

POLYANILINE-TiO₂ NANOCOMPOSITE FORMATION AND CHARACTERIZATION

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Abstract -Aniline and Titanium dioxide (TiO₂) were polymerized into textiles by inverted emulsion polymerization method. Aqueous mixture of Aniline, a free radical oxidant and TiO₂ nanoparticles are utilized to synthesize the hybrid nanocomposites. FTIR and XRD analysis were used to confirm the formation of nanocomposites.

Key Words: Aniline, TiO₂ nanoparticles;

1. INTRODUCTION

The emerging field of electro textiles can be viewed as an integration of technologies of materials, electronics and textiles in order to create a new generation of flexible/ comfortable small or large multifunctional textile structure with electronics capabilities. The reason is that apart from exhibiting properties like anti flammability, antistatic, crease resistant and hygienic, these materials also act as 'smart' or 'intelligent' textiles.[1-3]

This can be the first step towards development of flexible battery construction using conducting polymer TiO₂ Nano composite. In the present investigation an attempt has been made to incorporate organic conducting polymer such as PANi along with inorganic TiO₂ nanoparticles into textile matrix such as that of cotton.[4,5] Organic polymers such as conducting polymers have been shown to be excellent hosts for trapping nano particles of metals and semiconductors because of their ability to act as stabilizers or surface capping agents.[6-7]

2. Material and Methods:

Aniline, Conc. HCl, Ammonium per sulphate (APS) all of A.R. Grade were obtained from S.D. fine chemicals ltd. India. Titania nanopowder, Cetyl Trimethyl Ammonium Bromide (CTAB), Chloroform were obtained from Aldrich as Reagent grade. Aniline was distilled twice before use. Cotton was obtained from piyush syndicate, India. The IR, ATR absorption spectra of various samples were recorded in the range 500- 4000 cm⁻¹ using a Perkin -Elmer FTIR spectrometer model paragon 500.

Result and Discussion:

FTIR:

Since the samples were dark green in color Attenuated Total Reflection (ATR) Fourier transform IR were recorded instead of FTIR. In the PANi spectrum it is in correlation with previously reported results [8]. The bands at 1496 cm⁻¹ shows the characteristic C=C stretching of the quinoid and benzoid rings. The peak at stretching of the secondary aromatic amine and a C-H out of plane bending vibrations respectively. The above observations indicate the formation of PANi in our sample i.e. inside the textile matrix. Fig.1 indicates that all characteristic bands of PANi are present between 750-1500 cm⁻¹ and these are all found in PANi-TiO₂ nanocomposites. The relative intensity of some bands has changed due to the presence of TiO₂ nanoparticles. The presence of TiO₂ nanoparticles led to the shift of some peaks in the PANi macromolecules for e.g., the peaks at 1496, 890, 815 cm⁻¹ shift to 1489.46, 880.70 and 812 cm⁻¹ respectively. Because Titanium is a transition metal, it has intense tendency to form co-ordination compound with nitrogen atom in PANi Macromolecule. This interaction may weaken the bond strength of C=N, C=C & C-N in PANi Macromolecule. This result confirm the presence of PANi and TiO₂ in nanocomposites

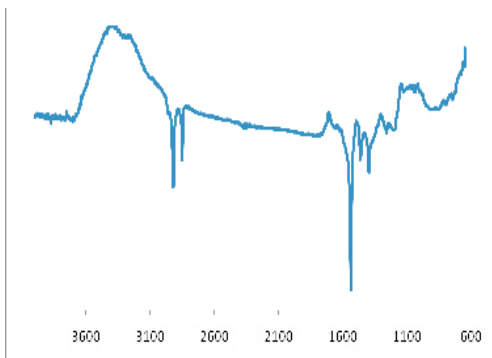


Fig.1 Cotton +PANI

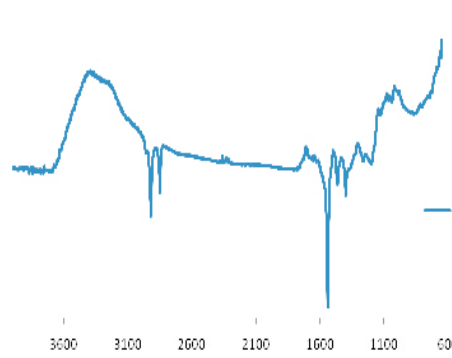


Fig.2 Cotton+PANI+TiO2

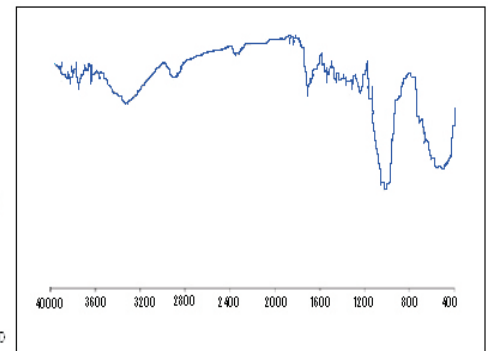


Fig.3 Pure Cotton

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XRD Analysis:

The peaks of cotton appearing at 2θ=15°, 23° slightly shifts in position at 15° and 18° respectively. The corresponding 26° and 28° in pure TiO₂ spectra in fig.5 they shift to 25.8° and 2θ=28 remains at the same position with decrease in intensity and few other peaks of TiO₂ 2θ= 48°, 55° are also appeared in the samples with diminished intensity. However the calculation of % crystallinity showed that decrease of about 5%. The presence of PANi has only added to the general

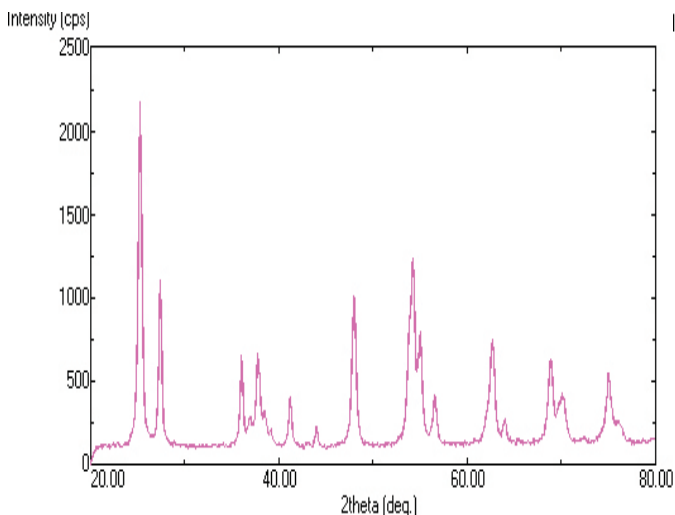


Fig.5 Cotton+PANI+TiO2

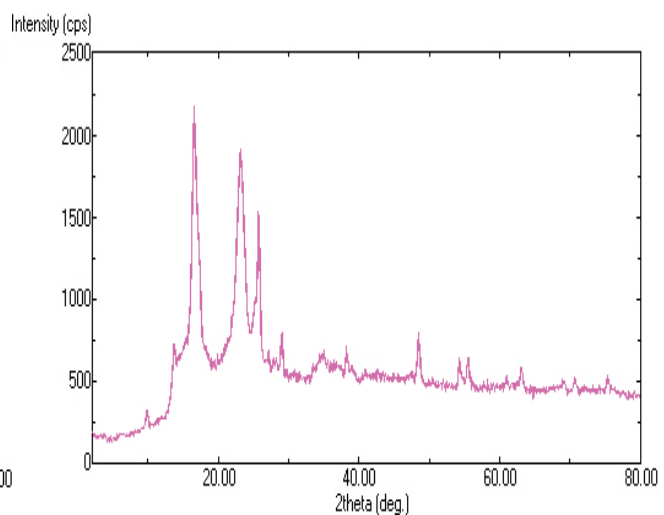


Fig.4: Pure TiO2

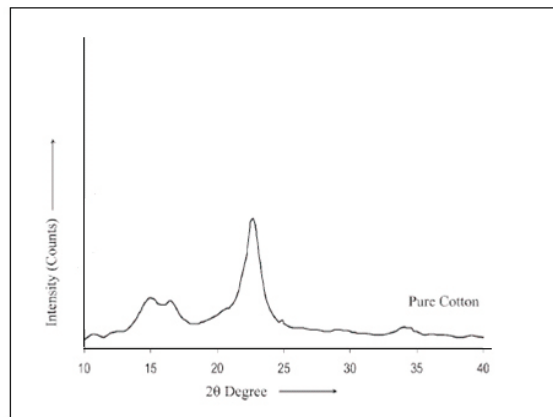


Fig.6 XRD of Pure cotton

Scattering backgrounds. The shifts with diminished intensity may be attributed to the presence of TiO₂ in the cotton matrix. As per the nucleation and growth theory it is known that the TiO₂ nanoparticles are intrinsically produced in the initial stage of polymerization of PANi [7,12]. As a result the formation of PANi -TiO₂ nanocomposites should be the effect of free aniline cation radicals adsorb on the surface of TiO₂ nanoparticles growing together by the inverted emulsion polymerization method. Thus PANi and TiO₂ together get impregnated in to the matrix of cotton.

REFERENCES

1. Malhotra BD(2002) Handbook of Polymers in Electronics Rapra Technology Ltd, UKa
2. Nalwa, H.S.,; ed. Handbook of Organic and conductive Molecules and Polymers, Vol-1-4; John wiley: New York, 1997
3. Bajaj, P. Indian J. Fibre Text Res 2001, 26, 162
4. Scrosati B(1993) Application of electroactive polymers, Chapman and Hall London.
5. Gupta, S., Ed. Smart Textiles- Their production and markeing strategies; NIFT: New Delhi,2000
- 6.X.W.Li,etal Appl. Surf. Sci., 217,16(2003)
7. Desai, etalIn Proc. Of the International conf. on High Performance Textiles and Apparels, Kumarguru college of Technology, Coimbatore, India, July 2004; P. 475
8. E. M. Genies, etal , Polyaniline: a historical survey, synth. Met. 36(2), P.139 ,1990
9. F.Trinidad, etal J. Electrochem. Soc. 138,1991, P 31863
10. M. Malta, etal electrochem, Commun., 5, 1011 (2003) .
11. L.J.Zang, M.X.wang, J. Phys. Chem. 107(2003), 6748
12. E. M. Genies, etal , Polyaniline: a historical survey, synth. Met. 36(2), P.139 ,1990