J Integr. Sci. Technol, 2013, 1, 1, 25-27 Article

Journal of Integrated
Science and Technology

Integrated Science

# Synthesis and fourier transform infra-red spectroscopy of polyaniline doped with $TiO_2$

Asha, Sneh Lata Goyal* and Nawal Kishore

*Department of Applied Physics, Guru Jambheshwar University of Science and Technology, Hisar-125001, Haryana, India.*

Received: 4-4-2013 Accepted: 24-5-2013 Available Online: 24-5-2013

**ABSTRACT**

Polyaniline (PANI) is one of the most studied conducting polymers, not only due to the facility in preparation procedures, but also related to high stability to the environmental exposition. In this paper we report the synthesis of PANI and its composites with nano-$TiO_2$ (PANI/$TiO_2$) at different doping concentrations by oxidative chemical polymerization method. The characterization of PANI and its various composites were done by Fourier Transformer Infra-Red (FTIR) spectroscopy. The FTIR results confirm the PANI and PANI/$TiO_2$ composite formation.

*Keywords: Polyaniline, Polymers, $TiO_2$, Chemical polymerization , Fourier transform infra-red spectroscopy*

## Introduction

Polyaniline (PANI) has certain advantages over other conducting polymers, including simplicity and rapidity of preparation by electrochemical method, and the ability to be formed in aqueous electrolytic solutions. It has good mechanical flexibility and environmental stability [1] and its conductivity could be controlled with acid/base (doping/undoping). Electrically conducting polymers have generated tremendous interest due to their potential applications in various fields such as rechargeable batteries, electrochromic display devices, separation membranes, sensors and anticorrosive coatings on metals [2-6]. Conducting polymers are a novel class of synthetic metals that combine the chemical, electrochemical and mechanical properties of polymers with the electronic properties of metals and semiconductors.

**Address:**
Dr. Sneh Lata Goyal
Department of Applied Physics,
Guru Jambheshwar University of Science and Technology,
Hisar-125001, Haryana, India.
Tel: 01662-263382
Email:goyalsneh@yahoo.com

----

Cite as: *Asha et al., J Integr. Sci. Technol., 2013, 1(1), 25-27.*



Although a variety of conducting polymers have been synthesized and investigated, PANI and its composites have very strong potential on a large scale for the industrial applications mentioned above [7-9]. In this paper we report the synthesis of PANI and its composites with nano-$TiO_2$ (PANI/$TiO_2$) at different doping concentrations by oxidative chemical polymerization method. The characterization of PANI and its various composites were done by Fourier Transformer Infra-Red (FTIR) Spectroscopy.

## Experimental details

*Synthesis of PANI:-*

To prepare PANI, 0.2 M aniline hydrochloride (Aldrich) was oxidized with 0.25 M ammonium peroxidisulphate (Aldrich) in aqueous medium. Both solutions were left to cool in the refrigerator for 2-3 hours and then mixed in a beaker drop-wise, maintained at a temperature between 0-4 $^0$C in an ice bath, stirred for 2 hours and left for 24 hours at rest to polymerize in refrigerator. Thereafter PANI precipitate was collected on a filter paper and was washed with 1 M HCl and acetone till the filtrate becomes colorless. Polyaniline (emeraldine) hydrochloride powder was dried in air and then in vacuum at 45$^0$C. PANI prepared under these conditions was taken as standard sample.

*Preparation of PANI/nano-$TiO_2$ composites:-*

The samples of PANI and nano-titanium dioxide composites were prepared by adding 20, 40 and 50 weight percentage of nano-titanium dioxide to 0.2 M aniline hydrochloride (Aldrich) solution in distilled water before oxidizing with vigorous stirring for 2 hours in order to keep the nano-titanium dioxide suspended in the solution. Following this procedure, three different PANI/$TiO_2$ composites with different weight percentage, 20%, 40% and 50 weight % of nano-titanium dioxide were prepared and named as nt20, nt40 and nt50, respectively.

**Results and discussion**

The FTIR spectra of PANI, PANI/$TiO_2$ and nano-$TiO_2$ is shown in figure1, 2 and 3 respectively. The FTIR spectrum of PANI shows characteristic vibrations in the region of 1000-1500 $cm^{-1}$. It shows characteristic bands at 520$cm^{-1}$, 815$cm^{-1}$, 1163$cm^{-1}$, 1317$cm^{-1}$, 1495 $cm^{-1}$ and 1589 $cm^{-1}$. The bands at 520 and 815 $cm^{-1}$ are due to C-H out of plane bending vibration and para-disubstituted aromatic rings, respectively [10].

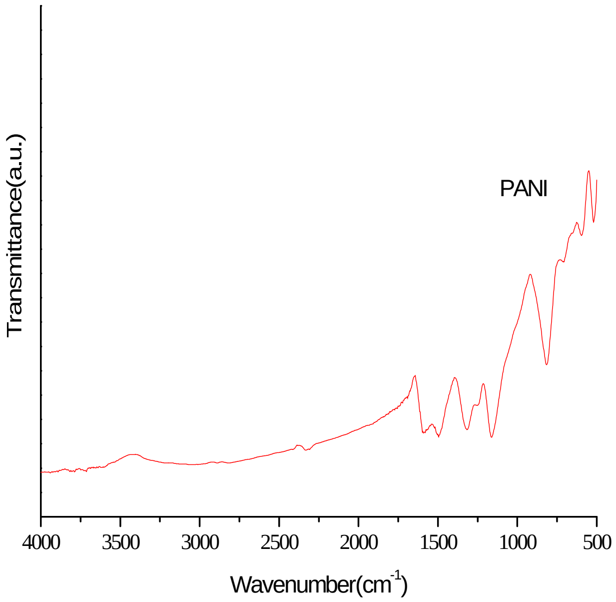


Figure1. FTIR spectra of PANI

A band appearing near 1317 $cm^{-1}$ represents the C-N stretching vibration [10]. In plane bending vibration in C-H occurs at 1163 $cm^{-1}$ [11]. The presence of bands in the range of 1450-1600 $cm^{-1}$ are attributed to non- symmetric $C_6$ ring stretching modes[10].

The higher frequency vibration at 1589 $cm^{-1}$ has a major contribution from the quinoid rings, while the lower frequency mode at 1495 $cm^{-1}$ shows the presence of benzenoid ring units. The broad band observed at 2400-2750 $cm^{-1}$ is due to aromatic C-H stretching vibrations while the band at 2950-3300 $cm^{-1}$ is due to N-H stretching of aromatic amines[11].

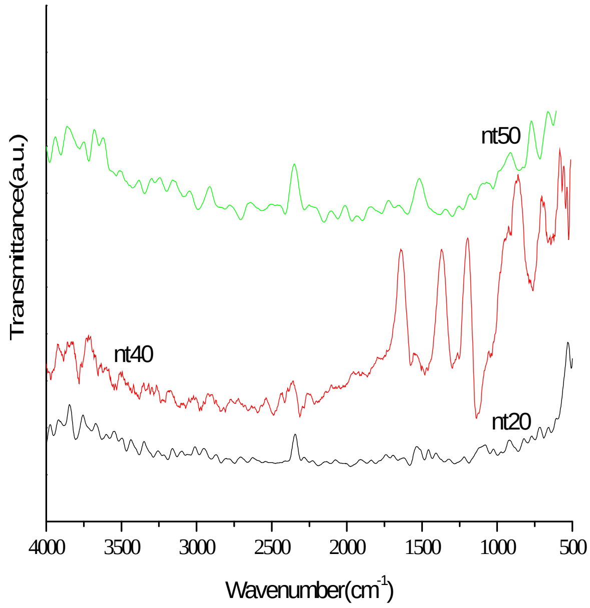


Figure2. FTIR spectra of PANI/$TiO_2$ composites

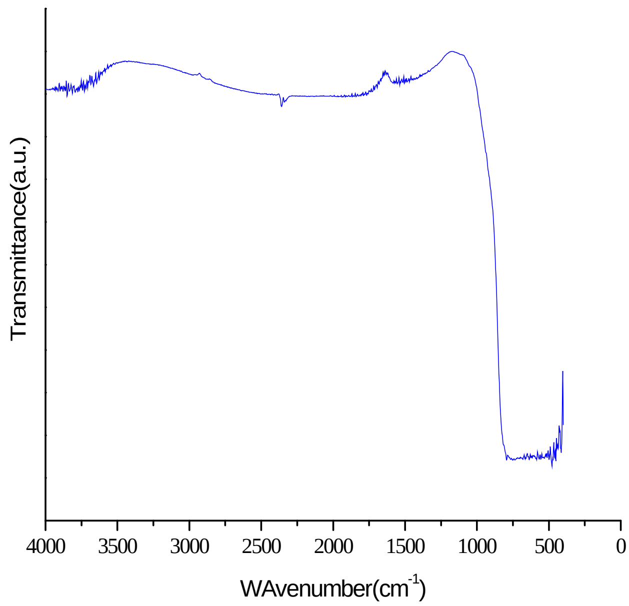


Figure3. FTIR spectra of nano- $TiO_2$

In nano-$TiO_2$, broad bands around 636 $cm^{-1}$ and 3750 $cm^{-1}$ correspond to Ti-O-Ti and O-H stretching frequencies [11]. In case of composites of PANI/$TiO_2$ there exists small shifting in frequencies of PANI bands. In PANI/$TiO_2$ composites the bands of nano-$TiO_2$ are also visible. The FTIR results confirm the PANI and PANI/$TiO_2$ composite formation.

## References and notes


1. Pud, A., Ogurtsov, N., Korzhenko, A., Shapoval, G, *Prog. Polym. Sci.* **2003,** 28, 1701-1723.
2. Gonzalez-Rodriguez, J. G., Lucio-Garcia, M. A., Nicho, M. E., Cruz-Silva, R., Casales, M., Valenzuela, E., *Journal of power Sources* **2007,** 186, 184-190.
3. Jeyaprabha, C., Sathiyanarayanan, S., Venkatachari, G., *Applied Surface Science* **2006,** 253, 432-438.
4. Zhong, L., Zhu, H., Hu, J., Xiao, S. and Gan, F., *Electrochimica Acta* **2006**, 51, 5494.
5. Chang, K. C., Jang, G. W., Peng, C. W., Lin, C. Y., Shieh, J. C., Yeh, J. M., Yang, J. C. and Li, W.T., *Electrochimica Acta* **2007,** 52, 5191-5200.
6. Mirmohseni, A., and Oladegaragoze, A., *Synth. Met*. **2000,** 114, 105-108.
7. Gemeay, A. H., El-Sharkawy, R. G., Mansour, I. A. and Zaki, A. B., *Journal of Colloid and Interface Science* **2007,** 308, 385 -394.
8. Majid, K., Awasthi, S., Singla, M. L., *Sensors and Actuators A* **2007,** 135, 113-118.
9. Mirmohseni, A., and Oladegaragoze, A., *J. Appl. Sci.* **2002,** 85, 2772-2780.
10. Chen S A, Chung K R, Chao C L and Lee H T, *Synth. Met.* **1996,** 82, 207-210.
11. Ganesan Raman and Gedanken Aharon , *Nanotechnology* **2008,** 19, 435709-435713.



**Asha** obtained M.Sc. degree in Physics from MDU, Rohtak, Haryana, India in 2008. She also qualified NET+JRF (CSIR) and GATE in the same year. Currently, she is working as an Assistant Professor in BPS Mahilla Vishwavidyalaya, Khanpur Kalan, Sonipat, Haryana. She is also doing Ph.D. from Guru Jambheshwar University of Science and Technology, Hisar, Haryana. She is working on the area of Synthesis and Characterization of Conducting Polymers. She is also a life member of Indian Society of Technical Education.



**Prof. Sneh Lata Goyal** did her M.Sc. from Rajasthan University, Jaipur, Rajasthan, India, M.Phil. & Ph.D. from Kurukshetra University, Kurukshetra, Haryana, India. She is serving as Professor in the Department of Applied Physics, Guru Jambheshwar University of Science & Technology Hisar. She is handling two research projects, one sponsored by DAE, BRNS, BARC, Mumbai & other by UGC, New Delhi. She had published more than 25 research papers in the Journals of International repute and attended a number of International & National Conferences & Symposia to present the research papers. She had attended four workshops related to her research area organized by DAE-BRNS.



**Prof. Nawal Kishore** did his M.Sc. from Kurukshetra University, Kurukshetra, Haryana, India and Ph.D from Indian Institute of Technology, New Delhi. He served as Lecturer in the Deptt. of Physics, M.D. University, Rohtak & was promoted to the post of Reader in 1990. He joined the Department of Applied Physics, Guru Jambheshwar University of Science & Technology Hisar in October, 2001 as Professor. He has served as the Chairman of the various departments in the university viz. Deptt. of Applied Physics, Deptt. of Printing Technology, Deptt. of Bio Medical Engg., Deptt. of Electronics and Communication Engg. He has handled research projects sponsored by UGC, DST & DRDO. He has published more than 60 research papers in Journals of International repute and a number of books and has presented his work in various International and National Seminars, Conferences and Symposia. He is presently holding the post of Coordinator, TEQIP-II in GJUS&T, Hisar.