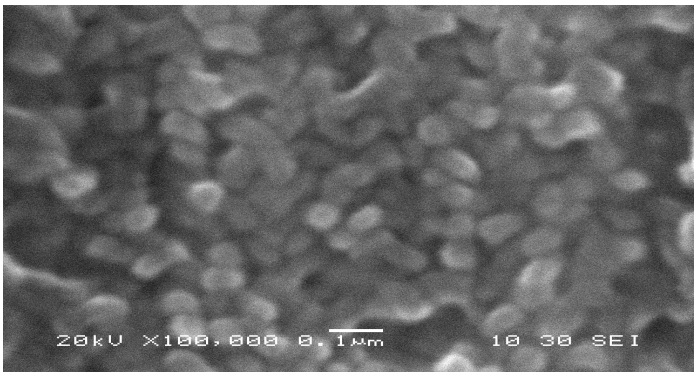

Fig.6. Scanning electron micrograph of PANI-HCl matrix

The scanning electron micrograph was recorded using JEOL, JSM-6360A SEM machine. The Scanning electron micrograph of synthesized PANI-HCl matrix is shown in Figure. 6. It is granular like structure, it show very good uniformity and porosity, which is suitable for immobilization of biocomponent**.**

E. Conductivity studies of PANI- HCl matrix

The electrical conductivity of synthesized PANI-HCl matrix was measured by four probe technique and it was 0.4 7 S/cm.

IV. CONCLUSIONS

The conclusions arrived from the studies are as follows:

Potentiometric measurements were used to identify the redox processes are achieved the electrochemical properties of Polyaniline.The FTIR analysis and UV transitions of aniline were confirmed from the UV spectral studies confirm that, successfully synthesized and outstanding in promoting the NH3 gas sensing performance of the material.

V. ACKNOWLEDGEMENT

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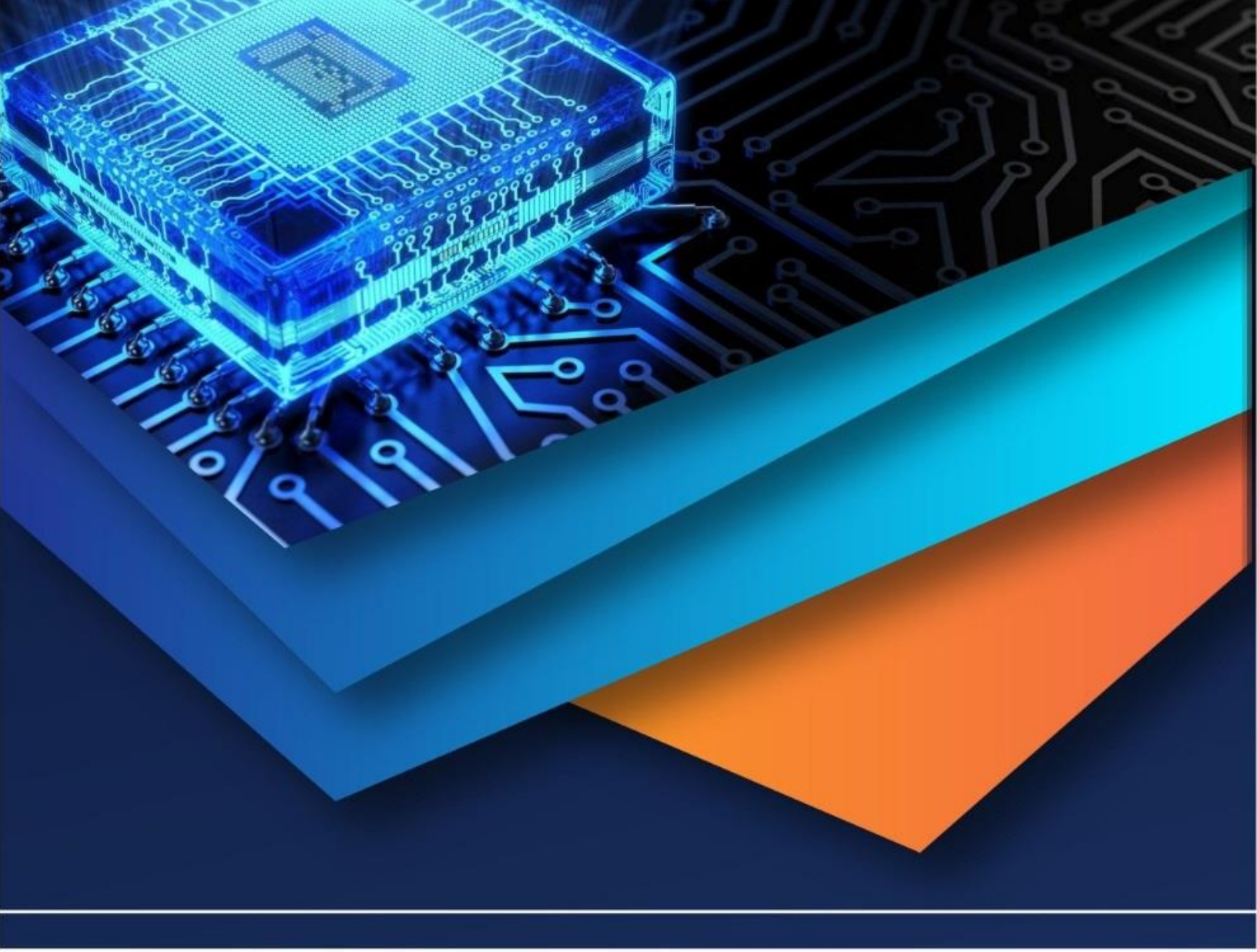

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