Synthesis and characterization of Titanium (Ti) Rich polyaniline (PANi)

*S.R. Takpire

**Department of Physics, Department of Physics, MJF commerce science And V. R Raut Atrs College, Bhatkuli Dist. Amravati..*

Abstract

In this present work, titanium doped polyaniline (PANi) composite was synthesize by chemical oxidative rout. $TiCl_4$ used as the oxidizing agent in polymerization reaction. The morphological structural, and optical anlyasis of as- synthesize composite were done through X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Field emission scanning electron microscopy (FESEM), photoluminescence. The photoluminescence excitation appeared at the around the 300 nm and emission at 390 nm, it indicating the high charge generation efficiency. In as- synthesize composites Ti was present confirm from the analysis of XRD.

Keyword: *polymerization; polyaniline; composite*

Introduction

In recent year, in the development of new type efficient polymeric composites material in commercial and scientific research field. There was rising focus towards the synthesis of conducting polymers like polyaniline (PANi), polypyrrole (PPy) and polythiopene (PTh) due to their high electrical conductivity, interesting electrochemical properties, and easy processability [1-3]. Amongst all conducting polymers, polyaniline and its composite with metal oxide has received a significant amount of attention due to its environmental stability, simple doping/de-doping chemical reaction and promising electrical, electrochemical, optical properties [4-7]. PANi/metal oxide and PANi/graphene have high electrical and optical properties, show much assurance for commercial application in battery materials, photovoltaic devices, gas sensor technology, and nonlinear optics [8-10]. Most of researcher conducting polymer have synthesize by oxidative and electrochemical process by using the $FeCl_3$ [11].

In the light of above discussion, we synthesized Ti doped PANi composites via chemical rout by oxidation process by using $TiCl_4$ as oxidizing agent. As- synthesize PANi/Ti composite was characterized through XRD, FE-SEM, FTIR spectroscopy, PL analysis.

Experimental

Aniline monomer and titanium chloride (TiCl4) (AR grade) chemicals were purchased from commercial sources SD fine, India and used without any further purification. The 1 mol.wt % of aniline monomers were added in beaker, After the rigorous stirring of solution of aniline monomers added 1 mol wt.%TiCl4 in that solution. it was observed that as soon as the TiCl4 was added to the monomer solution, the colour changed almost instantaneously and the solution became dark black. The soft jet- powder composite powder of PANi/Ti was obtained, dried in a desiccator's overnight and again dried in an oven at 40°C.

Result and discussion

Figure 2 shows the typical X-ray diffraction (XRD) pattern of the PANi/Ti composite. In this pattern observed the some broad peak between 22° -30° and 35.6° positions so it reflects that it is crystalline nature but other position weak peak so its reflect amorphous phase. This simultaneous amorphous and crystalline nature in same material confirms the semicrystallization of as-prepared samples powder.

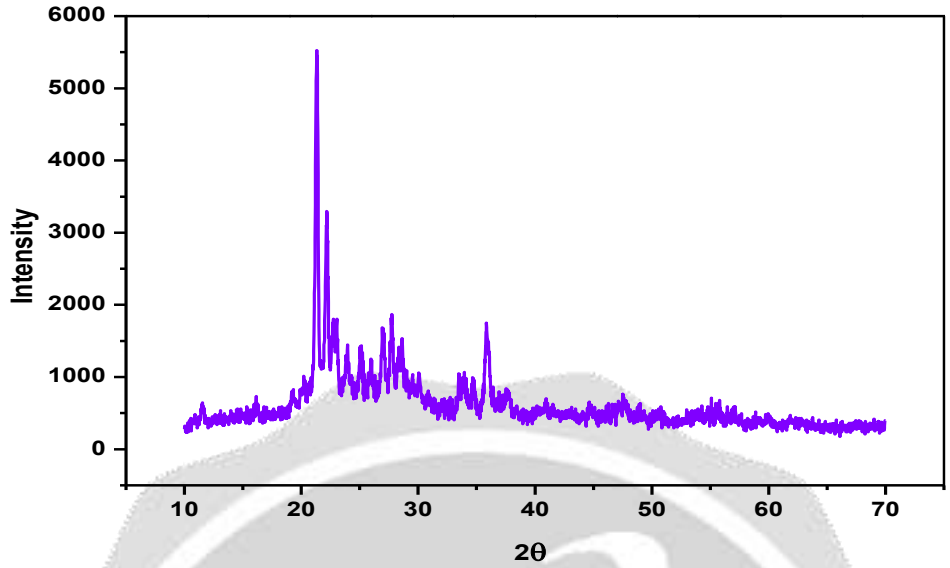

Figure 1. XRD pastern of PANi/Ti composite.

FTIR analysis

Figure 2 depicts the FTIR spectra of as synthesize Ti doped PANI composite powder samples, which were recorded in the range 4000-400 cm^{-1} to confirm polymerization. The peak at 1450 cm^{-1} attributed the C=C stretching quincy of the quinoid ring of the PANi unit, The peak between 750 to 600 cm^{-1} indicates the Ti-O stretching frequency of the TiO_2 unit thus confirming the formation of Ti layer.

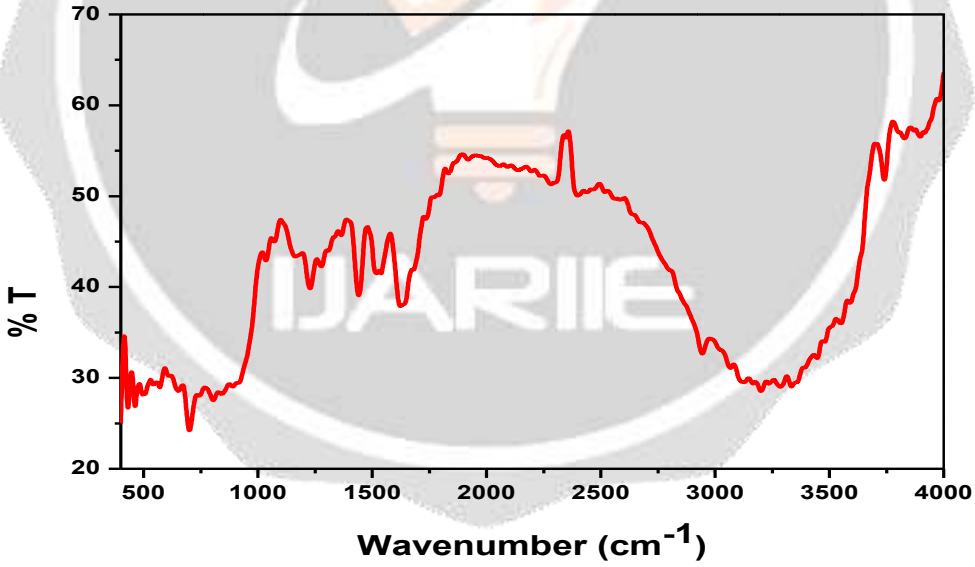

Figure 2. FTIR Spectra of PANi/Ti.

FESEM

Figure 3 shows the FE-SEM image of as synthesize Ti doped PANI composite powder samples.

FE-SEM was applied to study its surface morphology. It was unveiled that PANi/Ti composite consists of non uniform porous structure formed.

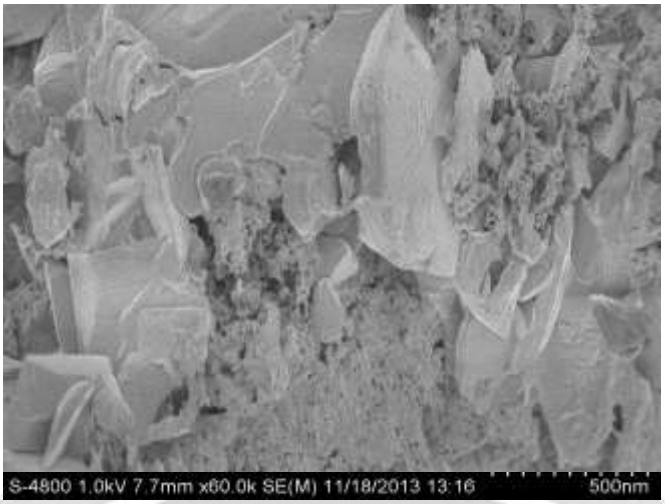

Figure 3. FESEM image of PANI/Ti composite.

Photoluminescence

The combined Photoluminescence spectra of Ti doped PANi was represented in Figure 4, from the observation excitation at 380 nm was monitored at 497 nm and the PL emission spectra was recorded in the range 450–600 nm monitored at 380 nm. The optimum intensity of emission spectra was obtained at 397 nm, may due the high charge generation efficiency. The PL emission spectra of Ti doped PANi shows wide broadband excitation in the UV region.

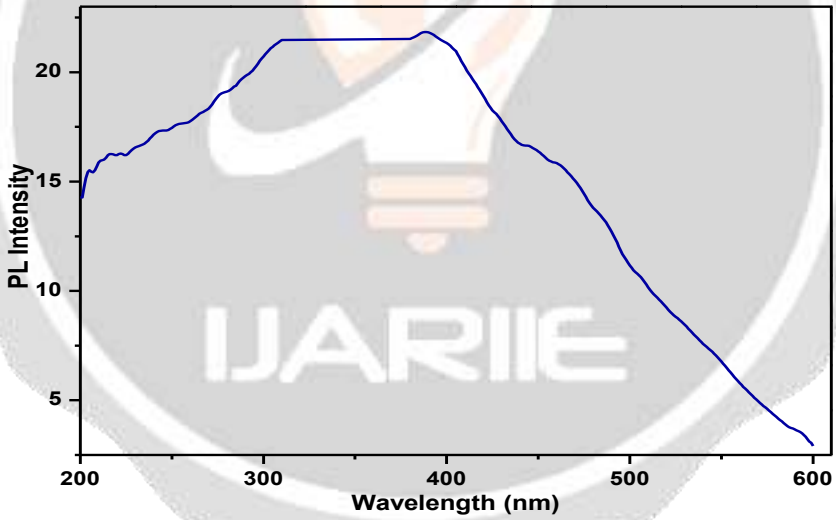

Figure 4. PL spectra of PANi/Ti composite.

Conclusions

In summary, we have successfully synthesized Ti doped PANi and Characterization was done through XRD, FTIR, FE-SEM, PL analysis.

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