*Int. J. Chem. Sci.: 8(2), 2010, 1130-1134*

# EVALUATING INTEGRATED INTENSITIES OF FTIR ABSORPTION BANDS (II) PROPYLENE – ETHYLENE COPOLYMER

**B. SANJEEVA RAO[*], J. SAPTAGIRI PRASAD[a], N. SOMI REDDY[b], T. V. APPA RAO[c], S. KALAHASTI[d] and A. RAJU[e]**

Dept. of Physics, Kakatiya Govt. College, HANAMKONDA (A.P.) INDIA
[a]Dept. of Physics, Malla Reddy Institute of Technology & Science, SECUNDERABAD (A.P.) INDIA
[b]Dept. of Chemistry, Kakatiya Govt. College, HANAMKONDA (A.P.) INDIA
[c]Dept. of Physics, NIT, WARANGAL (A.P.) INDIA
[d]Dept. of Physics, Kakatiya University, WARANGAL (A.P.) INDIA
[e]Dept. of Physics, Chaitanya P.G. College (Autonomous), Hanamkonda, WARANGAL (A.P.) INDIA

## ABSTRACT

Fourier transform infrared spectroscopy is applied to investigate radiation induced changes in propylene-ethylene copolymer. Variation in intensities of FTIR absorption variation in intensities of FTIR absorption bands is taken as an evidence for chemical changes induced by irradiation of copolymer. Among the various FTIR bands observed for irradiated PE copolymer, the 3100 cm$^{-1}$, 1720 cm$^{-1}$, 2950 cm$^{-1,}$ 1150 cm$^{-1}$ and 997 cm$^{-1}$ absorption bands have shown a remarkable change in intensity. Absorption of these bands is measured by theoretical methods. Based on these values, radiation induced changes in PE copolymer is explained.

**Key words**: PE Copolymer, FTIR technique, Radiation induced changes, Absorption measurements, Theoretical method.

## INTRODUCTION

Polypropylene and propylene – ethylene (PE) copolymers are well known for their use and application[1]. Radiation induced changes in these polymeric systems is a point of interest over four decades[2,3]. To study these changes, various experimental techniques are used in literature including ESR, DSC and Fourier transform infrared technique.

In this context, the authors have recorded FTIR spectra under different conditions. The observed FTIR absorption bands are assigned to various chemical groups present in the

---

[*] Author for correspondence

copolymer. Absorption of each group is measured by double integration methods. These values are compared.

## EXPERIMENTAL

PE Copolymer in the form of powder is of commercial origin. The copolymer is irradiated with cobalt 60 gamma source with a dose rate of 0.2 M.rad / hr. The copolymer is made into pellet along with potassium bromide. FTIR spectra of pure and irradiated PE copolymer have been recorded on NICOLET 283 Model spectrometer using KBr optics.

## RESULTS AND DISCUSSION

FTIR spectrum of un-irradiated PE copolymer is shown in Fig. 1. The spectrum posses various absorption bands as shown in Table 1. FTIR spectra of PE copolymer irradiated to different radiation doses are shown as curves 1, 2, 3 in Fig. 2. The intensity/ absorption of these bands are measured by double integration methods which include trapezoidal method and Simpson method. The intensities are obtained by graphical method and the intensities obtained by different methods are compared. The integrated intensities of various absorption bands are as listed in Table 2. Plots of integrated intensity against radiation dose are drawn for 3100 cm$^{-1}$, 2950 cm$^{-1}$, 1720 cm$^{-1}$ and 1150 cm$^{-1}$ absorption bands are shown in Figs. 3, 4, 5 and 6.

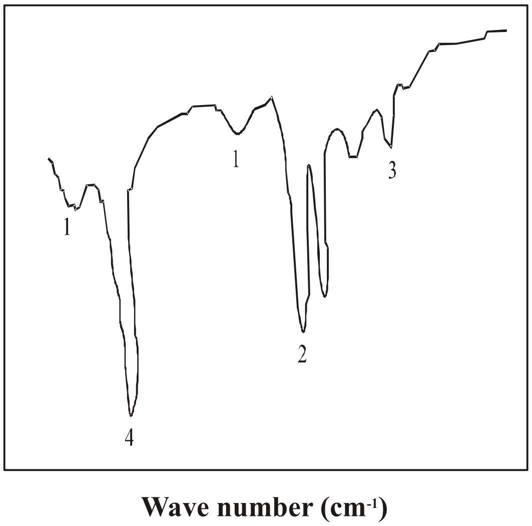

**Fig. 1: FTIR Spectrum of un-irradiated PE copolymer**

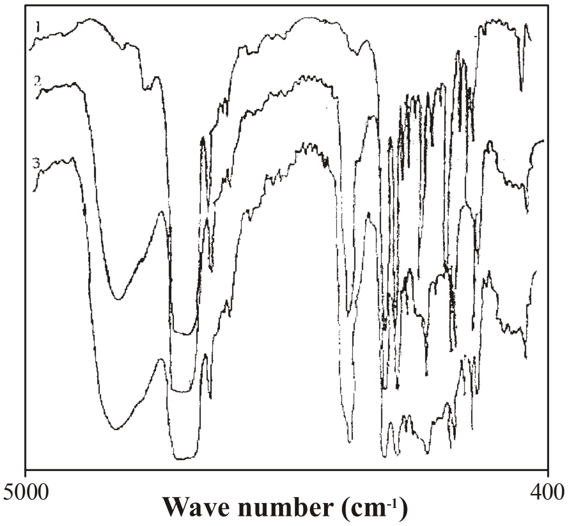

**Fig. 2: FTIR Spectrum of irradiated PE copolymer of different doses**

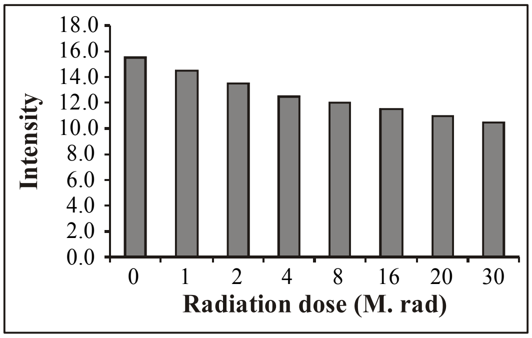

**Fig. 3: Variation of average value of intensity of band at 3100 $cm^{-1}$ against radiation dose**

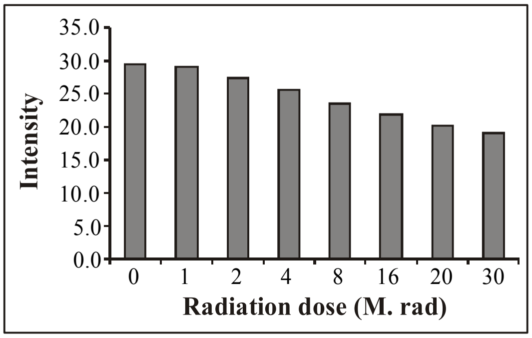

**Fig. 4: Variation of average value of intensity of band at 2950 $cm^{-1}$ against radiation dose**

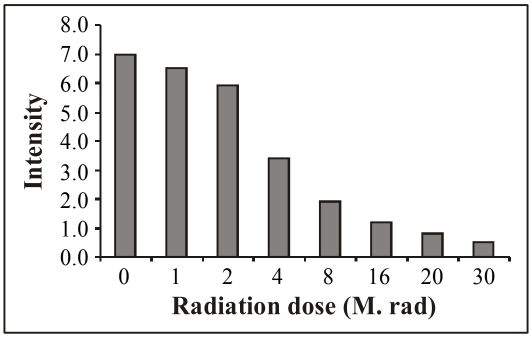

**Fig. 5: Variation of average value of intensity of band at 1720 $cm^{-1}$ against radiation dose**

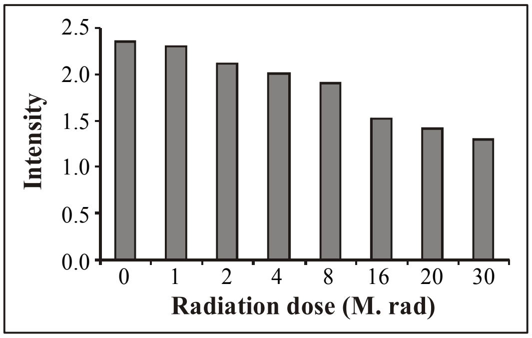

**Fig. 6: Variation of average value of intensity of band at 1150 $cm^{-1}$ against radiation dose**

FTIR spectrum of un-irradiated PE copolymer show various absorption bands assigned to different chemical groups in the copolymers and these are listed in Table 1.

**Table 1: FTIR absorption bands of un-irradiated PE copolymer**

| Band position ($cm^{-1}$) | Intensity | Assignment |
|---|---|---|
| 2950 | Strong | $\delta$ $CH_3$/$\delta CH_2$ |
| 2820 | Strong | $\delta$ $CH_2$ |
| 1460 & 1434 | Strong | $\delta$ $CH_3$/$\delta CH_2$ |
| 1370 | Strong | $\delta$ $CH_3$ |

Cont...

| Band position ($cm^{-1}$) | Intensity | Assignment |
|---|---|---|
| 1230 | Weak | δ CH, δ$CH_2$ |
| 998 | Medium | δ $CH_3$ |
| 840 | Medium | δ $CH_2$ |

On irradiation, some of the absorption bands have shown a variation in intensity and some new absorption bands are observed. These bands are listed in Table 2.

**Table 2: FTIR absorption bands of in irradiated PE copolymer**

| Band position ($cm^{-1}$) | Intensity | Assignment |
|---|---|---|
| 3100 | Strong | COOH/OH group |
| 1720-1715 | Strong | C=O group |
| 1715 | Medium | COOH group |
| 1645 | Medium | Vinyl group |

The intensity of absorption bands are measured by double integration methods viz., trapezoidal method, Simpson method and graphical method. The values of intensity obtained by these methods are listed in Table 3. The intensity values obtained by these methods for each band are almost same. It can be observed from Table 3, the absorption increased with the increase of radiation dose.

**Table 3: Intensities of various absorption bands at different doses**

| Radiation dose (M. rad) | Average values of absorption | | | |
|---|---|---|---|---|
| | 3100 $cm^{-1}$ | 2950 $cm^{-1}$ | 1720 $cm^{-1}$ | 1150 $cm^{-1}$ |
| 0 | 10.50 | 29.50 | 0.5 | 2.35 |
| 1 | 11.00 | 29.00 | 0.8 | 2.30 |
| 2 | 11.50 | 27.50 | 1.2 | 2.11 |
| 4 | 12.00 | 25.50 | 1.9 | 2.01 |
| 8 | 12.5 | 23.50 | 3.4 | 1.91 |
| 16 | 13.50 | 21.8 | 5.9 | 1.52 |
| 20 | 14.50 | 20.20 | 6.5 | 1.42 |
| 30 | 15.50 | 19.00 | 7.0 | 1.30 |

A plot of FTIR intensity against radiation dose is shown in Fig. 3. It indicates increase in intensity of 3100 cm$^{-1}$ and 1720 cm$^{-1}$ absorption bands consequent to an increase in COOH group. A decrease in intensity 2950 cm$^{-1}$ and 1150 cm$^{-1}$ absorption bands is indicative of cleavage of $CH_2$ / $CH_3$ groups on irradiation. Therefore, it may be concluded that cleavage of $CH_2$ / CH groups might have occurred on irradiation. The free radical formed during irradiation, might abstract atmospheric oxygen to form COOH groups, which has been observed by the presence of bands at 3100 cm$^{-1}$ and 1720 cm$^{-1}$. Formation of these groups has also been confirmed earlier[7,8].

## REFERENCES

1. J. L. Williams, T. S. Dunn, H. Sugg and V. Stannett., Radiation Phys. Chem., **9**, 445 (1977).
2. H. L. Allison, Packaging, **30 (3)**, 25 (1985).
3. B. Sanjeeva Rao, N. S. R. Reddy and A. P. Jhadav, Proc. Curr. Trends Phys., Warangal (2004).
4. A. Rivaton, D. Lalande and J. Gardette, Nuclear Instruments and Methods (NIMB), **6**, 223, 187 (2004).
5. K. Tsuji and T. Seiki, Polymer J., **1**, 133 (1970).
6. H. Yoshida and B. Ranby, J. Polym. Sci. C, **12**, 163 (1966).
7. L. Burlinska, Bojarski and J. Michoclik, Rad, Phys. Chem., **47(3)**, 449 (1996).
8. J. Adams and T. Watanabe, J. Appl. Polym. Sci., **60**, 1839 (1996).

*Accepted : 18.12.2009*