Characterization of Synthesized Conducting Polymers by Using Different Solvents

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Abstract
This work describes the synthesis and characterisation of soluble and conducting polyaniline via a chemical polymerisation process. This polymerisation route produces polyaniline, which is highly soluble in a variety of organic common polar solvent/water mixes. The effect of synthesis parameters such as solvent type and its concentration on thermal stability was examined, as well as the solubility and other properties of the resultant PANI. In addition, the synthesised materials were characterised using a variety of methodologies, including XRD analysis and FTIR spectroscopy. Finally, TGA was used to gain information about the thermal behaviour of the materials.

1- Introduction

Over the last few decades, the enhancement in the requirement for composite materials has seen an explosion. These now have the availability as materials which possess a particular combination of different properties. Owing to its unique properties as brilliant redox recyclability, inexpensiveness, particularity in proton dopability, being stable chemically, being easily synthesized, changeable electrical conductivity (could be altered by change in the pH of preparation); Polyaniline (PANI) has made it to the top list in worldwide search for industrially available conducting polymers [1]. Various industrials products as coatings (of conductive nature), diodes (emitting light), rechargeable batteries, antistatic materials, gas sensors have been the basis for which studies have been made on composites which are based on insulating polymers and conducting polymers[2]. A huge number of applications as rechargeable batteries[3-4], sensors, devices of electronic nature[5-6], diodes (emitting light)[7] corrosion protection of metals[7-8], glues and paints of conducting nature, shielding of electromagnetic type , formulations of anti- static forms, gas-separation membranes coatings and such others are based on the potentials of conductive polymers such as polyanilines. PANI is being created in the current work via chemical oxidative polymerization .It could be investigated as to how the solvents affects the synthesized polymer

2- Materials and methods

Various types and concentration of organic solvents as THF, DMSO and DMF were used to carry out polymerization of aniline using its aqueous solution. It was studied as to how these solvents affect the polymerization of aniline and its conductivity. The investigations involved in the studies were done using XRD, TGA and FTIR spectroscopy[-9].

3- Results and Discussion

3.1- FTIR spectrum of PANI with different organic solvents in

FTIR spectrum of the samples Owing to the symmetric and asymmetric carbon hydrogen stretching bands are observed at 2923.62,2923.25,2923.21 and 2825.55 cm^{-1}. Because of carbon double bonded carbon stretching absorption beaks are observed at 1654.43, 1637.67 and 1637.68 cm^{-1}. Because of carbon double bonded nitrogen stretching absorption bands are seen at 1476.12, 1489.67, 1490.77 and 1491.15 cm^{-1}

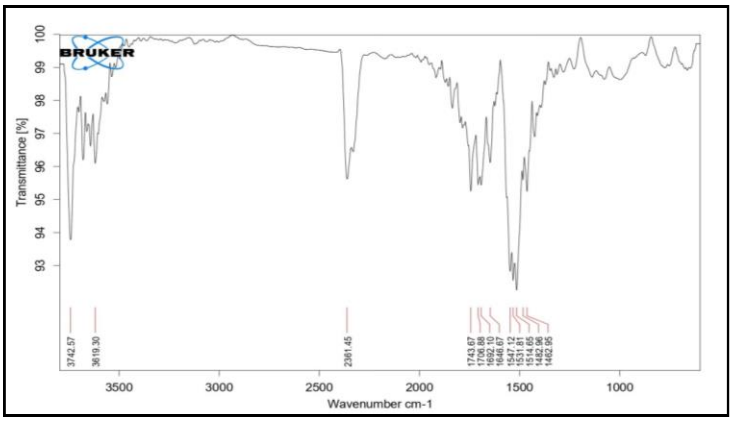

Figure 1: FTIR spectrum of PANI when 3 ml DMF was used.

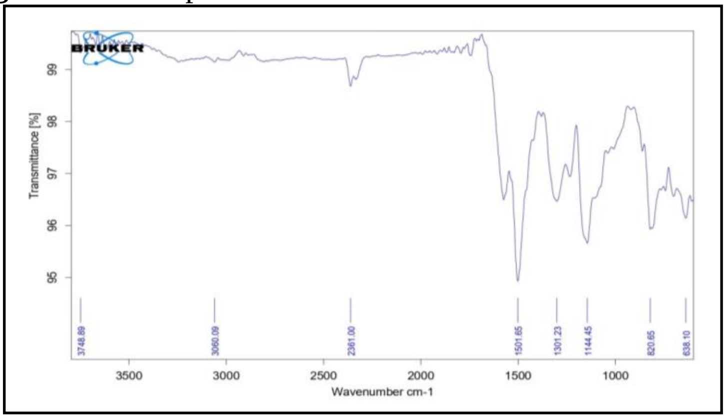

Figure 2: FTIR spectrum of PANI when 7 ml DMF was used

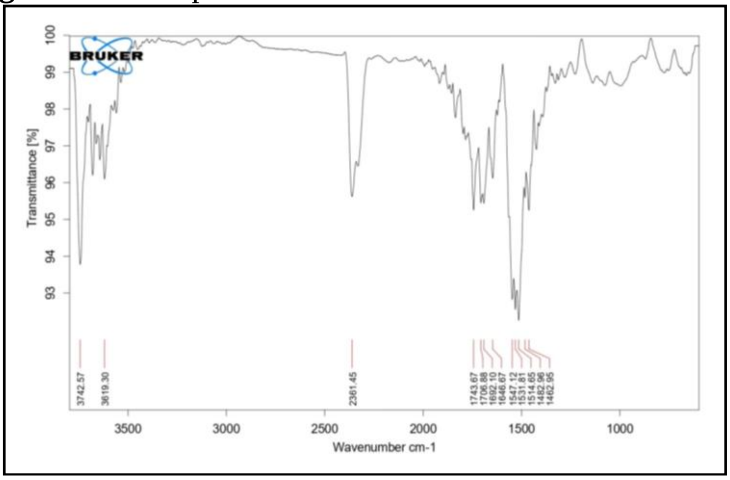

Figure 3:FTIR spectra of PANI obtained at 3 ml DMSO

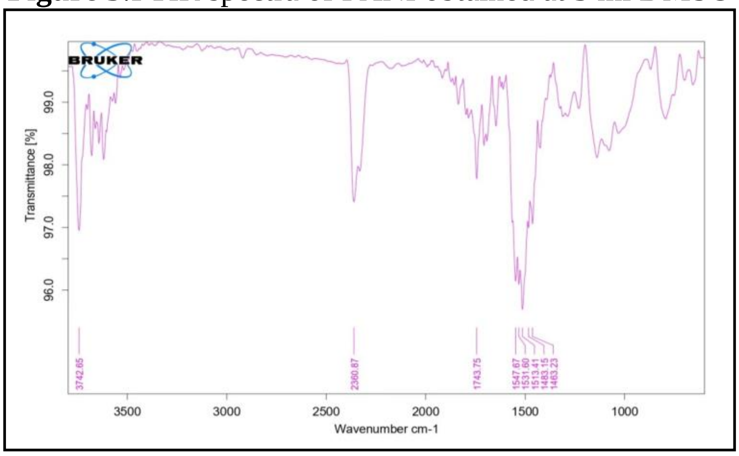

Figure 4: FTIR spectra of PANI obtained at 7 ml DMSO

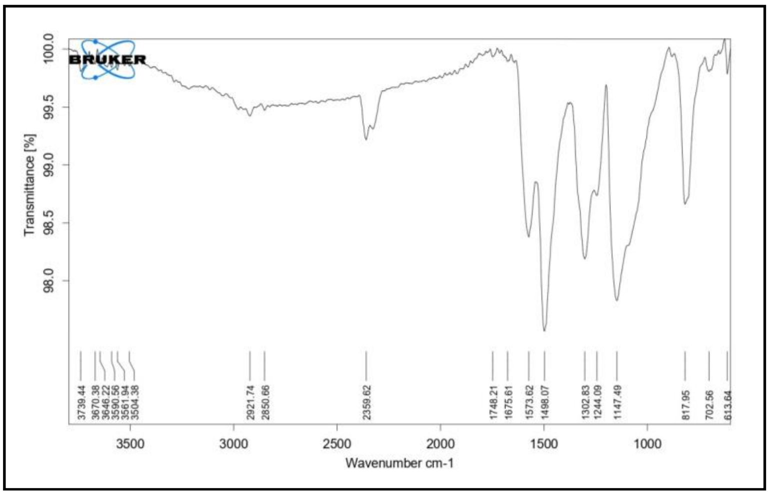

Figure 5: FTIR spectra of PANI obtained at 3 ml THF

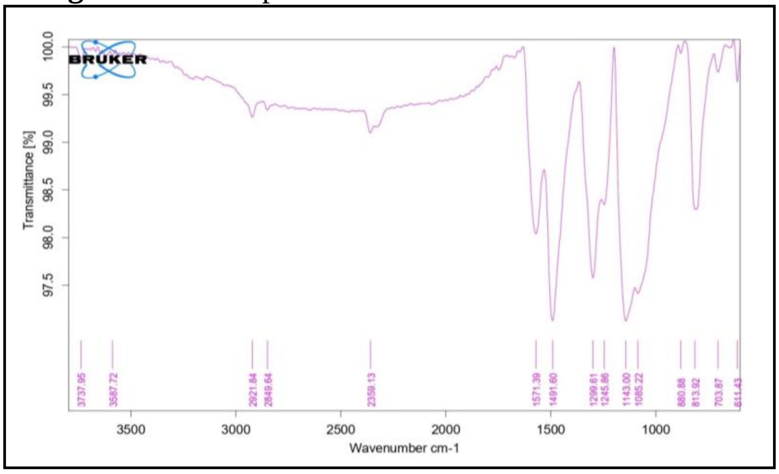

Figure 6: FTIR spectra of PANI obtained at 7 ml THF

3.2- XRD (x-ray diffraction)the addition of organic solvents in PANI

There is possibility of measuring the percentage of crystallinity by using XRD data.

Table 1: XRD data for effect of solvents

Solvents	Peaks	Area of the peaks	Total area	Crystallinity
THF(3 ml)	21.46, 26.18	6581.58	32363.83	20.33%
THF (7 ml)	25.02,26.06,28.06	6543.58	25805.07	25.35%
DMF(3 ml)	23.84,25.12,26.08	3203.58	7598.58	42.16%
DMF(7 ml)	24.04.25.84	4838.29	17227.94	28.08%
DMSO(3 ml)	22.14,25.28	4029.36	21976.09	18.33%
DMSO(7 ml)	15.74,24.96,26.98	5818.485	22715.58	25.61%

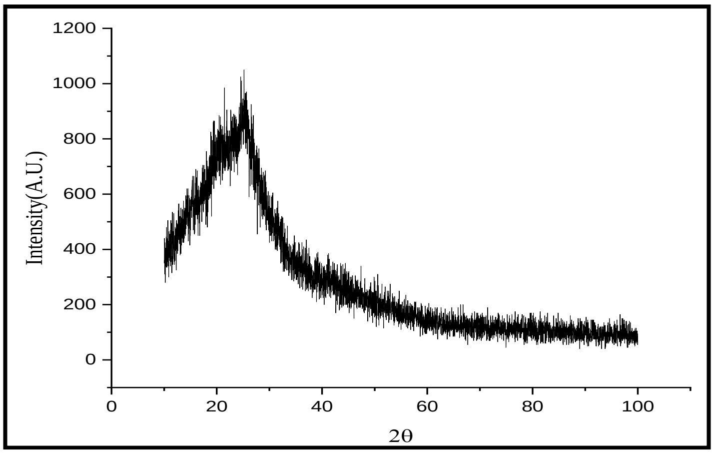

Figure 7: XRD spectra of THF 3 ml

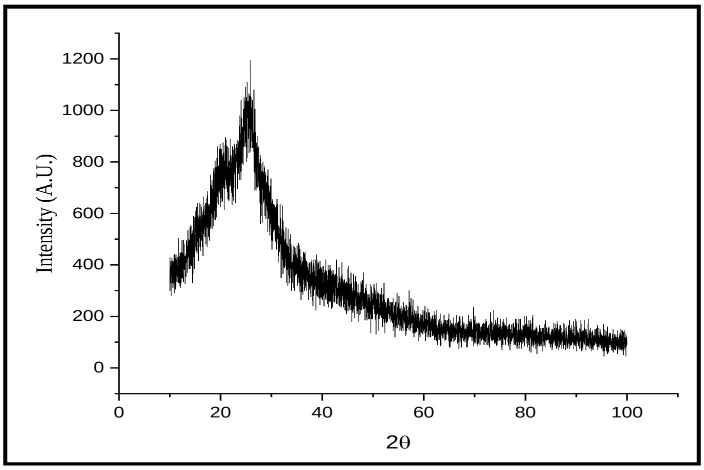

Figure 8: XRD spectra of DMF 7 ml

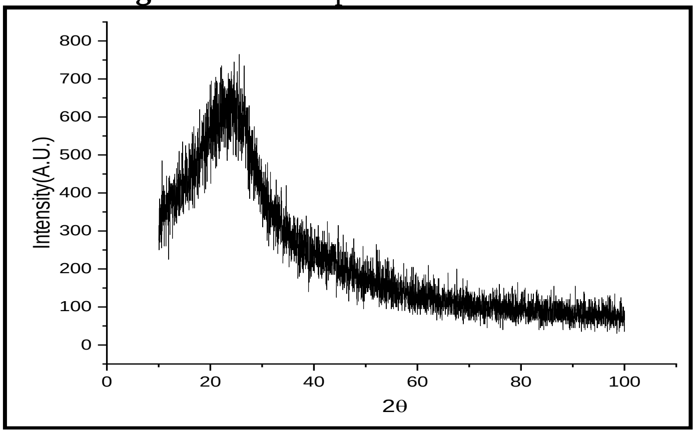

Figure 9: XRD spectra of DMSO 3 ml

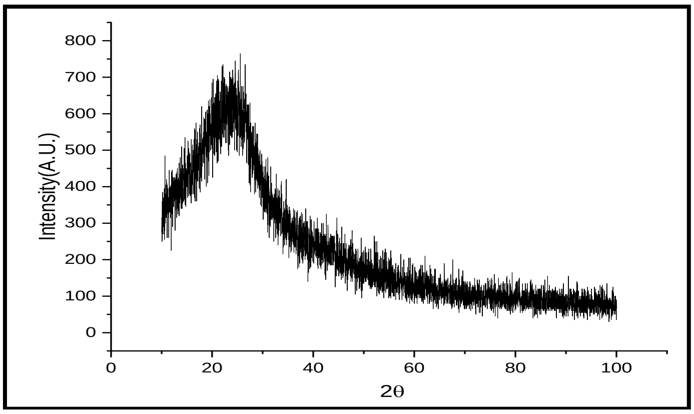

Figure 10: XRD spectrum of DMSO 7 ml

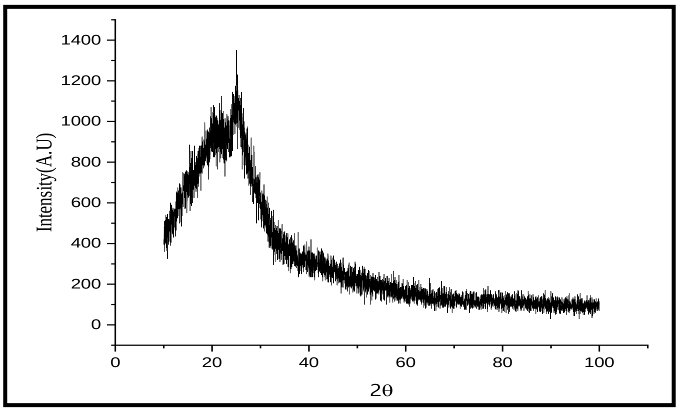

Figure 11: XRD spectra of THF 7ml

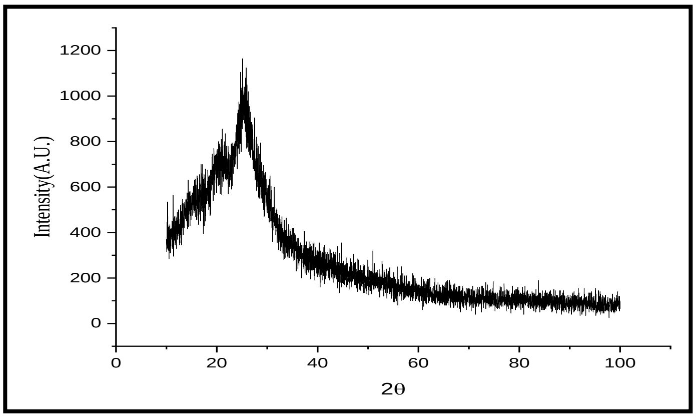

Figure 12: XRD spectrum of DMF 3ml

3.3- TGAby usimg differentorganic solvents in PANI

The thermogravimatric analysis curve revealed that the weight loss occured in three steps. Out of the three weight losses the first one happened at 130 degree centigrade. This weight loss was believed to be because of the loss of absorbed water. Another weight loss (the second one) was observed between the temperature ranges 130 to 250 degree centigradeand it represent the thermal stability of the compounds. The third weight loss was seen close to 250 degree centigrade and it represent the degration completion of the compounds.

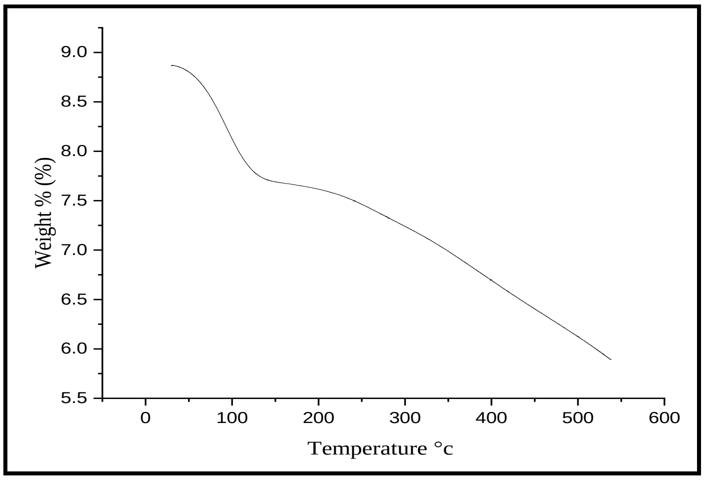

Figure 13: TGA analysis of PANI obtained at 3 ml of DMF

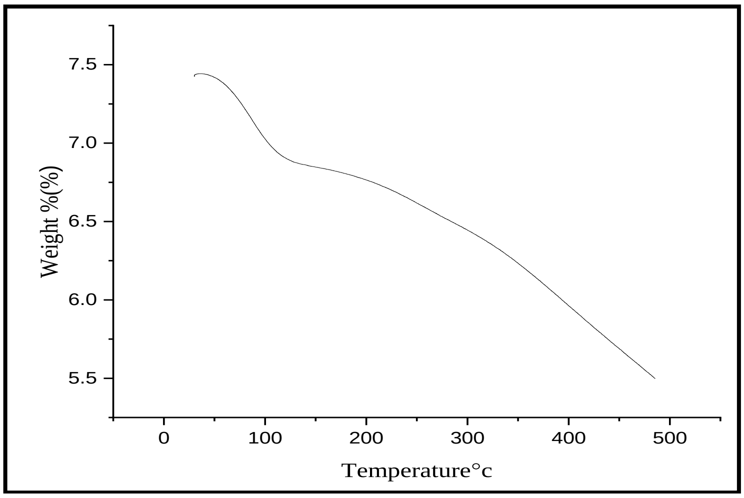

Figure 14: TGA analysis of PANI obtained at 7 ml of DMF

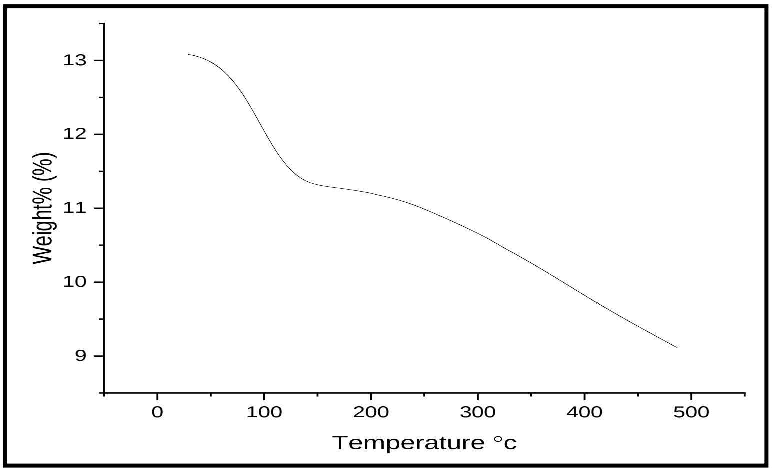

Figure 15: TGA analysis of PANI synthesized by adding 3 ml of DMSO

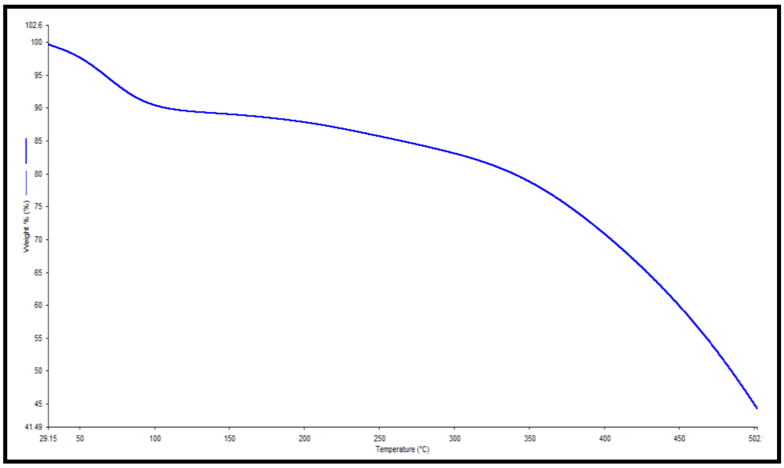

Figure 16: Represents TGA analysis of PANI synthesized by adding 7 ml of THF

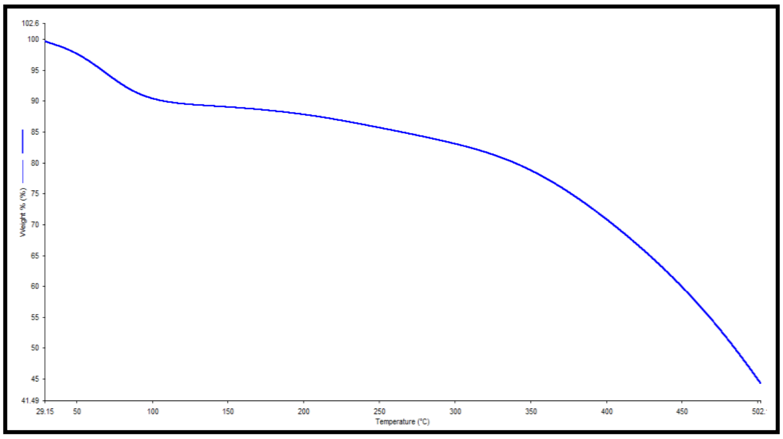

Figure 17: TGA analysis of PANI obtained at 3 ml of THF

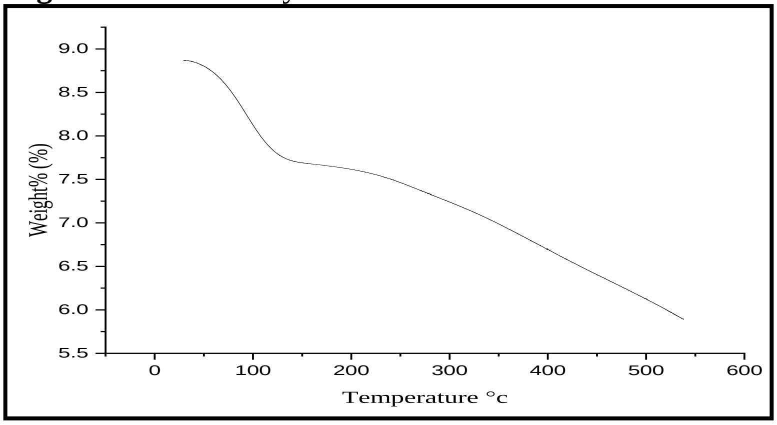

Figure 18: TGA analysis of PANI obtained at 7 ml of DMSO

4- Conclusions

The studies reveal that the use of organic solvents helps in increasing the level of doping of the resultant polyaniline obtained. When the solvent used was THF, the rate of polymerization was seen to increase

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