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THIN FILM VIA CHEMICAL BATH DEPOSITION ROUTE: PREPARATION OF NANO ZNO/ POLY O-METHOXYANILINE COMPOSITE

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ABSTRACT:

Metal oxide polymer composite thin films achieve great attention due to their unusual properties. Conducting polymers have applications as molecular wires for nanotechnology applications in molecular electronics. In the present study, the conducting polymer polyaniline was deposited on pre-deposited nano-ZnO thin films on glass substrate by chemical bath deposition (CBD) technique. Ammonium persulfate is used as an oxidizing agent during polymer deposition. Nano-ZnO thin film was deposited by microwave assisted CBD technique. Deposited composite film was characterised by FTIR spectroscopy.

KEYWORDS: Nano- Composite, CBD technique, FTIR

1. INTRODUCTION

Conducting polymers and their composites have been successfully applied in batteries, sensors, electrochromic devices, capacitors, solar cells, corrosion inhibitor's, light emitting diodes, metallization, coating for metal surfaces etc [1-2] . The extensive use of polyaniline(Pani) and their composites is due to its ease of synthesis, light weight, less processing cost, chemical stability and conductivity which can be as high as 10 to 10^3 Scm^{-1}[2-3,4].

Conducting polymer can be deposited on conducting surface by electrochemical methods[5], spray pyrolysis, chemically in acidic media using an oxidizing agent.

Polyaniline exists in three different forms such as leuco-emeraldine base(fully reduced), emeraldine base, (partially oxidized) and pernigraniline base (fully oxidised). Among the different oxidation states of polyaniline, the emeraldine salt (ES) is only one the show electrical conductivity. The emeraldine salt can be converted to emeraldine salt (ES) and viceversa, by protonation/deprotonation with acid /base.

ZnO nanoparticles have received great attentions because of their unique catalytic, electrical, electronic and optical properties as well as their low cost and extensive applications in diversified areas[6-7]. We believe the utilization of ZnO nanoparticles in composites with Poly O-methoxyaniline (POMA) may result in new material with useful structures and properties[8-10]. In this study POMA/nano ZnO composites were prepared via chemical bath deposition (CBD) Route.

With the rapid development in semiconductor industries and increasing demand of superior performance for devices, the ability to precisely modulate material interfaces is playing an increasingly dominant part in development of new technologies relevant to our lives. The composite materials showed improved performance of solar cells, and sensors which require high sensitivity are demanded by the surface characteristics of the materials[3,12-15]. Therefore, controlling the structures of material surface and fabricating surfaces with composite materials are extremely important. In present study efforts will be taken to optimize the parameters to synthesis nanocrystalline composite thin films of nano ZnO/Polymer by ultrasonicated CBD technique and the deposited films were characterized by IR spectroscopy.

2. Experimental

Materials used include, O-Methoxy Aniline, Ammonium per sulphate, HCl and nano thin films of ZnO on glass substrate. Chemicals are purchased from sd-fine chemicals of analytical grade.

Preparation of nano-ZnO thin films were synthesised by microwave assisted chemical bath deposition system [11]. First the nano thin film was deposited on glass substrate. Composite film was prepared by immersing the deposited nano ZnO thin

film in a bath. The bath was prepared as follows, 1M HCl solution was prepared with the double distilled water with proper HCl solution supplied by the supplier. O-Methoxy Aniline solution was poured in the 1M HCl solution to get 0.1 M of O-Methoxy Aniline in the total solution volume. The solution was heated in ultrasonic bath to 50^0C at this temperature pre- deposition nano ZnO thin film was immersed in the solution, ammonium per sulphate was added as per requirement. Then ultrasonic wave knob started and kept the system for 1 minutes for the preparation of composite thin films. Due to ultrasonic bath of deposition ions are embedded into the nano ZnO thin film and the composite film may be form as per the one of the scheme shown in Fig 1 and Fig2 [20].

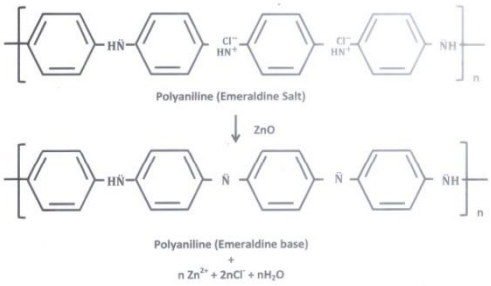

Fig. 1 *Scheme I*

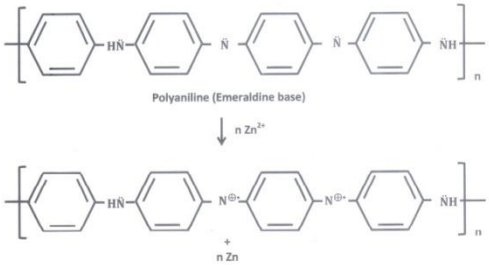

Fig. 2 *Scheme II*

3. RESULTS AND DISCUSSION

For the confirmation of the conducting polymer/ZnO composite deposition deposited film was characterised by FTIR spectroscopy (fig. 3). The broad peak ranging between 500 cm^{-1} and 550 cm^{-1} can be assigned to ZnO group. The vibrational frequencies of C-N are obtained at 1285 cm^{-1} corresponding to ring 3,4. The peak at 1493 cm^{-1} corresponding to C-N of the ring 3. The C-N of the ring 4 is observed at 1531 cm^{-1}. C=N of the ring 2 has two vibrational modes at 1599 cm^{-1} and 1659 cm^{-1}. Two vibrational modes are noticed for the ring 4 and the ring 1,2,3 at 1341 cm^{-1} and 1573 cm^{-1} The band appeared at 1166 is assigned to the ring 1,2,3,4[5,16-19].

The IR peaks at 1600 and 1500 are due to the quinoid (C=N) and benzoid (C-N) group respectively[16-19]. The ratio of quinoid to benzoid absorption peaks was used to estimate the extent of oxidation of the polymer

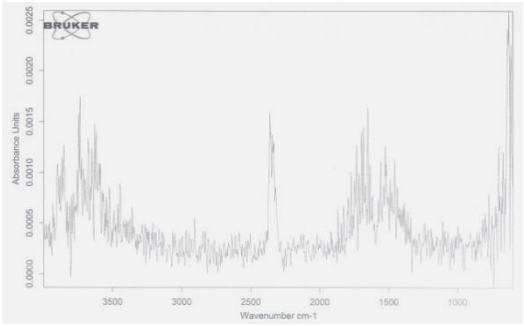

Fig. 3 *FTIR spectroscopy of composite nano ZnO/Polymer thin film*

4. CONCLUSIONS

The formation of Poly O-Methoxy aniline/nano-ZnO composite thin film was successfully achieved by the chemical bath method. The formation of quinoid and benzoid ring ratio of which reveals the extent of oxidation of polyaniline the formation of oxide and reduced state of polyaniline. Detailed of the conductivity dependent and oxidation extent of polymer composite on concentration of O-Methoxyaniline and supporting electrolyte will be studied in future. Also surface morphology will be studied in the future.

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