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Synthesis And Morphological Study Of Polyaniline

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Abstract: An experiment was done for the synthesis of the two types of polyaniline one is with the solvent and the other is without the solvent, after that we dry in the vacuum oven, which gives the two different types of morphologies. The polyaniline was prepared by the chemical oxidative polymerization method. For the characterisation of the polyaniline here we use scanning electron microscopy, X-ray diffraction, Fourier transform infrared spectroscopy. Polyaniline is easily synthesised and available at a low cost. The prepared polyaniline has shown the amorphous nature of material.

Keywords: Conducting polymers, Scanning electron microscopy, X-ray diffraction, Morphology.

1.0 Introduction

Synthesis of the two types of polyaniline one is with the solvent and the other is without the solvent, after that we dry in the vacuum oven, which gives the two different types of morphologies. The polyaniline was prepared by the chemical oxidative polymerization method. The fibrillar growth of polymer is favourable for the system of polyaniline [1]. For the characterisation of the polyaniline here we use scanning electron microscopy, X-ray diffraction, Fourier transform infrared spectroscopy. Polyaniline is easily synthesised and available at a low cost. Polyaniline is having both optical and electrical properties and they are stable in environment. polyaniline has wide applications and used in both electronic and optical devices such as Light emitting diodes, sensors and fuel cells. It is also used in Electronic circuit boards and transistors [2-5]. We observed that the polyaniline which was synthesised with the solvent shows the both fibrillar and granular morphology. And the polyaniline which was synthesised without the solvent shows only the granular morphology. The electrical conductivity of the samples was observed with the help of the electrometer. While monitoring the polymerization by the static and dynamic light-scattering measurements, the aggregates are observed and we found that these aggregates may be in spherical shape or rod like structure which lead to the formation of the polyaniline with bulk nanofibrillar morphology [6]. Conducting polymers also show thermal properties. The intrinsically conducting polymers shows Electrical conductivity which rely on the nature of the dopant used, temperature and oxidant to monomer concentration ratio. Polyaniline (PANI) is widely studied and has attracted many in the previous decade because of the presence of the NH- groups in its polymer chains, Electrical conductivity, chemical and Environmental stability. Enzymatic polymerization is one of the methods for the synthesis of the polyaniline (PANI) used by Zemel and Quinn **[7**, 8]. Enzymatic polymerization gives us the low-conducting polyaniline (PANI) because these reactions will be taking place at a greater pH values, which is greater than 6.0.

2.0 Experimental work

Materials Used

1M HCl (37% purity, Merck) as a dopant, APS (98% purity, Merck) as an oxidant, Aniline ($C_6H_5NH_2$; 99% purity, Merck) as a monomer, potassium dichromate, Distilled water (200ml). In this work polyaniline has been prepared, in which APS has been added in the solution form designated s PANI.

2.1 Synthesis of PANI

Apparatus was cleaned and dried. Firstly 200 ml of 1M HCL was prepared and then taken into the 250ml conical flask. 4.564g of ammonium peroxydisulfate $(NH_4)_2S_2O_8$ is dissolved in a 50ml volumetric flask using distilled water, which is an oxidant added to the flask. Now start stirring the solution with the help of magnetic stirrer for 20 minutes. To this 4 ml aniline is added to the solution. The 4 ml aniline should be added dropwise. Then stir the entire solution for and about 3 hours. Note the temperature should be monitored and it should be maintained in the range of 0 to 3°C. and the pH between 0 to 3. After the completion of stirring, we can observe a dark green precipitate solution is formed. Now filter the solution using Buchner funnel then we get the dark green precipitate. Wash the precipitate with the 1M HCL solution and then with acetone. Now put it in an oven for drying at the temperature of 70°C. Then make it into the powdered form. Finally, we get the desired product which is in dark-green colour.

3.0 Characterizations

3.1 X-Ray Diffraction

The characterization of the polyaniline samples of both salt and solution is carried out in XRD using radiation of the Cu Kα (Bruker, Specifications: Cu Kα $1.54A^0$, Company Name: D8 Advance). The crystalline material phase can be detected using this technique. Degree of crystallinity can be obtained. The materials of the amorphous are produced constantly when the beam of X-ray scattered by the portions of non-crystalline. The lines of the diffraction take place due to the portions of the crystalline.

3.2 Scanning Electron Microscopy

On the scanning electron microscope (JEOL, Specifications: JSM-7610Fplus, Company Name: JEOL India Private Limited), the images of PANI salt and PANI solution samples are figured out. 5kV is the accelerating voltage applied. In order to obtain the images of the required samples which are dried, the polyaniline samples of both salt and solution are placed on the carbon conductive tape then coating is done. with the help of the tape of carbon to the sample holder of aluminum samples were adhered.

4.0 Result and Discussion

4.1 X-Ray Diffraction

In the peak of x-ray diffraction, the polymer crystallinity order is shown by the half-width to height ratio which can be observed. The metallic conductive state exhibited by the highly ordered systems therefore there is more attentiveness on the conducting polymers which have crystallinity along with the orientation. we can also find low intensity peaks. From the (**Fig.1**) the PANI solution sample shows semi-crystalline peak of PANI. From the pattern crystalline material concluded as the sample. We examined that the polyaniline which was synthesized using with the solvent has high crystallinity as compared to the polyaniline which was synthesized using without the solvent [9]**.**

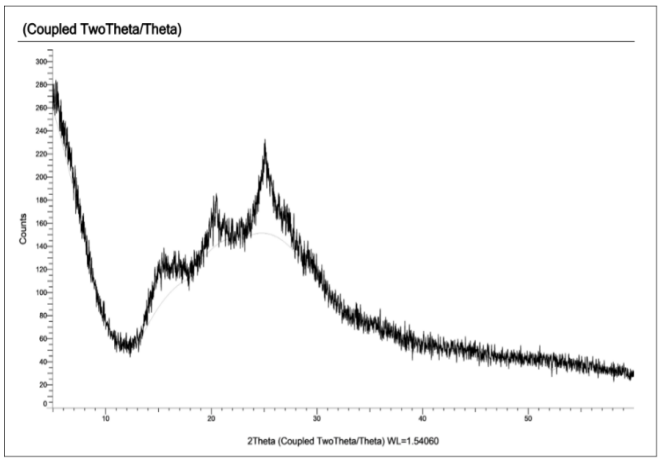

Fig.1: XRD of PANI

4.2 Scanning electron microscopy

The two images Depicts the polyaniline microstructures where the conditions are air as well as vacuum drying. The polyaniline which was synthesized using the solvent had shown the mixed morphology that is granular and fibrillar. And the polyaniline which was synthesized without using the solvent had shown the morphology of granular. By using the electrometer, we evaluate the samples electrical conductivities.

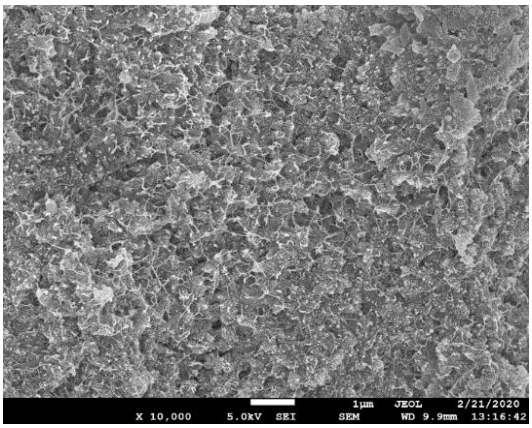

Fig 3: FESEM of PANI

2 milli liter of aniline was added dropwise in the solution. The rate of aniline addition could be the cause for the dual type morphology. There is decline in the density and increase in the volume in the case of nanofibers [10-13]. The grains in the granular morphology are interlinked which depicted the necessary binding energy in order to amalgamate with one other in the case of the polyaniline synthesized without solvent [14-18].

5.0 Conclusion

By the SEM characterization we can able to know what type of morphology that the samples show or exhibit. We can also compare the electrical conductivity of dual morphology with the singular morphology. The reduction in the polyaniline conductivity can also be known with the solvent as well as with the without solvent. We examined that the PANI which was synthesized using without solvent has less crystallinity as compared to the PANI which was synthesized using with solvent. It is not simply degraded by the normal conditions of the weather such moisture, temperature and other.

6.0 References

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