INVESTIGATION OF SYNTHESIS, STRUCTURAL AND ELECTRICAL PROPERTIES OF PANI/CdO COMPOSITE

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Abstract

Science and technology of nanoscale materials is enriched by developing new synthetic technology and its applications in various fields.The polyaniline matrix to form its Nano composite enhances the structural and properties of PANI for wider uses. Existing studies reports the research of CdO oxide dispersed PANI Nano composite with the help of oxidize agents APS by technique insitue method. . Compound of PANI with has been produced by addition with CdO oxide powder gradually in the response mixture through oxidative polymerisation with APS. The mixtures were well categorized like as XRD, SEM, DC conductivity of the pure polyaniline PANI NC with is studied as purpose of temp.

Keywords: PANI, SEM, XRD, DC conductivity.

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INTRODUCTION

Polymericmaterials have become an area of increasing interest in research because of the fact that these materials have great potential for solid-state devices. The present trend on conducting polymers especially polyaniline family has attracted much more attention of all the scientists worldwide, because of their easiest properties of synthesis, unique conduction mechanism, high environmental stability in the presence of oxygen and water, low cost, light weight and good sensing capability [1-3]. Conducting polymers have a wide variety of applications in the industrial and medical fields. The features of conducting polymers such as reversibility, availability in film form and good environmental stability enhance their potential use for practical applications. One of the most widely studied conducting polymer is polyaniline (PANI)[4-6]. Study this fields o essentially conduct of polymers in development almost 3 decading before while Shirakawa's groups establish drastically rise in the electrically conductivities Poly-acetylenes film while expose to iodinize vapors. Subsequent get through, a lot of conjugating molecule found polymerized and produce conjugates polymer moreover insulate or semiconducting corroded states. These conjugates polymer study essentially conduct polymer. The assets of the electrically above polymer are owing presence of π-electron and function of waves delocalizing in excess of extended portion polymeric order while the molecules organization of spine is planaring[5-6].Conducting PANI containing CdO, is called PANI-CdO composite with variable composition may lead to desirable properties. PANI can be synthesized by chemical or electrochemical routes. The PANI exists in a variety of forms which differ in the chemical and physical properties [7-10] such as leucoemeraldine (reduced form and is yellow in colour), protoemeraldine (brown), emeraldine (green), nigraniline (blue), pernigraniline (violet).Emeraldine, nigraniline and pernigrandline in highly crystalline forms were produced by oxidation with hydrogen peroxide, perchloric acid and potassium dichromate respectively [12]. Polyaniline receiving more attentions due to it's a sole reversibly doped protons, synthesis is very easy, governing electrical conductivities, electrical conduct ivies is high, naturally good stabilities. The three oxidation states are idealize in PANI oxidation in the first state reduces the $(C_6H_4NH)n$, these are poor conductors,colorless and more reactives. The second one is fully oxidized base $(C_6H_4N)n$; these oxidizes are colors in blu or violet , environmental stable but conductor is poor. Oxidation state third is wide oxidize state of PANI it is partly oxidize $([C_6H_4NH]_2[C_6H_4N]_2)n$ obtain the base is blue and salt is green this is unstable environmentally and the chemical behaviour does not change undergoes [13]. Polymeric conducting are recognized to demonstrate outstanding redox performance and consequently these are predictable to be potentially helpful for their application as catalysts. Polymer support catalysts have been investigate in the precedent. on the other hand, conducting polymers offer huge advantages due to effortlessness of synthesis, stability, processability under experimental conditions. Prepare the PANI composites contain metallic oxides with variables composite may leads to preventive property [14-16].

The present investigation was particularly focuses on the fabrication of PANI/CdO composites, which has wide properties like being odourless and nontoxic as well as possessing high hardness, greater purity and high melting point. However, CdO may be an add-on benefit in the field of polymers; particularly, provide good application when doped to PANI. Various representation techniques were used to examine the produced NCs

Materials and Method:

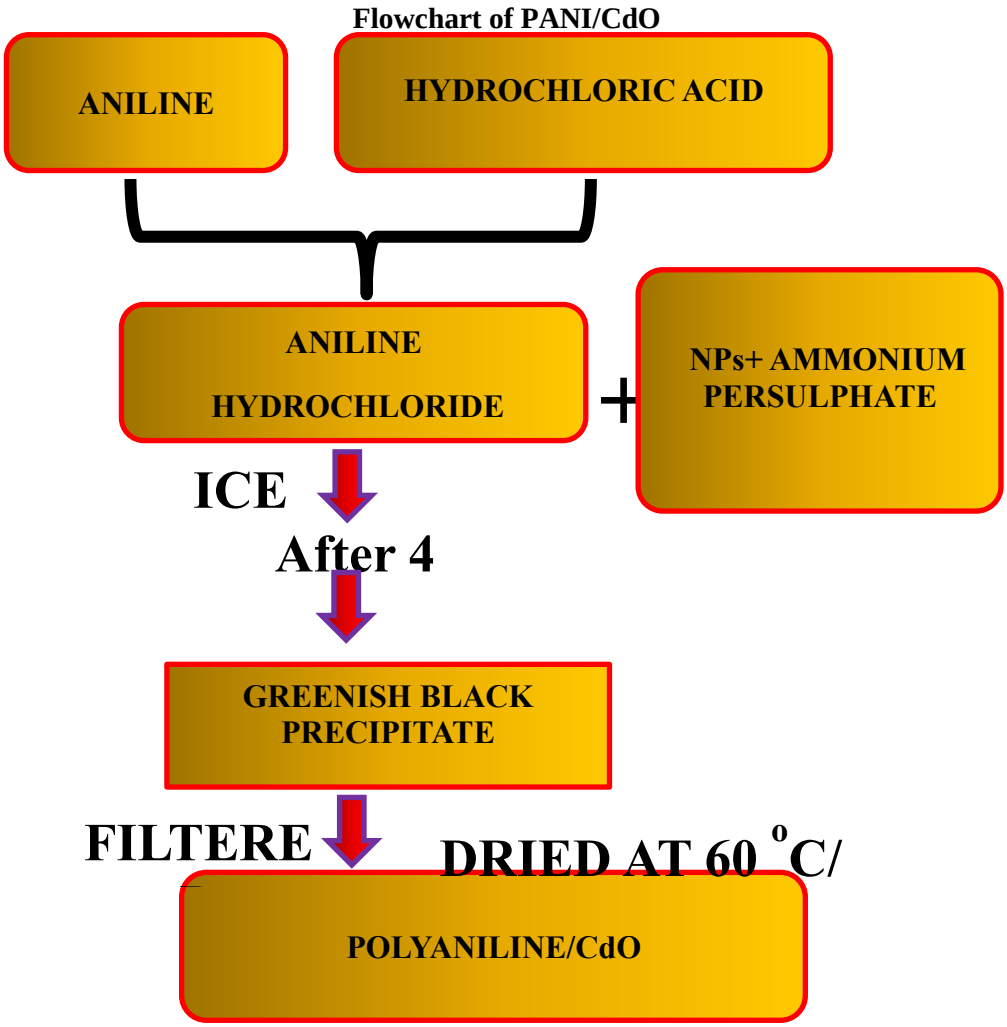
Sample preparation

Chemicals used to prepare polyaniline are aniline (Sigma Aldrich Chemicals), hydrochloric acid (HCL, Sigma Aldrich Chemicals), ammonium persulfate $(NH_4)_2S_2O_8$ (Sigma Aldrich Chemicals). All the chemicals used in this experiment were analytical grade. PANI was synthesized by employing chemical oxidative polymerization method using aniline as monomer in the presence of HCL as catalyst and $(NH_4)_2S_2O_8$as an oxidant.

Polyaniline−cadmium oxide composite:

The 0.1M solution of aniline is dissolved in a beaker along with prepared solution of 0.1N of hydrochloric acid and this mixer is stirred for one hour by magnetic stirrer at room temperature. After one hour of constant stirring, the prepared solution of 0.1M of ammonium persulfate was added drop wise to the solution of aniline hydrochloric acid using pipette. Cadmium oxide was added in the mass fraction to the above solution with vigorous stirring in order to keep the CdO homogeneously suspended in the solution. This mixer was stirred for 10 hr for the completion of reaction, then it kept for 24 hr to settle down. Later the prepared solution is filtered using vacuum pump and buchner funnel. Then precipitate was filtered, washed with deionised water and with acetone in order to remove the oligomers and excess ammonium

persulphate, and with 1 N HCl solution to remove the Cl^- ions and unreacted aniline. Finally, the precipitate was dried in an air oven for 24 hr at room temperature to achieve a constant mass [17]



Results and Discussion

X-ray diffraction:

X-ray diffraction (XRD) is a central technique for the determination of the structure and composition of obtained composites. The XRD confirmation of the crystal phases of polyaniline and PANI/iron composite samples depicted in figure 1 and 2 respectively. The broad diffraction peak was observed between diffracted angle 2θ ranges from 26^0-30^0 which is characteristic peak polyaniline suggests the amorphous nature of the prepared PANI. The broad diffraction peak with d spacing d=3.29 corresponds to the reflection (200) due to parallel and perpendicular periodicity of the polymer (PANI) and no extra diffraction peaks are observed. Compared to pure PANI, it is observed that, the intensity of the prominent peak is decreasing from 1800 counts to approximately 1300 counts as doping CdO concentration increases. This decrease in the intensity of the peak suggest that the, Cdo is dispersed in the PANI matrix.[18-20].

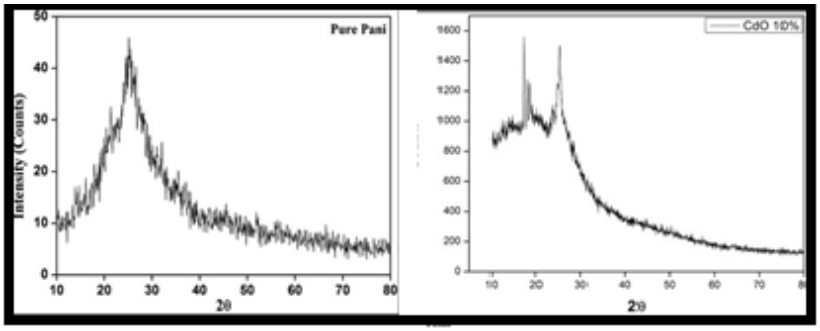
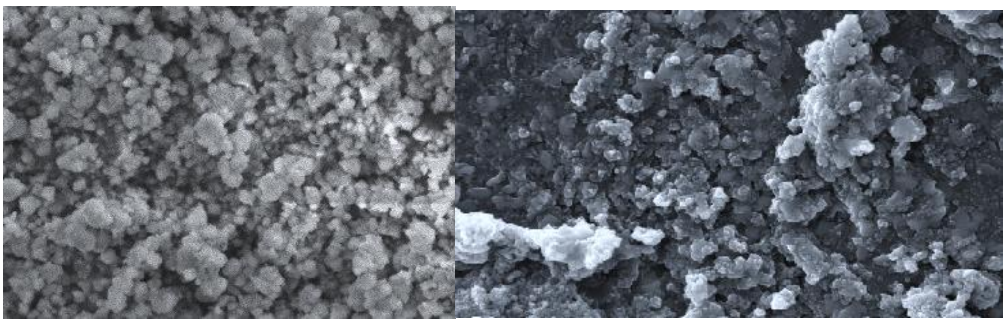


Fig : illustrate XRD patterns of PANI

SEM

SEM micrograph of conducting polyaniline manufactured by chemical oxidative method is shown in figure it can be clearly seen that the micrograph of polyaniline is branched and same. Since Hydrochloric acid is used as protonic acid in the research of polyaniline, the attendance of microcrystalline arrangement can be seen. The occurrence of microcrystalline structures in polyaniline in these particular samples can be confirmed from XRD studies. Since conducting polymers are very sensitive to the temperature, due to the interaction between electron and the sample, considerable amount of heat is generated which causes the development of mall cracking in the sample during SEM recording. A granular morphology of the microcrystalline structures is measured and is found to be about 312 nm in diameter for polyaniline which is consistent with other reports. The contrast in the image is a result of differences in scattering from different areas of the surface as a result of geometrical differences. SEM image shows agglomeration of particles having irregular shape which confirms the CdO were non-equally distributed in the polymer matrix. And also, from the SEM image it is observed that CdO particles were surrounded by PANI matrix and hence it appears as agglomerated macromolecules. [21-23]



SEM micrograph

DC CONDUCTIVITY OF PURE POLYANILINE

The charge transport mechanism in the natural PANI and PANI/ CdO composite, for the electrical conductivity as behavior of temperature is examined. The dc electrical conductivity increases exponentially with increase in temperature which is suggesting the behavior of the semiconducting nature. Fig shows the DC conductivity of polyaniline it is observed that the conductivity increases with increase in temperature it's because of hopping of polarons from one state to another state and this is the characteristics behaviour of semiconducting materials Figure- is the dc conductivity plot of the PANI and composite as function of temperature. The conductivity of the PANI and composite PANI increases with increase in the temperature which is the characteristic behaviour of the material suggest the semiconductor nature of the material. It is observed from figure that, conductivity of PANI showing in two phase i.e., the conductivity in the range 100°C - 140°C and 160°C - 200°C. [16-19]

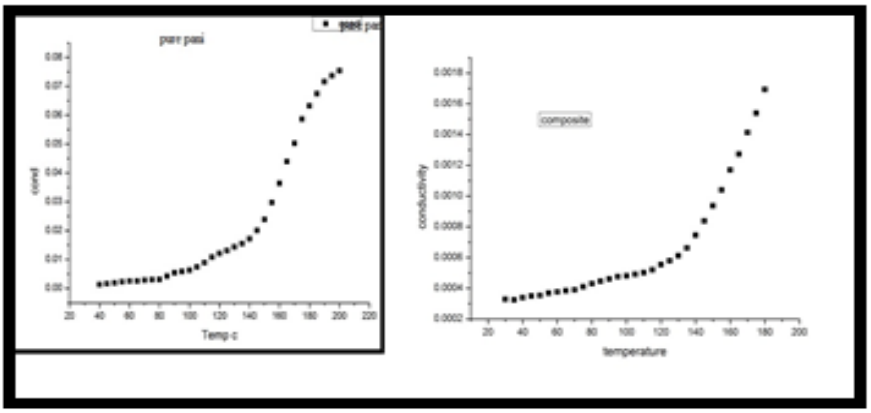


Fig shows the DC conductivity of polyaniline

Conclusion

In conclusion, the Pani/CdO NCs were successfully produced using an in-situ polymerization scheme. The amorphous nature of

pure PANI and the cubic phase of CdO nanoparticles are confirmed by XRD patters and also the morphology of pure PANI and blends was investigated in depth with SEM micrographs. The DC Conductivity of Pani/CdO displays superior electrical characteristics when compared to the other NCs. samples might be related to the chain length, as evidenced by the IR graph. Enhanced charge polarization might be the cause of increased conductivity. The extreme temperature-dependent DC conductivity seen in Pani/CdO samples might be related to the chain length, as showed by the IR graph. Enhanced charge polarization might be the cause of amplified conductivity. To summaries, the current Pani/CdO hybrids NCs are promising materials for fabricating optoelectronic devices, according to the findings and the designed NCs materials belongs to the semiconductor.

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