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Green Fabrication Of Polyaniline - AgO Nanocomposites For Structural And Morphology Studies

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Abstract: Polymers with metal oxide materials constitute a new class of polymer composite materials, that integrates materials science and technology. Chemical oxidation of aniline is carried out for Polyaniline (PANI) and in-situ polymerization for PANI/AgO nanocomposites materials. The AgO nanoparticles can be synthesized by solution-based methods including co-precipitation, hydrothermal, micro emulsion process, sol-gel techniques, combustion reaction and so on. We adopted Green synthesis of multifunctional Silver oxide nanoparticles (NPs) were prepared by low temperature solution combustion route employing *Aloe-Vera* gel as a fuel. The current investigation demonstrated green engineering method for the synthesis of multifunctional AgO nanoparticles in the PANI matrix have a greater influence. Obtained PANI/AgO NCs were characterized structural and morphology via PXRD, FTIR, SEM AND TEM.

***IndexTerms* - PANI, AgO, Nanocomposites, XRD, SEM.**

I. Introduction

Research on conducting polymer composite materials combines the science and technology of polymeric materials. Conducting polymers have a variety of applications in the Industrial, Scientific and Medical (ISM) fields. Applications like anticorrosion, static coating electromagnetic shielding etc. comes under I generation. II Generation of electric polymers have applications such as transistors, LEDs, solar cells batteries etc. Controlled conductivity, high temperature resistance, low cost and ease of bulk preparation make these materials attractive in the engineering and scientific world [1-5]. The features of conducting polymers such as reversibility, availability in film form and good environmental stability enhances their potential use for practical applications. One of the most widely studied conducting polymers; polyaniline (PANI) can be obtained chemical or electrochemical method. Polymeric materials have become an area of increasing interest in research because of the fact that these materials have great potential for solid state devices [4-6]. PANI has received much attention because of its unique reversible proton doping, high electrical conductivity, ease synthesis, environment friendly and cost effective. Conducting PANI containing such metal oxide materials called PANI nanocomposite with variable compositions may lead to desirable properties. These materials are especially important owing to their bridging role between the worlds of conducting polymers [12-15]. However, in this paper has been reported the synthesis technique of PANI and PANI/AgO nanocomposites. The characterization such as XRD and SEM of PANI and PANI/AgO were carried out by characterization tools and studied.

II. Chemicals And Materials

All of the chemicals were purchased from commercial foundations and were used exactly as they were. Sigma Aldrich provided analar-grade chemicals such, as Silver nitrate hexahydrate [$Ag(NO_3)_2 6H_2O$], Aniline [$C_6H_5NH_2$], ammonium per sulphate [$(NH_4)_2S_2O_8$], hydrochloric acid [HCl); Sulfuric acid (H2SO4); Citric acid ($C_6H_8O_7$) purity, and acetone [CH_3COCH_3]. Fresh aloe-vera gel was extracted from the plant. Relevant glassware and Ceramic crucibles. Autoclaves are used to sterilize instruments, glassware and plastic-ware, Ceramic crucibles solutions and media.

III. The Polymer Synthesis

In order to make Polyaniline, an aqueous solution of aniline is combined with ammonium per sulphate ($(NH_4)_2S_2O_8$). A greenish black precipitate was produced, which was filtered out and treated with acetone as a cleaning agent. PANI powder was formed and then dried for 24 hours in a hot air oven at around 80 °C and finally obtained the pure PANI as shown in Fig 3.1.

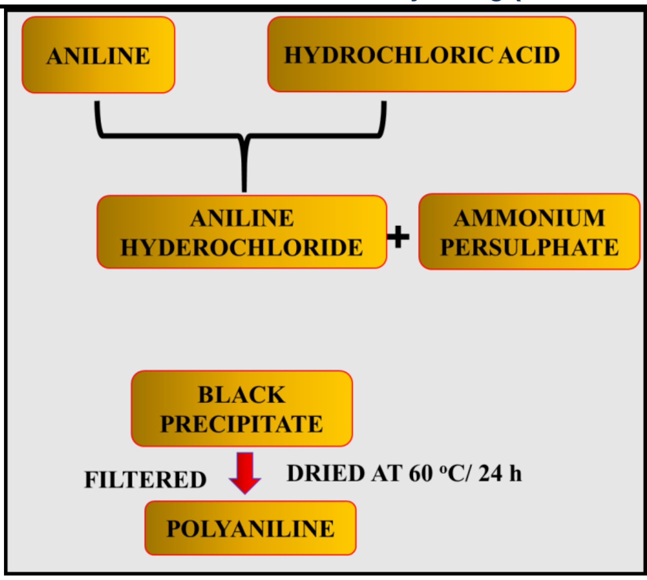

Fig 3.1 Synthesis flowchart of PANI

IV. Green Synthesis of AgO Nanoparticles

Using Aloe-Vera (A.V.) gel as an organic fuel, a low-temperature Solution combustion method was used to produce AgO NPs. In a ceramic crucible, 1.690 grams of Silver nitrate hex-hydrate was placed, and 15 ml of A.V. gel was put into the crucible and place on the magnetic stirrer for uniform mixture. The response combination was then placed in a pre-heated muffle furnace at a temperature of 600 degrees Celsius. The metallic nitrates and the fuel undergo a combustion process shown in Fig 4.1. resulting in nano powders of AgO.

Fig 4.1. Schematic representation of the combustion synthesis of Silver Oxide nanoparticles

V. Synthesis of PANI/AgO Hybrid Nanostructures

An in-situ polymerization method was used to combine PANI with AgO NCs. To achieve homogeneity, 0.1 M aniline was combined with 1M hydrochloric acid (HCl) and agitated for 15 minutes. Silver oxide (AgO) NPs were added to the aforementioned mixture at the appropriate weight percentage to homogeneously distribute the AgO NPs. The oxidizing agent, 0.2M ammonium per-sulphate, was added to the polymer mixture drop-by-drop with constant stirring and kept at ice temperature for 4 hours to complete polymerization. The precipitate was filtered before being washed in acetone and de-ionized water. To get a uniform mass, it was calcined for 24 hours at 80°C in a hot air oven. This method was used to make PANI/AgO NCs with different percentages of AgO (i.e., 5, 10, 15, 20, and 25wt percent). as shown in Fig.5.1.

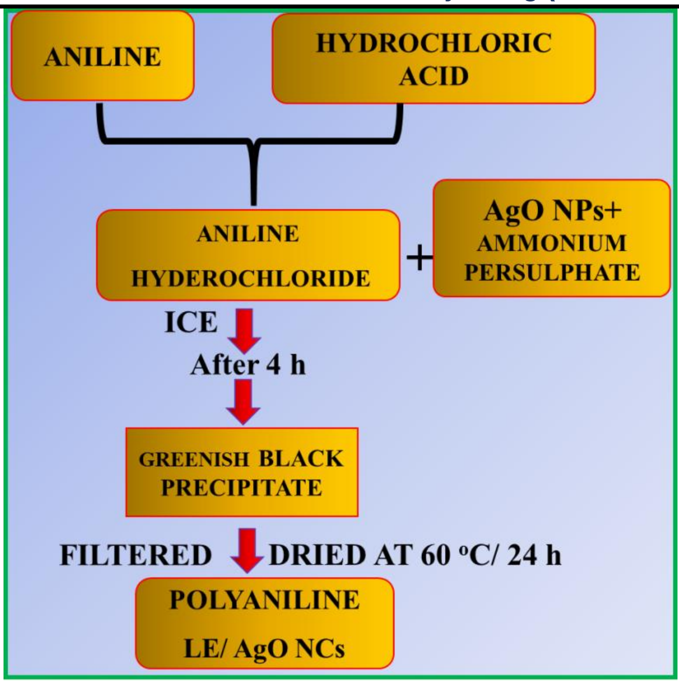

Fig.3.1 Chemical structure of PANI/AgO NCs

VI. Structural Properties

6.1 Powder X-Ray diffraction (XRD) Studies

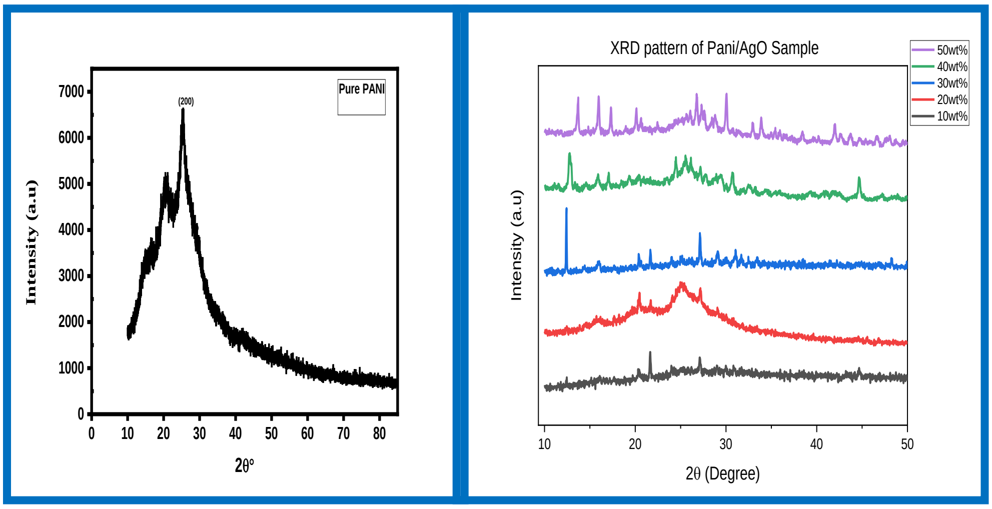

Fig.6.1 PXRD graph of Pure PANI and PANI/AgO NCs

Figure.6.1 shows X-ray diffraction pattern of PANI. X-ray diffraction pattern of PANI suggests that it is amorphous in nature with a broad peak centered on $2\theta \approx 25.56°$, another Figure shows the X-ray diffraction pattern of PANI / AgO nano composite with 10-50 wt. % of AgO in PANI [9-12]. It is seen that the sharp peaks of AgO indicates the crystalline nature of the nanocomposite. It is confirmed that AgO has retained its structure even though it is dispersed in PANI during polymerization reaction. The crystallite size is calculated by Debye Scherer equation is given by$D= 0.89\ \lambda / \beta \cos\theta$ where β is a full width half maximum (FWHM) [12-15].The average crystallite size is 21nm.

6.2 Fourier Transform Infra-Red Spectroscopy Studies (FTIR)

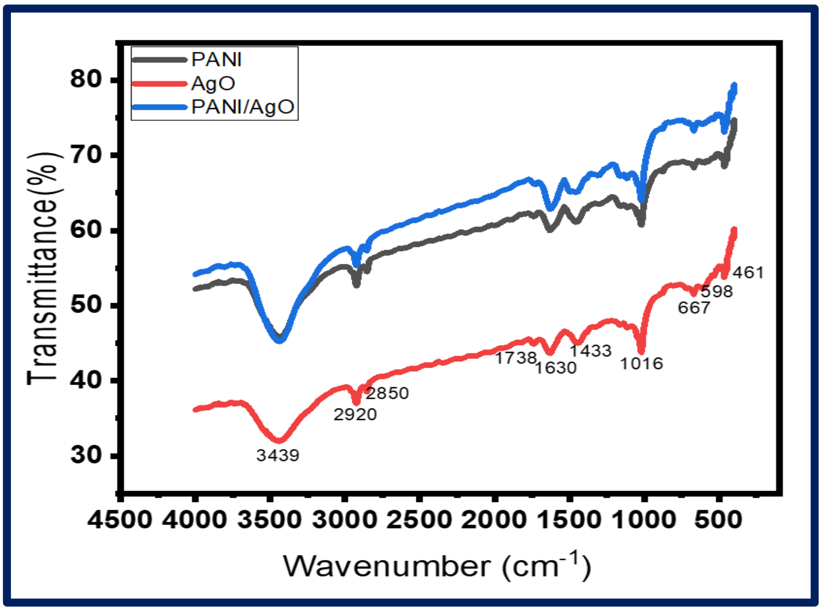

Fig.6.2 FTIR Spectra of Pure PANI, AgO and PANI/AgO NCs

VII. Morphology Studies

7.1 Scanning Electron Microscopy (SEM) analysis

Scanning Electron Microscopy (SEM) images provided the morphology and particle size particulars of the nanocomposites. The SEM images of the synthesized NPs was shown in **Figure.7.1**. The surface morphology of the prepared PANI/AgO NPs revealed that the particles are formed in a nano-semicircular rod shape [9-12]. However above 10 wt% AgO NPs are surfaced in excess of the matrix due to the excess amount NPs added in it. It is initiate that the nanocomposites above 20 wt % highly agglomerated structure.

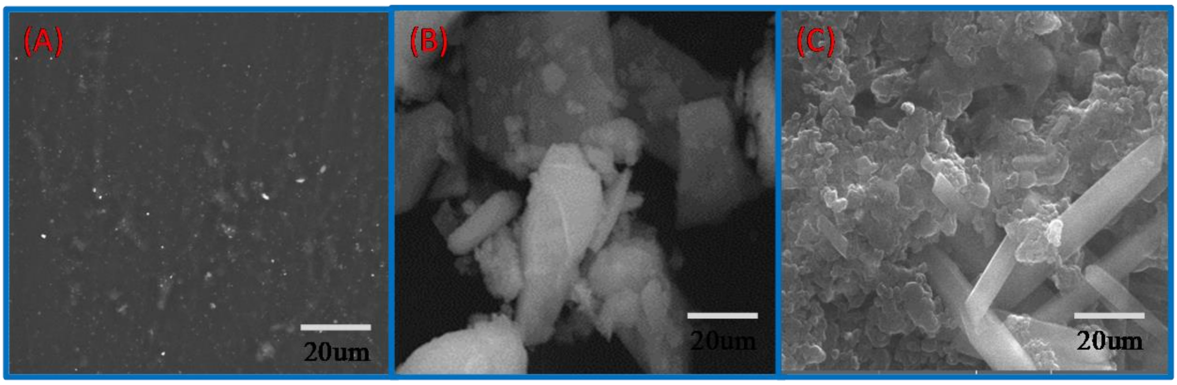

Fig.7.1 SEM image of (a) Pure PANI (b) Pure AgO and (c) PANI/AgO50wt% NCs

7.2 Transmission Electron Microscopy (SEM) analysis

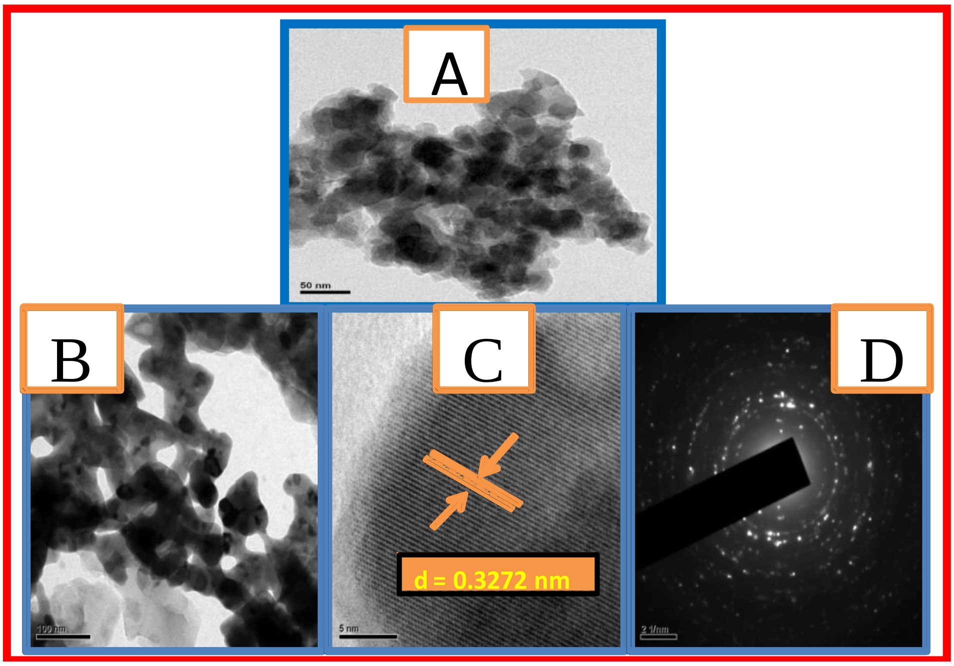

Fig 7.2 TEM Micrographs of (a) Pure PANI (b) Pure AgOand (c-d) PANI/AgO50wt% NCs

It is evident from the figure that, the prepared particles are in nano system and which are in excellent agreement with the average particle size obtained from the PXRD data [9-12]. as of micrographs of TEM, particles size was around 22nm. Figure.7.2 (a-b) and (c-d) Shows TEM image of PANI/AgO NCs (50 wt %) NCs.

CONCLUSIONS

We adopted Green synthesis of multifunctional Silver oxide nanoparticles (NPs) were prepared by low temperature solution combustion route employing *Aloe-Vera* gel as a fuel. The current investigation demonstrated green engineering method for the synthesis of multifunctional AgO nanoparticles in the PANI matrix have a greater influence. Obtained PANI/AgO NCs were characterized structural and morphology via PXRD, FTIR, SEM AND TEM.Insitu oxidation polymerization is carried out for the synthesis of conducting PANI nanocomposites. Structural changes of pure PANI and pure Nano metal oxide has taken place due to the presence of oxide material in the PANI as observed by XRD pattern, crystallite size and obtained the average crystallite size is 21nm which is good correlation with the TEM analysis. Similarly morphology and bonding changes is observed in composite material compared to pure PANI and pure metal oxide.

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