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AAAMPS COPOLYMER FOR DOSIMETRIC APPLICATIONS

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ABSTRACT

Possibility of acrylamide (AA)-2-acrylamido-2-methyl propane sulfonic acid (AMPS) copolymer for dosimetric applications has been investigated using Fourier transform infrared (FTIR) spectroscopy technique. The copolymer has exhibited various FTIR absorption bands, characteristic of copolymer. On irradiation, a change in intensity of some of the absorption bands is observed. Based on intensity- radiation dose variation, the copolymer could be used for dosimetric applications.

Key words: Radiation dosimeter, AAAMPS copolymer, FTIR technique, Radiation dose, Absorption bands.

INTRODUCTION

Measurement of radiation dose is an important aspect. Living and non-living beings are continuously exposed to different types of radiations. Radiation absorbed by them is an important aspect. Excess exposure leads to severe hazards including health and stability. Therefore, measurement of radiation dose absorbed by a body is an important aspect. For this purpose various radiation dosimeters are used. Out of them the polymer dosimeters are an important class, as they are very cheap and easily handle. If any molecular system undergoes any physical, chemical property varies linearly with radiation dose, that can be applied for dosimetric applications. Based on these principles, thermoluminescence (TSL)[1], electron spin resonance (ESR)[2] and calorimetry dosimeters[3] are very prominent. Regarding polymer dosimeters, El-Kheir et al.[4] have studied polycarbonate (PC) as α-particle dosimeter. Based on their observations, they have suggested that some of the absorption bands that PC could be used as alpha particle as well as neutron radiation dosimeter.

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Bartolotia et al.[5] have reported alanine/polyethylene as solid state dosimeter. These authors have used amino acids, instead of alanine to construct an ESR dosimeter with a view to improve performance. But the results showed that alanine is more suitable for ESR dosimetric applications.

In this context, the authors attempt to investigate the AA copolymer for dosimetric applications. The AA copolymer is exposed to gamma rays to different radiation doses, monitoring intensities of FTIR absorption bands, the authors have observed that AA copolymer could be used for dosimetric applications.

EXPERIMENTAL

AA copolymer in the form of powder is used. Synthsis and characteristics of AA copolymer is reported by Ranga Rao and Raviprasad[6]. The copolymer is exposed to gamma rays to different radiation. FTIR spectra of AA copolymer are recorded by making pellets along with potassium bromide. FTIR spectra are recorded on Perkin-Elmer spectrometer. Gamma irradiation are done with cobalt 60 gamma source.

RESULTS AND DISCUSSION

FTIR spectrum of unirradiated AA copolymer is shown in Fig. 1. The spectrum consists of absorption bands characteristic of both the polymers i.e. polyacrylamide and poly AMPS. They are as listed in Table 1. These absorption bands are assigned to respective chemical groups present in the copolymers. These assignments are listed in Table 2.

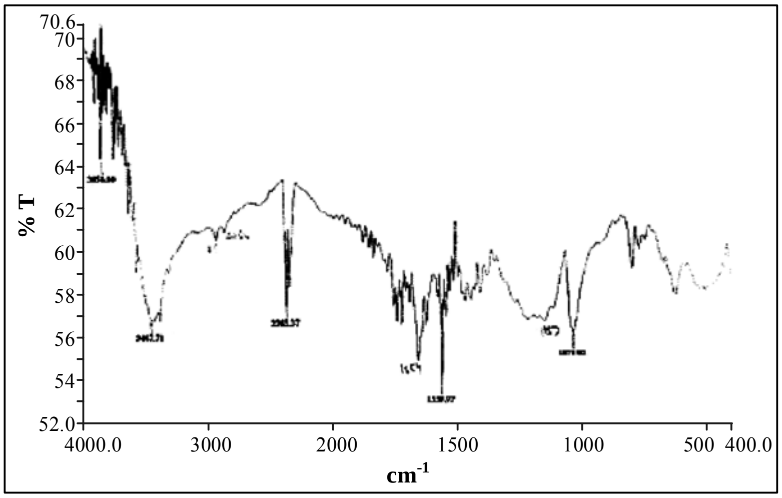

Fig. 1: FTIR spectrum of unirradiated AA Copolymer

Table 1: Characteristic absorption bands of PAAM, PAMPS and MA copolymer

Polyacrylamide	Poly AMPS	MA copolymer
3600-3130	3600-3130	3600-3130
2930	2933	2930
1650	-	1650
-	1566	1560
1470	1470	1470
	1450	1450
	1150	1150
	1030	1033
	622	622

Table 2: Assignment of absorption bands in AA copolymer

Chemical group	Group of frequencies	Designation
SO_3H	3700-3110	I
	1290-1060	
	1090-950	
	670-600	
$CONH_2$	3700-3110	II
	1650-1000	
CONH	3700-3110	III
	1650	
	1550	
CH_3-CH-CH_3	1450-1370	IV
CH_3/CH_2	2933, 1450	V

The absorption bands can be broadly classified to six groups. The first group of frequencies belong to sulfonic acid groups (SO_3H), at 3700-3110, 1290-1060, 1090-950 and 670-600 Hz. The second group belongs to amide group ($CONH_2$), which give absorption bands at 3700-3110 and 1650-1000 Hz. The third group belongs to amine group (CONHR), which gives absorption bands in the region of 3700-3110, 1650 and 1550 Hz, the fourth group is asymmetric methyl group (CH_3-C-CH_3), which gives absorption bands at 1450-1370 and the fifth group is methyl/methylene group, which gives absorption band at 2930 Hz position.

FTIR spectra of AA copolymer irradiated to 1, 2 and 3 Mrad doses of irradiation are recorded and the spectra are shown in Figs. 2, 3 and 4, respectively. It is observed that there is a shift together with a change in intensity of absorption bands. The absorption bands observed for irradiated spectra are given in Table 3, among these bands, the 1030 cm^{-1} absorption band is mostly affected by irradiation. As this band is assigned to sulfonic acid groups, on irradiation, effects might have occurred on these groups mostly. A plot of 1030 cm^{-1} absorption band against radiation dose is shown in Fig. 5. As the graph is linear, based on the variation in intensity, the copolymer could be applied for dosimetric applications.

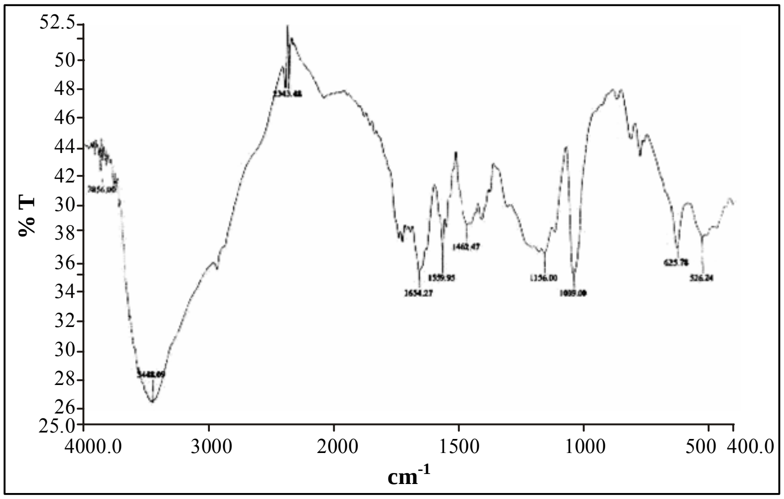

Fig. 2: FTIR spectrum of 1 Mrad dose irradiated AA copolymer

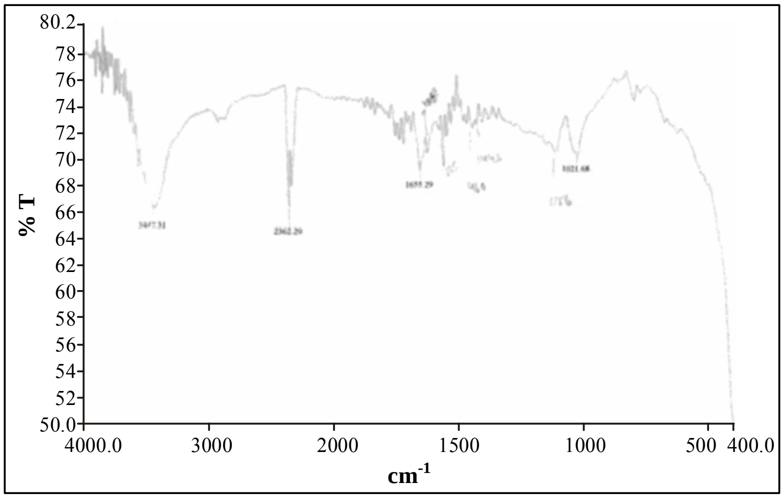

Fig. 3: FTIR spectrum of 2Mrad dose irradiated AA copolymer

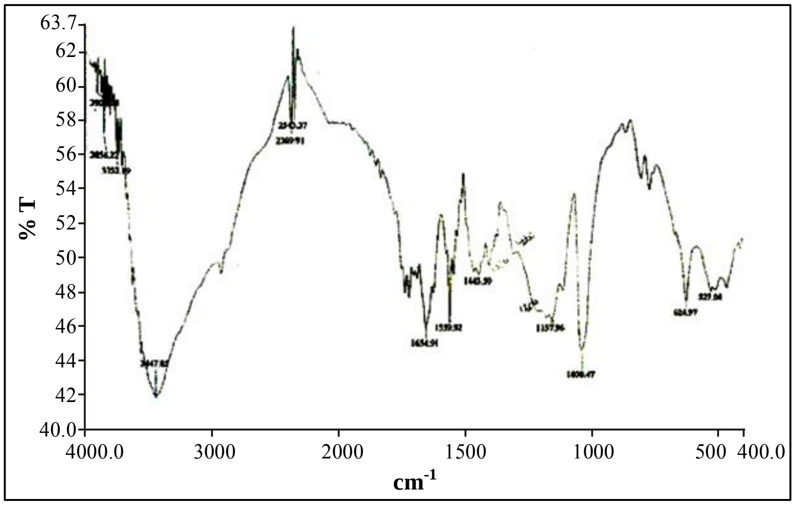

Fig. 4: FTIR spectrum of 3 Mrad dose irradiated AA copolymer

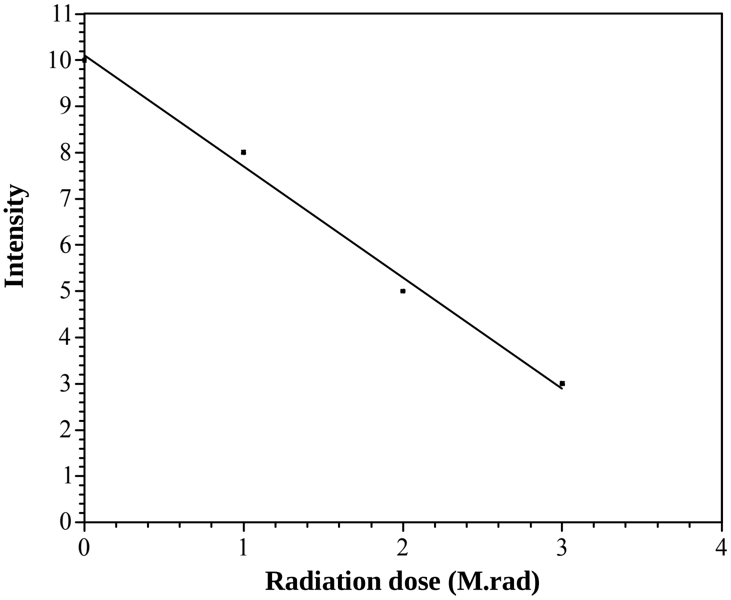

Fig. 5: Variation of intensity against radiation dose

Table 3: FTIR absorptic bands of irradiated AA copolymer to different radiation doses

Unirradiated	Radiation dose			
	1 Mrad	2 Mrad	3 Mrad	Assignment
3447/3387/3300	3448	3447	3447	I, II, III
2950	2950	2950	2950	V
2880		2880		
1654	1654	1655	1654	II, III
1560	1559	1559	1559	II
1460	1462	1462	1462	II, IV
			1448	II, IV
1370	1370	1370	1370	II, IV
1256	1250		1250	I, II
1150	1150	1130	1150	I, II
1038	1039	1021	1038	I, II
850	850		850	
790	790			
625	625	625	629	I
	520		521	

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