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RESEARCH ARTICLE

RAMAN EFFECT OF CARBON ION INDUCED PMMA

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ABSTRACT

The results of Raman spectroscopy of carbon-ion-induced poly (methyl methacrylate) PMMA with ion doses from 1.0 x 10^{11} to 1.0 × 10^{12} ions/cm^2 are reported. The Raman spectra recorded in the 0–3500 cm^{-1} range, showing the formation of new carbon–carbon bands for the irradiated samples at higher ion fluence.

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INTRODUCTION

The curiosity to ion-irradiated polymers is due to the happening of two processes upon ion implantation: the first one is the scission of polymer chains and appearance of free radicals preceding the aggregation of the clusters resulting in the development of network of conjugated bonds at lower ion doses (<10^{16} ions/ cm^2) and the second the carbonization at higher ion doses (>10^{16} ions/cm^2) (Kavetskyy et al., 2014). With its exceptional optical transparency, attractive electrical and mechanical properties, and good compatibility with human tissue, poly-(methyl methacrylate) (PMMA), a transparent thermoplastic, has been investigated for use in various applications, such as optical windows and lenses, medical technologies and implants, and micro fluidics and biochips (Ozcan and Hasirci, 2007; Lhoest et al., 1995; Schulz et al., 2001; Yoshinari et al., 2006). To expand the applications of PMMA, surface modification, such as plasma and/or ion-beam treatments, has been studied to modify the chemical, mechanical, and optical properties by tuning the chemical functionality.

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Antireflective structures generated on PMMA by plasma treatment showed reduced surface reflection (Schulz et al., 2010; Kaless et al., 2005). The nano texturing of PMMA using oxygen plasma treatment for protein microarray applications was reported and the nano textured PMMA, which has a high surface area, appreciably increased protein adsorption compared to an untreated PMMA surface was also detected (Sougeni et al., 2010). The present study deals with the Raman Spectroscopy of carbon ion irradiated PMMA samples.

MATERIALS AND METHODS

The specimens of poly (methyl methacrylate) PMMA in the form of flat polished thin films (25μm) were procured from Good Fellow Ltd. (England). These films were used as-received form without any further treatment in the size of 1 cm x 1 cm. The samples were mounted on the sliding ladder and irradiated with carbon(85 MeV) ion beams using 15 UD pelletron facility for the general purpose scattering chamber (GPSC) under vacuum of ~10^{-6} Torr at Inter-University Accelerator Center, New Delhi. The electronic energy loss (eV/Å), ion range (μm), nuclear energy loss (eV/Å) of characterize carbon (85 MeV) ions in PMMA polymer is ~26.25, 240.48 and1.151 E-02 respectively (Ziegler, 2008).

The range of all ions is more than the thickness of polymer films. The ion beam fluence was varied from 1 x 10^{11} to 1 x 10^{12} ions $cm^{-2.}$ In order to expose the whole target area, the beam was scanned in the x-y plane. The beam current was kept low to suppress thermal decomposition and was monitored intermittently with a Faraday cup. The time of irradiation was calculated using the formula:

ϕ : Ion fluence,

ρ: Density of polymer,

$\frac{dE}{dx}$: Stopping power of ion

Table 1. Doses for given fluence of silver ion of studied polymer

Polymer	Ion Fluence (ions/cm^2)	Carbon (85MeV) (kGy)
PMMA	Pristine	0.00
	1 x10^{11}	35.90
	3 x10^{11}	107.69
	1x10^{12}	358.97

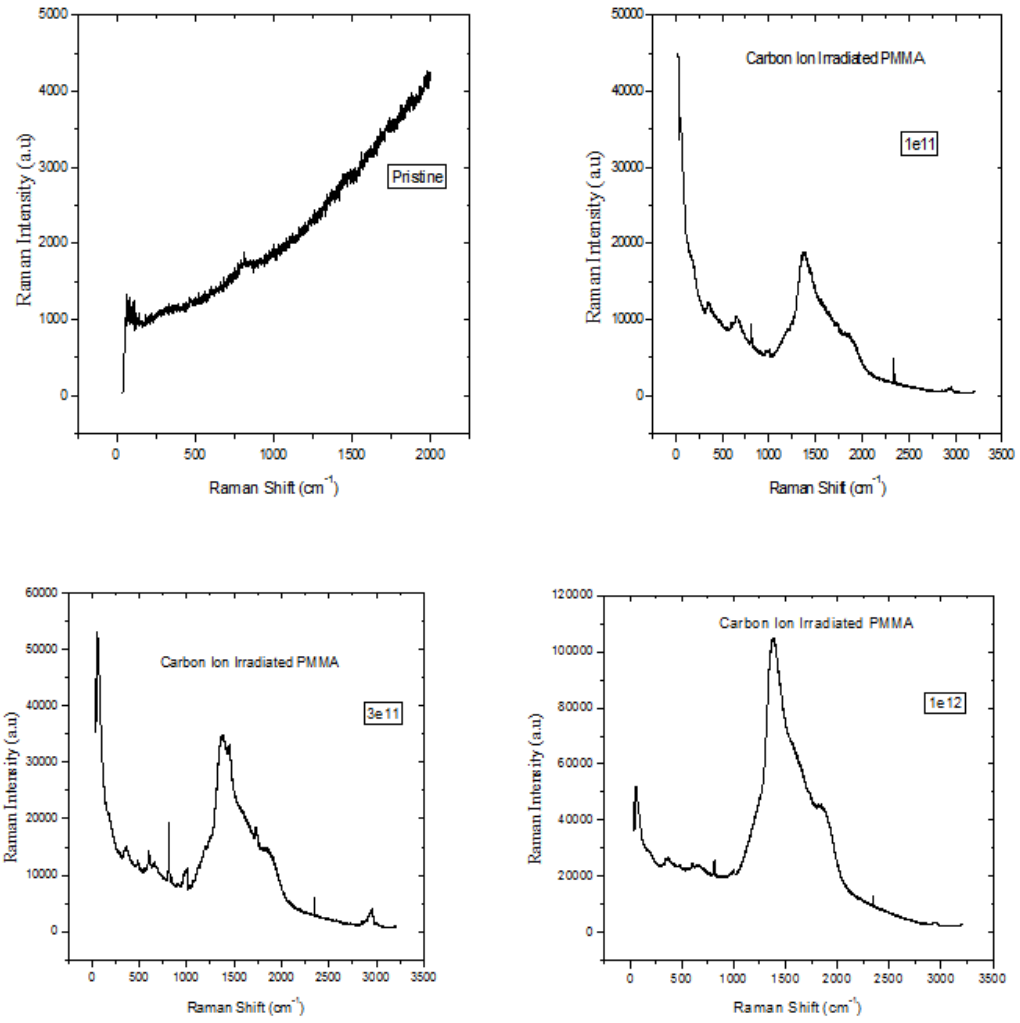

Fig.1. Raman Spectra of Carbon ion induced PMMA samples of varying fluences

$$T = \frac{\phi A}{beamcurrent(pnA)} \quad (1)$$

ϕ: Ion fluence, A: area of the film.

Polymer Doses (Table 1) for the given fluence were calculated using the formula (Geiβ et al., 1998) as given below:

$$\text{Dose} = 1.602 \times 10^{-10} \times \frac{1}{\rho} \times \frac{dE}{dx} \times \phi \quad (2)$$

RESULTS AND DISCUSSION

The Raman spectra of polymethylmethacrylate PMMA is recorded in the 0–3500 cm^{-1} range and depicts a prominent peak at 1381 cm^{-1} and are known as the D Band (Defects Band) (Jindal et al.,2013). The peaks may be due to the formation of new carbon–carbon bands for the irradiated samples at higher ion. The Raman spectra of carbon ion induced PMMA is shown in Fig. 1.

Conclusion

The peak shown by the Raman spectra of poly (methylmethacrylate) PMMA may be due to the formation of new carbon–carbon bands for the irradiated samples at higher ion.

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REFERENCES

Geiβ O.B., Kramer M., and Kraft G. 1998. Efficiency of thermo-luminescent detectors to heavy charged particles, Nucl. Instr. Meth. Phys. Res. B, 142, pp.592-598.

Jindal, P., Goyal, M. and Kumar, N. 2013. Modeling composites of multi-walled carbon nanotubes in polycarbonate Int. J. Com-put. Methods Eng. Sci. Mech. 14 (6), pp. 542—551.

Kaless, A., Schulz, U., Munzert, P., and Kaiser, N. 2005. NANO-motheye antireflection pattern by plasma treatment of polymers, Surf. Coat. Technol. 200, pp. 58–61.

Kavetskyy, T., Tsmots, V., Kinomura, A., Kobayashi, Y., Suzuki, R., Mohamed, H. F.M., Šauša, O., Nuzhdin, V., Valeev, V., and Stepanov, A. L. 2014. Structural defects and positronium formation in 40 keV B 390 þ- implanted polymethylmethacrylate. J. of Physical Chemistry B 118(15), pp. 4194–4200.

Lhoest, J. B., Dewez, J. L., and Bertrand, P. 1995. PMMA surface modification under keV and MeV ion bombardment in relation to mammalian cell adhesion. Nucl. Instrum. Methods Phys. Res., Sect. B, 105, pp. 322-327.

Ozcan, C. and Hasirci, N. 2007. Plasma Modification of PMMA Films: Surface Free Energy And Cell-Attachment Studies. J. of Biomater Sci., Polym. Ed., 18(6), pp. 759-773.

Schulz, U., Munzert, P., and Kaiser, N. (2010). Plasma surface modification of PMMA for optical applications. J. Adhes. Sci. Technol., 24, pp.1283–1289.

Schulz, U., Munzert, P., and Kaiser, N. J. 2001. Surface modification of PMMA by DC ... microwave plasma treatment for the improvement of coating adhesion. Surf. Coat. Technol., 142/144, pp. 507-511.

Tsougeni, K., Tserepi, A., Constantoudis, V., and Gogolides, E., (2010) Plasma Nanotextured PMMA Surfaces for Protein Arrays: Increased Protein Binding and Enhanced Detection Sensitivity. Langmuir 26, pp. 13883-13891

Yoshinari, M., Kato, T., Matsuzaka, K. Hayakawa, T. , Inoue, T., Oda, Y., and Shimono, M. 2006 Adsorption behavior of antimicrobial peptide histatin 5 on PMMA. J. Biomed. Mater. Res., B Appl. Biomater. 77, pp. 47-54.

Ziegler J F. 2008 Stopping and range of ions in matter, *Srim.org*.

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