

Spectroscopic Studies of typical Nano material Polyaniline (Pure and with Taxol)

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Abstract:

Material with small grain sizes are now referred to as Nano Crystalline Materials and have been shown to having properties much improved over those exhibited by conventional grain sized polycrystalline materials. Nano crystalline materials are polycrystalline with grain sizes in the range 1 to 100 nm. Because of the extremely small dimensions, a large volume fraction of the atoms is located at the grain boundaries and this confers special attributes to these materials. Polyaniline is found to be suitable for a number of applications in computer manufacturing processes. Polyaniline can play significant roles in lithographic processes, which are used to fabricate integrated circuits. In the present case Polyaniline is prepared by chemical synthesis method. This is characterised by pure Polyaniline and Polyaniline with Taxol solution.

Key words: Polyaniline, Taxol, IR, XRD, SEM.....

Introduction:

The doping process of certain conducting polymers is accompanied by amends in colour.

This effect has been conveniently exploited in the realization of electro chromic display devices (ECD).

Polyaniline is found to be suitable for a number of applications in computer related manufacturing processes.

Polyaniline can play significant roles in lithographic processes, which are used to fabricate integrated circuits (ICs). Lithograph relies on radiation sensitive polymers called resists.

When irradiated these materials undergo cross linking molecular arrangement or other process that create a solubility difference between the irradiated or exposed areas of the polymer and the non-irradiated or unexposed areas of the polymer.

Taxol is spectroscopically active that is why it is promptly employed with this nano crystal.

Doped polyaniline, very reactive towards oxygen and moisture suffers irreversible loss of conductivity in atmosphere.

Some common methods:

Heating or sonication can be used on certain inorganic metal complexes to prepare nano scale particles. The metal particles have carbonaceous impurities and these lead to allow isolation of nano crystalline materials. In sol gel method direct precipitation of aqueous metal ions by addition of OH can initially cause get formation and then ultra fine precipitates

Preparation of polyaniline (PANI) by chemical method:

The primary advantage of this (chemical) method is good chemical homogeneous specification as chemical synthesis offers mixing at the molecular level. Molecular chemistry can be designed to prepare new materials by atomic and molecular level and the consequence effect on the desired materials macroscopic properties.

0.46g Ammonium peroxydisulphate (APS) was dissolved in small amount of water. Then 0.26g Naphthalene Sulfonic acid (NSA) was dissolved in water separately. NSA solution and 0.2ml of aniline mixed with APS solution with Taxol under stirring. After 4-5 hours continuous stirring, the solution was centrifuged and collect the sediment. The sediment repeatedly washed with water by 5 times. From the sediment the PANI was collected by the solvent removing by evaporation. The powder was in green (emerald green) colour (1). PANI was characterized by XRD, IR, SEM and TEM.

Structural characterization:

Fig (1) shows the IR spectra of PANI-NSA nano particles. The bands at 1631 & 1506 cm^{-1} are assigned to the stretching vibration of quinoid ring and benzenoid ring of PANI-NSA, respectively. The band at 1299 and 1146 cm^{-1} corresponding to C-N stretching vibration with aromatic conjugation are identical to those of PANI synthesized by a common method(1). When few drops of Taxol is added there is a heap in the graph at 2606 cm^{-1} as in Fig 2.

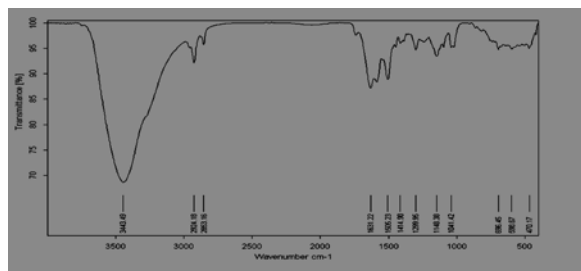


Fig. 1 IR spectrum of Polyaniline

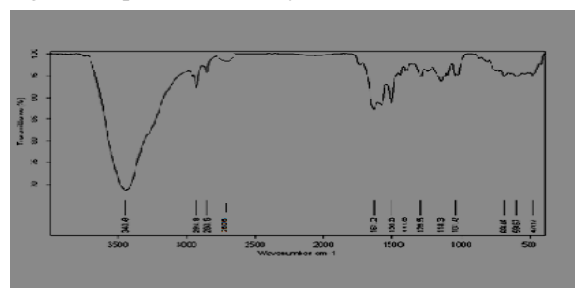


Fig.2. IR spectrum of Polyaniline with Taxol

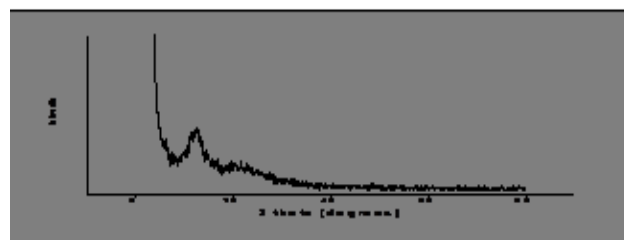


Fig.3. XRD of polyaniline

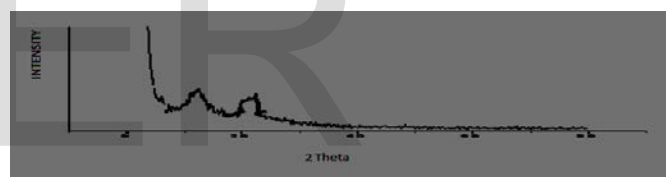


Fig.4. XRD of polyaniline with Taxol

Experimental:

Infrared spectroscopy:

The spectrum is an important record, which gives the sufficient information about the structure of a compound. This technique is generally employed to establish the identity of two compounds or to determine the structure of a new compound. Absorption in the infrared region is due to the changes in the vibrant and rotational levels. The most important source of infrared light for scanning the spectrum of an organic compound is Nernst glower which consists of a rod of the sintered mixture of the particles of the oxides of Zirconium, Ytterbium and Erbium. The rod is electrically heated to produce infrared radiations. The

spectrum is obtained for solid samples. Solid may be examined as an alkali halide mixture. Usually potassium bromide serves the purpose well. The substance under investigation should be absolutely dry as water absorbs strongly at 3710 cm^{-1} and also near 1630 cm^{-1} . Impurities in the compound can be detected from the nature of bands, which no longer remain sharp and well defined (2, 3).

X-Ray Powder Diffraction (XRD)

Bragg's law:

A beam of x-rays of wavelength λ is directed to the crystal at an angle θ to the atomic planes. In Bragg's law, the interaction between x-rays and the electrons of the atoms is visualized as a process of reflection of x-rays by the atomic planes. The incident angle θ (called the Bragg's angle) being equal to the reflected angle (4,5,6).

The Bragg's law condition for reflection can be written as $2d \sin\theta = n\lambda$

Where, n is an integer (order of difference), λ is the wave length, θ is the Bragg angle, d is the inter planar spacing. XRD pattern for PANI and PANI with Taxol is Fig 3 and 4 with a small heap in Taxol mixed PANI.

Crystal structure determination:

The powder diffraction of a substance is the characteristic of the substance and forms a sort of fingerprint of the substance to be identified. The peaks of the x-ray diffraction pattern can be compared with available data for the confirmation of the structure. For this comparison many standards are available, some of which are, Willars handbook, joint committee on powder Diffraction standards (JCPDS) and National Bureau of Standards (7-10).

Size of the Particle:

The size of the individual crystal is less than $0.1\mu\text{m}$, the term grain size is used. To find the average grain size, Scherer formula is used. The width of the diffracted curve increases with reduction in grain size of the material. Assuming that the diffraction line is

triangular in shape. (11-15) $\beta = (1/2) (2\upsilon_1 - 2\upsilon_2)$ and $\beta = (\upsilon_1 - \upsilon_2)$

The average grain size is calculated from the scherrer formula $D = 0.9\lambda/\beta \cos\upsilon$

Where, λ - is the wavelength of copper K line (1.5405\AA), υ - is the diffraction angle. β - is the full width half maximum of the peak, D - is the average grain size.

This method is an approximation method hence this can be compared with other analytical with TEM(16,17,18).

SEM and TEM method:

The SEM and TEM charaterisation methods of PANI with strongly acidic and mildly or medium acidic is given in Fig 5a and 5b and the Pure PANI SEM study is in Fig 6, also the PH curve is given in Fig 7 for the acidity and basicity of PANI as in consideration for Fig 5 as the value is 5 the mid way for neutral and cationic aniline respectively.

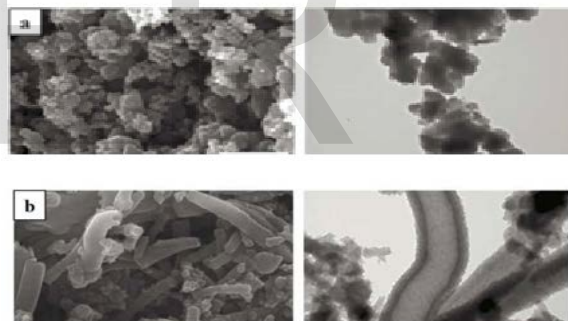


Fig.5.SEM of PANI (left) and TEM of PANI (right) prepared at: (a) strongly acidic solutions, (b) mildly acidic conditions.

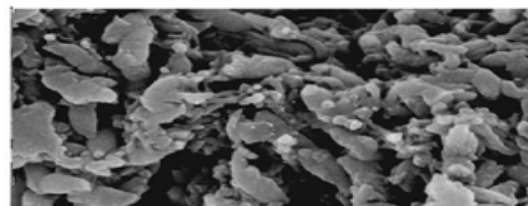


Fig.6. Scanning electron micrograph of the pure PANI

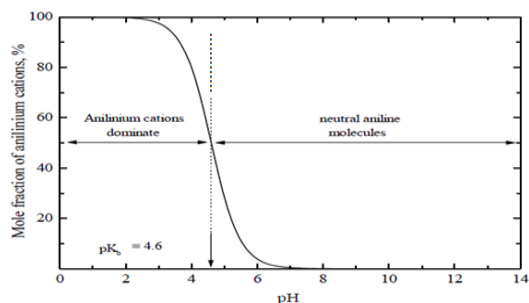


Fig.7. pH curve for Aniline

Conclusion:

We prepared polyaniline nano particles by chemical method using NSA as a dopant. PANI was characterized by IR, XRD, and SEM and TEM. The XRD peaks are identified. Scanning electron microscopy (SEM) is used in the surface analysis to identify the presence of defects, cracks if any, it is clear that the grown label material has no major defects. This vital technique reveals the understanding surface morphology. Taxol has thermal and spectroscopic (fluorescence, IR, NMR, and circular dichroism) analyses provided evidence of complex formation that was stable in the solid state but not the same in solution, suggesting an explanation for the observed precipitation upon dilution (19-25), that is why it is employed for Nano materials like PANI.

Profile

I am K.Senthil Kannan M.Sc (Gold medalist), M.Phil, B.Ed, P.G.D.C.A., M.B.A., M.A., D.C.H., C.I., (Ph.D) and passed SLET (UGC) in the first attempt and having more than 6 years of research experience and more than one decade of academic Exposure. Published two books and more Papers in National and International level.



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