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STUDIES ELECTRICAL PROPERTIES OF PANI/MgO

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ABSTRACT

Effected by in situ chemically oxidative path has been preparedPANI and PANI/MgO oxide doped Polyaniline with altered adding weight percentage of MgOby ammonium persulfate (NH4)2S2O8 as an oxidant & HCL as catalyst. Compound of PANI with dissimilar weight fraction of (MgO) has been produced by addition MgO powder slowly in the polymerization solution of aniline & APS. Further these mixtures were described by XRD & SEM systems to examine their structural and morphological studies. As a part of electrical studies, AC conductivity was studied as a function of frequency.

***KEYWORD*: PANI,SEM, XRD, AC**

INTRODUCTION

The primary focus of recent polymer research has been the advancement of novel nano-composites to enhance the fundamental properties of neat polymers. This focus has led to a proliferation of nanostructures within the polymer environment, aiming to improve characteristics such as Young's modulus, tensile strength, and thermal properties. The main objectives revolve around achieving optimal and uniform dispersion of nanofillers to maximize the available surface area for interaction with the polymer.[1-5]PANI Is an organic conducting polymer it shows both conductivity and semi conductivity properties with the help of electrochemically and chemically routes.PANI deliberate in different methods which vary in chemically and physically possessions: leucoemeraldine is a completely reduces form and is yellow, protoemeraldines is brown, emeraldines is green, pernigranilines is violetand nigranilines is blue[6]. Conducting polymers exhibit electrical properties akin to metals while retaining the advantageous characteristics of organic polymers such as lightweight, corrosion

resistance, elasticity, and cost-effectiveness. Their appeal lies in their ability to be customized for specific applications through modifications in polymer structure and variations in organic moieties. Current commercial applications of conducting polymers span various industries including electronics, plastics, medicine, etc., encompassing thin-film transistors, batteries, antistatic coatings, electromagnetic shielding, artificial muscles, light-emitting diodes, gas and bio-sensors, fuel and solar cells, corrosion-resistant coatings, and more [7-8].Consider the example of polyacetylene, a conjugated polymer where CH3 units are linearly linked with alternate double and single bonds between carbon and hydrogen atoms. This arrangement results in two energetically degenerate kekule structures, which couple to form a surface effect known as a kink or soliton. Solitons represent non-linear phenomena involving the undispersed transport of energy in a medium. In conjugated systems, solitons may be neutral, positively, or negatively charged depending on the number of electrons in the π orbital. The difference between the number of bonds and the degrees of freedom in these lattices determines the presence of zero-frequency 'floppy modes,' indicating mechanical instability, also known as isostaticity.[9]. In conducting polymer systems, two types of hopping processes are involved: inter-chain hopping where carriers move from one chain to an adjacent one, and intra-chain hopping where carriers move along the chain due to conjugational defects. Polyaniline, for instance, exists in three oxidation states, with emeraldine being the most attractive due to its tunability. Various synthesis routes such as in-situ polymerization, dispersion technique, enzymatic polymerization, or solution blending can produce polyaniline. Conductive polyaniline, as well as its composites with metallic oxides, exhibit desirable properties due to their bridging role between the conductivity of polymeric and metallic materials. [10]. Metal oxide-polymer composites have garnered significant attention due to their synergistic properties resulting from both constituents. For instance, MgO, a functional oxide material, when combined with PANI, can lead to improved properties. Characterization techniques such as XRD and SEM are employed to study changes induced by doping in conducting polymers/composites. Additionally, studies on electrical properties provide insights into the behavior of these materials.[11]. The conductive polyaniline contain the property likes metallic oxides resources well-known as composites polyaniline also dissimilaralignment might lead to desirable’s property. Particularly those polyaniline materials were important to owing their bridging role between the worlds of polyaniline conductivity of polymeric [6-9]. Metal oxide detached polymer mixtures have involved a great deal of attention from researchers, because they regularlyshowsurprising hybrid possessions synergistically resultant from both mechanisms. MgO is one of the examples of oxide material,which is known for functional oxide materials with prominent applications .Planning of compounds of PANI covering such metal oxide with variable arrangements maylead to preventive properties [12-13] The current study (PANI) is select as conduct polymers, MgOused to make composites with PANI to tailor various electric and thermoelectric properties of PANI and its composites. Characterization of the

conducting polymers / composites prepared was done to bring out the changes happening due to doping. Diverse characterization techniques working were, XRD and SEM. study on convey properties such as electrical studies were completed for these conducting polymer composite.[14]. A nanostructure metallic oxide is promises the novel material polymer with blended due to its shows good electrical, thermal, physical, chemical, mechanical properties. Separately from the physical property shows good in nanocomposite Attractive to build up an low-cost, simplistic and quick technique use in a solitary-phases binary metallic oxide it obtains numerous application. [15].

MATERIALS AND METHODS

Research of polyaniline Ammonium persulphate (0.2 M) was added drop wise to a stirred solution to prevent warming of the aniline (0.2 M) solution dissolved in 2mol of an aqueous solution of hydrochloric acid (1N) at a room temperature. Following this addition, stirring was resumed for 2h using a mechanical stirrer to ensure completion of the reaction. The time of the initial coloration of mixing the reactants depends upon the temperature and concentration of the protonic acid. During the polymerisation reaction, HCl was used as a protonic acid and the temperature was maintained at room temperature. The end product was a green coloured precipitate. This precipitate was filtered, washed with deionised water, with acetone in order to remove the oligomers and excess ammonium persulphate, and with 1N HCl solution to remove the Cl^- ions and unreacted aniline. Finally, the precipitate was dried in an air oven for 24 h at a temperature of 50◦ C to achieve a constant mass. B. Doped with MgO Synthesis of the PANI–Bismuth oxide composites was carried out by polymerisation in situ. Aniline (0.25mol) was dissolved in 2N HCl and stirred for 15 min to form aniline hydrochloride. oxide was added in the mass fraction to the above solution with vigorous stirring in order to keep the MgO homogeneously suspended in the solution. To this mixture, 0.2 M of ammonium per sulphate, which acts as an oxidant was slowly added drop-wise with continuous stirring at room temperature for 8 hrs to completely polymerise the monomer aniline. The precipitate was filtered, washed with deionised water, and finally dried in an oven for 24 hrs to achieve a constant mass. In this way, PANI–MgO composites containing various mass fractions of in PANI were synthesized.

RESULTS AND DISCUSSION

SEM-SCANNING ELECTRON MICROSCOPE

Figure 2 shows SEM graph of PANI/MGO composite.in this graph shows the particle is aggolomerated, highly non porous granular size and strong interconnecting each other.Upon very high magnification, the observation reveals the presence of homogeneously distributed PANI/MgO within the polymer sample. The SEM study

conducted on the samples shows numerous aggregated particles and pores, which have been minimized due to the homogeneous distribution of MgO in PANI. The presence of distinct MgO crystals significantly impacts electrical parameters such as conductivity and dielectric behavior of these composites. Image contrast arises from variations in scattering across different surface areas due to geometric disparities between Polyaniline and MgO

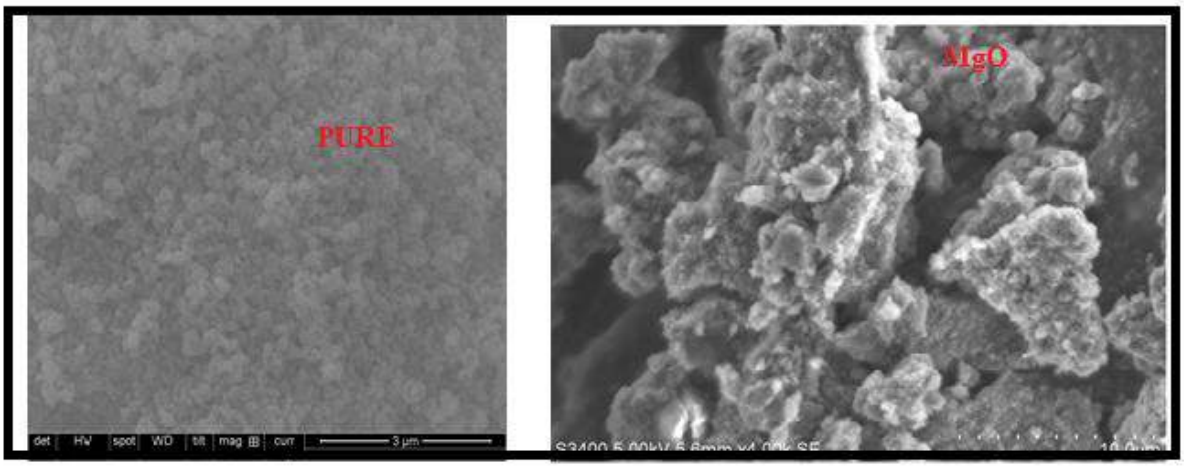

Figure1: sem graph of (a)PANI and (b) PANI/ MgO composites

AC CONDUCTIVITY

Figure shows the electrical conductivity of the undoped polyaniline and PANI/MgOcomposite as function of measured frequency. Almost the same trend in the variation of the conductivity of the PANI and its composites was observed. Initially the conductivity of the PANI and its composites was found to be almost constant up to 5logf and a drastic increase was observed after this frequency. This behavior of the conductivity may due to the hopping conductivity of electrons increasing at relatively high frequency. The ac conductivity of Polyaniline exhibit two phases in the frequency range 50 Hz (1.75 logf) to 10^6 Hz (6.69 logf). In frequency range between 50 Hz (1.75 logf) to 10^5 Hz (5 logf), the conductivity values are almost constant. The conducive increase suddenly in the frequency range 10^5– 10^6 Hz (6.69 logf).However the increase seen in the conductivities of the composites except composite 5%. It can also been seen that the conductivity of the PANI/MgO composite increases with increase in the content of MgO in the PANI matrix may due the increase in effective dispersion of MgO particles.

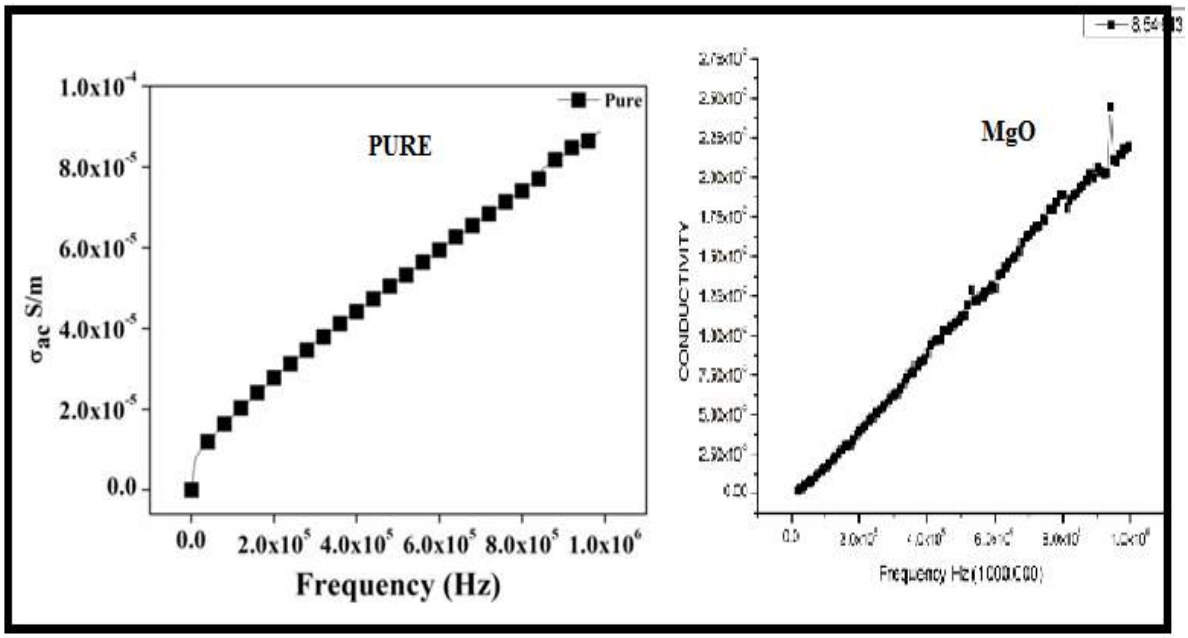

Figure shows the electrical conductivity of the undoped polyaniline and PANI/MgO

CONCLUSION

The polyaniline and PANI/MGO composite has been successfully synthesized by chemical oxidation using aniline hydrochloride as a monomer. The XRD studies confirm the formation of PANI and it's composite. The XRD pattern indicates that PANI/ MGO composite have an orderly arrangement of the polymer chain, whereas synthesized PANI is slightly crystalline in nature. The increased conductivity was attributed to the formation of a better charge transport network in the relatively insulating PANI matrix. The investigation of PANI/ MGOnanocomposites confirmed their stability and suitability for solar cells and optoelectronics devices. Dielectric characterization demonstrated that MGO particles exhibit a strong effect on the dielectric properties of resultant PANI/ MGO composites

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