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Synthesis and characterization of silver Nano composite polyaniline

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ABSTRACT
Conducting Polyaniline were prepared in the presence of oxidizing agentpotassiumdichromate by chemical oxidation method. The PANI/ Ag Composite were synthesized with various Compositions viz.,0.5N,0.05N,0.005N,0.0005N of $AgNO_3$ in PANI. The surface morphology of the composite were analyzed using Scanning electron microscope (SEM) show that Ag particle are embedded in polyaniline chain to form multiple phases. The powder X-ray diffraction (XRD), Spectrograph suggests that they exhibit semi-crystalline behavior. It was also found that the electrical conductivity of PANI/Ag nanocomposite was about 100 times higher than that of pure polyaniline.
Keywords: Polyaniline, Silvernanoparticle,SEM,XRD, Electrical Conductivity.

I. Introduction

The nanocomposites with an organized structure usually provide a new functional hybrid, with synergistic properties over their single component counter parts which have attracted considerable attention for their potential applications. Conducting polymer nanocomposites possess the advantages of both low dimensional systems (nanostructure filler) and organic conductors (conducting polymer). The reinforcement of polymers are done by fillers which play a major role in strengthening the properties of the nanocomposites.Uniform dispersion of the nanosized filler particles produces ultra large interfacial area per volume between the filler and the host polymer . The conducting polyaniline (PANI) is one of the promising conducting polymers due to its high conductivity, ease preparation, good environmental stability and large variety of applications which make this polymer suitable as a matrix for preparation of conducting polymer nanocomposites.

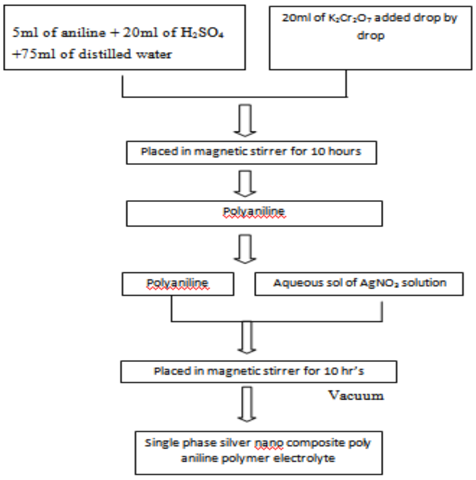
It is easily prepared by the oxidation of aniline in aqueous medium. The composites based on conducting polymers and noble metals, such as silver can be prepared by many ways. Some of the ways are simple blending of both components , the polymerization of aniline in the presence of preformed metal nanoparticles , the deposition of metal on conducting polymer while using various oxidants, such as glucose, the reduction of noble-metal compounds with PANI and the oxidation of aniline with noble-metal compounds. Simultaneously aniline can be oxidized with noble-metal compounds to produce PANI andcorresponding to metal.We present here the preparation of conducting polyaniline/silver nanoparticles (PANI-Ag) - nanocomposite by in-situ polymerization of aniline in the presence of silver nitrate as precursor using sulphuric acid and its characterizations.

II. Experimental methods

Aniline (99.5%), silver nitrate (99.5%) and potassium dichromate(99.5%) were procured from Sigma Aldrich.Aniline was distilled prior to use. All supplementary chemicals were analytical grade and solutions were prepared with double distilled water.The XRD measurement was performed on a Philips PW1710 automatic X-ray diffractometer using Cu-Kα wavelength (λ=1.54059 Å).

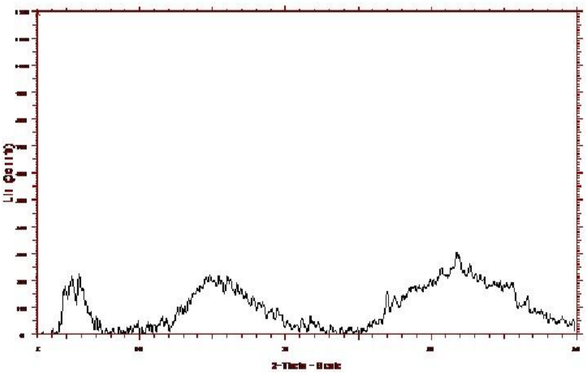
Synthesis of PANI-Ag nanocomposite

0.2M aniline was dissolved in 1M sulphuric acid and the silver nitrate was mixed. The solution was oxidized using APS with the same molar ratio to that of aniline and the mixture was kept at room temperature (30°C). The reactionwas slow, characterized by an induction period extending for week. Green solid produced in the oxidation chemical method and it was collected by filter after 10 hours , rinsed with corresponding nitric acid and dried at room temperature. The reaction is as follow

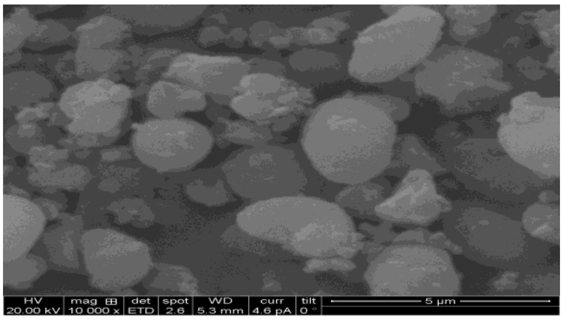


III. Results and discussion

XRD pattern of PANI-Ag nanocomposites is shown in **Fig. 1**. The sharp peaks of the XRD pattern indicate that the synthesized nanocomposite is well crystalline and confirms the formation of single crystalline Ag nanoparticles in PANI/Ag. Bragg's reflections at 2θ = 4.2, 6.3, 15.5, and 32.4 degree corresponds to {111}, {200}, {220}, and {311} lattice planes, respectively, for the face-centered cubic (fcc) structure of silver nanoparticles embedded in PANI. The broadening of peaks shows the formation of nanocomposite and the average crystallite size was estimated to be 12 nm using Scherrer formula

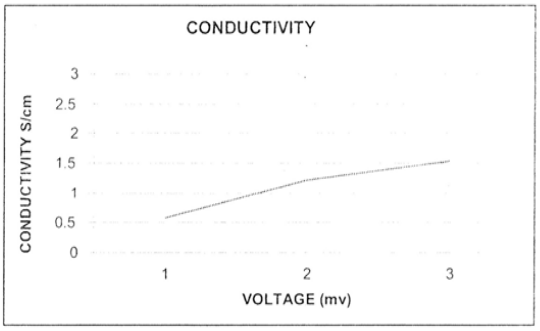


XRD pattern of PANI-Ag nanocomposite.



SEM image of PANI/Ag nanocomposite

Scanning electron microscopy images of PANI-Ag nanocomposite are shown in **Fig. 2**.It can be seen from the figure that the finestructure of PANI-Ag nanocomposite is uniform distribution all over the sample.



Electrical Conductivity of PANI-Ag nanocomposite as a function of temperature.The conductivity decreases above 70^{o}C due to the presence of absorbed water and its removal may have caused structural changes in the hygroscopic PANI polymer chains which revealed a small weight loss below 125^{o}C. The conductivitydecreases with increasing temperature is owing to chemical change, its degradation or evaporation of dopant. Furthermore, it has been reported that a dry sample has lower conductivity than a hydrated sample and loss of moisture results in a decrease ofconductivity for polyaniline and PANI-Ag nanocomposite.The increase of conductivity until the criticalpoint is attributed to polymer chain mobility and activation of dopant while the decrease of conductivity can be attributed to the volatization of dopant, followed by structural change. The change of chain structure by thermal treatment and interchange interaction between two components has an effect on morphological change. In addition, with increasing temperature, the intermolecular spacing between adjacent chains of the composites is decreased. The electrical conductivity of composites represented by silver nanoparticles.

IV. Conclusion

PANI-Ag nanocomposite was successfully synthesized by simple chemical oxidation method. PANI-Ag nanocomposite is well crystalline with average crystallite size of 12nm. SEM study reveals the surface morphology of PANI-Ag nanocomposite. The combination of PANI as a semiconducting polymer with silver as a noble metal may produce hybrid material that behaves as semiconductor at low temperature and as metal at high temperature.

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