

# A Study on Chemical Structural Modification of Conducting Polyaniline (Pani) by Gamma Irradiation



## Physics

**KEYWORDS :** conducting polymer ,PANI, Gamma Irradiation, FTIR Spectra.

**A.Raju**

Department of Physics, chaitanya Degree & P.G College, Hanamkonda, Warangal

**Ch.Srinivas**

Department of Physics, S.R Degree & P.G College Hanamkonda, Warangal

**S.Kalahasti**

Department of Physics, Kakatiya Univesity, Warangal

**B.Sanjeeva Rao**

Department of Physics, Govt., Degree College, Mulugu, Warangal

### ABSTRACT

*Polyaniline (PANI) is one of the important conducting polymers. It can be synthesized by Chemical or Electro-chemical routes. Due to unsaturated groups present in the PANI it is known to exhibit conducting properties. Gamma Irradiation of Polymer is reported to be one of the important methods to alter chemical structure which in turn brings a change in physical properties. On the other hand Gamma Irradiation treatment is reported enhance conducting properties. Therefore , the authors have investigated Gamma Irradiation in PANI. Fourier Transform Infrared Spectra of non irradiated and irradiated PANI are recorded. Unirradiated PANI structure of PANI exhibited different absorption bands corresponding to PANI. They include 3900-3450 cm<sup>-1</sup> absorption band due to N-H stretching, 2927 cm<sup>-1</sup> absorption band due to CH/CH<sub>2</sub>/CH<sub>3</sub> groups, 1560, 1495 cm<sup>-1</sup> bands are assigned to Benzoic and Quinoid vibrations, 1136 cm<sup>-1</sup> absorption band due to sin member rings vibration. On irradiation a change in absorption of some of these bands observed. While some new bands are appeared, the results suggest that Gamma Irradiation caused a change in chemical structure of PANI.*

### INTRODUCTION

Polyaniline (PANI) is one among the important class of conducting polymers. It contain NH groups in its backbone. Due to the steric orientation of NH groups, the PANI is reported to exist in different configurations, which have different conducting properties(1). The PANI in its insulating form has an energy gap of 4.4ev and it also exist in semiconducting state has an energy gap of 1.5ev. while the PANI has also exist in conducting state. All these forms are inter transformable by oxidation and reduction reaction in the presence of Trivedi(2).

Modification of chemical structure of synthetic polymers and bi-polymers is reported in literature to alter application (3). Chemical methods involve extra costs and produce some undesired changes. In contrast radiation methods involve lesser costs and are convenient. Therefore gamma irradiation induced chemical changes of various polymers is reported recently (4,5). In this context the authors have made an attempt to modify the chemical structure of PANI by gamma irradiation to realize it, different conducting form. Since the chemical changes are readily modulated by FTIR absorption spectroscopy, the authors have recorded FTIR spectra of unirradiated and irradiated PANI under different condition.

### EXPERIMENTAL

Polyaniline (PANI) in the form of powder is used in the present studies. Synthesis and characterization of PANI is reported by Sasir kumar(6). PANI is made into pellet form along with potassium bromide having a thickness of 2mm. Gamma irradiations are performed with cobalt 60 gamma source having a dose rate of 10 KGy per hour in air at room temperature

### RESULT & DISCUSSION

S.No	Absorption band cm <sup>-1</sup>	Assignments	Intensity
1	3856	N-H Streching vibration /Ring	Strong
2	3752	N-H streching vibration /Ring	Strong
3	3447	N-H streching vibration /Ring	Strong
4	2927	CH/CH <sub>2</sub> /CH <sub>3</sub> / Ring	Weak
5	1560	Benzoic/quinoid group	Strong
6	1495	Benzoic/quinoid group	Strong
7	1136	Aromatic ring vibration	Medium
8	736	Phenol /NH <sub>2</sub> group	Medium

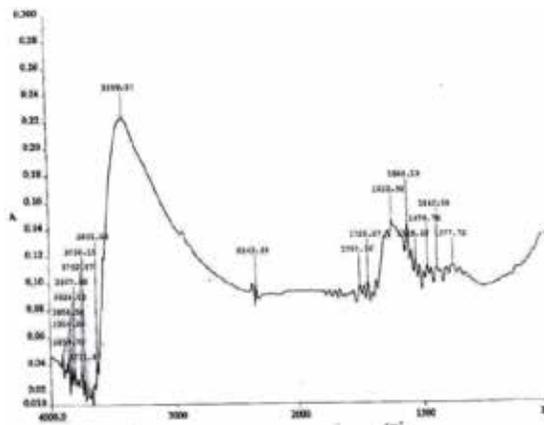


Fig.1: FTIR Spectrum of gamma-ray irradiated polyaniline

**Table 1: FTIR Absorption bands of unirradiated PANI**

FTIR spectra of unirradiated PANI has as shown in figure 1 The figure shows various absorption band that represent chemical structure of PANI. The absorption bands are centered around 3856cm<sup>-1</sup>, 3447 cm<sup>-1</sup>, 2927 cm<sup>-1</sup>, 1560 cm<sup>-1</sup>, 1495 cm<sup>-1</sup>, 1136 cm<sup>-1</sup> and 730cm<sup>-1</sup> and bands are associated various chemical groups of PANI as given in table 1.

S.No	Band position in cm <sup>-1</sup>	Band Assignments	Intensity
1	3904-3631	N-H Stzeching vibration and or aromatic group	Medium
2	3399	Aromatic group	Medium
3	2343	C≡≡N or C=N <sup>-1</sup> vibrations	Weak
4	1751-1720	Carboxyl group vibrations	Weak
5	1622-1560	Unsaturate group vibrations	Weak
6	1528-1479	Quinoid, Benzoid vibrations	Medium
7	1136	Aromatic Ring vibration	Medium
8	730	Phenolic / NH <sub>2</sub> group	Weak

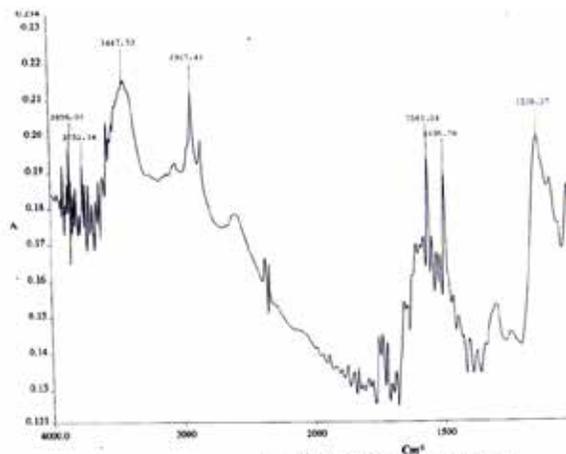


Fig: 2 FTIR Absorption Spectrum of Polyaniline

Table2: FTIR Absorption bands of irradiated PANI

The absorption bands of irradiated PANI are as shown in figure2. Gamma irradiation cause a change in intensity of absorption bands as given in table2 observed.

It can be observed from Fig1&2 and table 1&2 a change in intensity of some absorption bands with a shift either to words lower or higher wavelength. The 3856-3752  $\text{cm}^{-1}$  absorption band suffered a shift to words low wavelength side together with decrease in intensity. Therefore chemical group responsible for this absorption bands might cleave due to gamma irradiation. Present of 2343 $\text{cm}^{-1}$  absorption bands in irradiated PANI indicate of the presence of C=N/ C=N group or C=N resonating structure. Appearance of 1720 $\text{cm}^{-1}$  band indicates the presence of carboxyl group, which were produced due to irradiation of polymer in oxidized conditions. The presence of unsaturated groups, which might have produced due to the cleavage of N-H groups on irradiation. The increase of unsaturation together with already existing groups in conducting PANI may cause an increase in conductivity on irradiation .Therefore irradiation of PANI may bring out a change in chemical structure and enhance unsaturation there by increasing conductivity.

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