"Synthesis and Surface morphology of copper oxide nanoparticles embedded polyaniline nanocomposites"

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***ABSTRACT*:**

The Chemical Oxidation method is used to synthesize the Conduction Polyaniline(PANI)/ Camphorsulfonic acid (CSA)/ copperoxide (CuO) nanocomposites. The distinctive nature of nanocomposites were described by Scanning Electron Microscopy (SEM) X-ray diffraction (XRD) to examine the effect of copper oxide nanoparticles incorporation on its morphology of the conducting Polyaniline. SEM imaging discloses the appearance of copper metal ions evenly embedded into PANI. The XRD results depict the amorphization of the sample do the addition of CuO nanoparticles indicated by broadening the peaks.

Key words: Polyaniline Nano composite, SEM.

I. INTRODUCTION

In this modern era, the Conducting polymers play a major role in the field of material synthesis and research. List grows including, polyaniline, polypyrrole, polythiophene etc., which have got much impartment due to their easy synthesis and potential applications in compound and electronic devices. In addition, designing a proficient and minimal effort solar cell is an additional pride due to their significant electrical properties, for example, low working temperature, ease, adaptability and simple and processability. Polyaniline is one of the important conducting polymer in a present era [1-2].

The optoelectronic properties are affected by addition of polyaniline with different acidic substances and by altering the synthetic nature of conducting polymer which increases number of productive active sites[3-4]. Camphor sulfonic acid, p-toluene sulfonic acid, Lignin sulfonic acid, Tannin sulfonic acid, Hydrochloric acid, Sulfuric acid are potential dopants for Polyaniline. Out of these varied dopants, camphor sulfonic acid doped polyaniline has increased the compound strength, therefore unique changes has been observed in the properties and have executed as preferable changes in morphology materials over polyaniline itself [5-6].

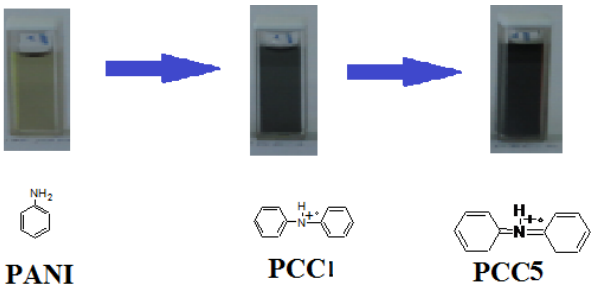
II. MATERIALS AND METHODS:

EXPERIMENTAL WORK:

Polyaniline (C_6H_7N) is distilled under reduced pressure, Camphorsulfonic acid (CSA, $C_{10}H_{16}O_4S$) acts as a active agent when added to liquid reduces its surface tension , Copper oxide (CuO) is utilized as provided. APS, ammonium peroxydisulfate $(NH_4)_2S_2O_8$) is used as oxidizing agent, hydrochloric acid (HCl) and all other chemical substances used were of high standard purity grade.

Synthesis Method

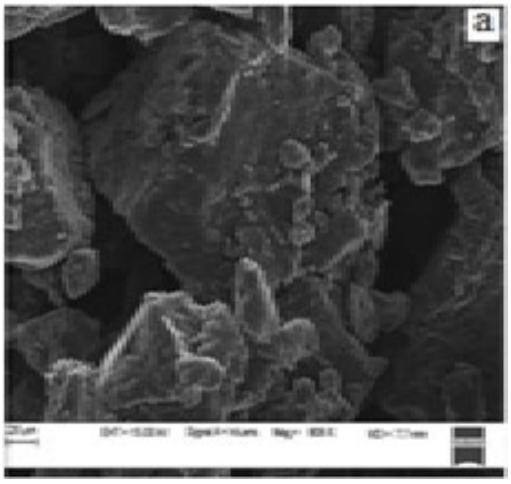
The oxidative chemical reaction method is used to synthesize PANI [7-8]. Double distillation of aniline monomer was carried out before using it in the preparation. 1M HCl solution is used to dissolve Aniline monomer and $(NH_4)_2S_2O_8$ (APS) and ice bath is further used to pre cool these two solutions. Ammonium peroxydisulfate solution was taken in pipette and aniline solution should be added to APS solution drop wise with continuous stirring and filtered to get green powdered sediment . In order to remove excess HCl, the powdered segment was thoroughly cleansed with distilled water and eventually dried at 55°C in a microwave oven to eliminate the moisture content and finally we will get the powdered sample after peeling out the sample from the filter paper and grind in mortar[14-15].



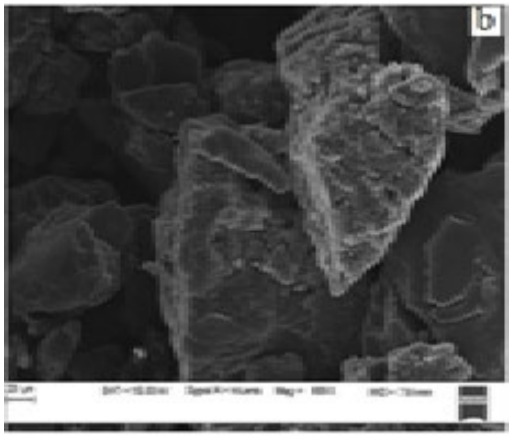
III. RESULTS AND DISCUSSION

Scanning Electron Microscopy

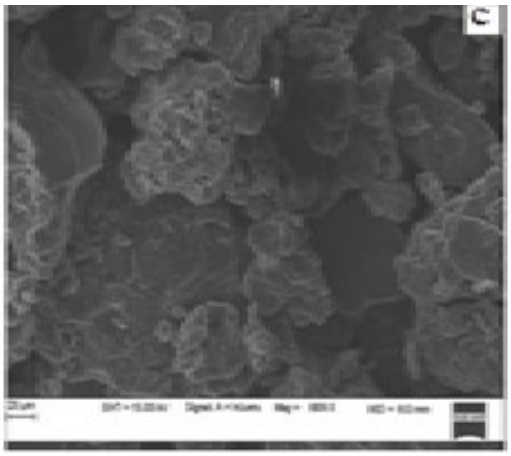
SEM images of these composites were taken to examine the external morphology of these composites. In order to limit the charging effects, all the images were captured using an operating voltage of 15 kV and with a magnification of 100X and volume contribution to the image contrast. The SEM micrographs of these samples are shown in Figure-1.



a)Polyaniline



b) PCC1



c) PCC5

Figure 1 Depicts the Scanning Electron Microscope images of a) Pure Polyaniline, b)PCC1 and c)PCC5.

SEM micrographs taken for PANI, PCC1 and PCC5 are shown in Figure 1. The copper oxide nanoparticles particles are spherical in shape with uniform width lying within in the range of ~50nm and are uniformly scattered. This feature makes PANI/CSA/CUO composites to have better physical properties.

X-ray diffraction Studies

The powder samples poured into desired pieces of required size were taken in the sample holder of Rigaku-Denki miniflex II desktop X-Ray diffractrometer with the settings of 30 kV and 15 mA, Scanning rate has been recorded for the range of 6º- 60º to every step size of 0.02º. the apparent size of the crystals indicates the integral breadth of the diffraction peaks[9].Thus the X-ray diffraction study of a material exhibited towards the microstructural aspects. X-ray diffraction patterns obtained are shown in Figure 2.

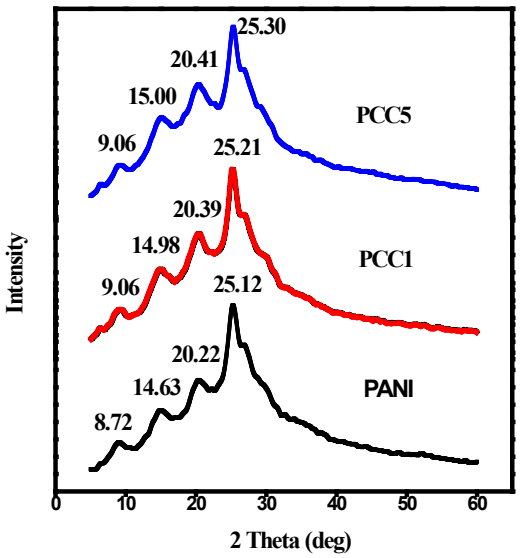


Figure 2 Depicts the X-ray diffraction pattern of Pure polyaniline , PCC1 and PCC5.

From the analytical results obtained for these composites, it is clear that the incorporation of nanoparticles have apparently changed the properties of the parent polymer considerably. Figure 1 shows the XRD patterns obtained for PANI and PANI-CSA-CuO nanocomposites. It is evident that the synthesized PANI and PANI-CSA-CuO nanocomposite matches with the reported JCPDS results, which confirms the preparation [10].

The XRD patterns obtained for these composites revealed that they are doped. Since the quantity of nanoparticles doped to the polymer is considerably very less, the particular reflections due to nanoparticles may not be significant. But the broadening of the reflections essentially validate the incorporation of nanoparticles due to which the composites becomes more amorphous in nature.[11-12]. Further this can be related and compared with the results of AC conductivity results of these prepared samples. The microstructural parameters obtained for these composites are given in Table 1.The calculated the crystallite size (P) by using Scherer Equation (1) and Lattice strain (SL) is estimated using this Equation (2) [10-13].

$$P = \frac{c\lambda}{\beta cos\theta} \qquad (1)$$

$$S_L = \frac{\beta cos\theta}{4} \qquad (2)$$

Table 1 Structural properties PANI, PCC1 and PCC5 composites

sample	2Θ(Deg)	FWHM(β)	P(nm)	S_L
Polyaniline	31.15	18.13	0.65	0.20
PCC1	31.25	18.23	0.69	0.21
PCC5	31.28	18.25	0.54	0.22

CONCLUSION

In summary, Conducting Polyaniline (PANI)/ Camphorsulfonic acid(CSA)/ Copperoxide(CuO) nanocomposite have been synthesized by in-situ chemical method and noble feature achieved with small amount of copper nano particle with CSA Surfactant. Equal distribution of copper nano particle in the polymer matrix was studied by SEM and XRD result indicates that the concentration of the copper oxide increases with decrease in crystalline size of PANI matrix.

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