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Influence of SHI upon nanohole free volume and micro scale level surface modifications of polyethyleneterephthalate polymer films

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Research Highlights

- Ion irradiation of PET polymer (used for gas separation applications) for structural, optical, chemical, surface and free volume studies.
- The amorphization and decrease of the band gap energy after ions irradiation.
- The value of R increased after ion irradiation due to the expansion of the polymeric chains and increase of the cavities.
- Increase in the surface roughness creating the site of track formation.

Abstract

Topographic micro scale and in-depth nano scale level modifications of polymeric materials play an important role in engineering their physical and chemical properties. Polyethylene terephthalate (PET) is an important class of semi- crystalline polymers used for gas separation properties. The gas diffusion and permeability parameters are directly related to the free volume fractions and the hole distributions. The controlled and precise ion beam irradiation can be used to induce surface and in-depth modifications in the properties of the polymers which help in modifying free volume holes and their distributions. In the present study, the investigation of free volume (nano scale level) and surface (micro scale level) properties of PET polymeric thin films after SHI treatment were employed by means of positron annihilation lifetime spectroscopy (PALS) and atomic force microscopy (AFM) respectively. The PET thin films were irradiated by 50 MeV lithium ions as a function of ion fluence. The value of hole radius (R) and intensity (I_3) of o-Ps were observed to be increased after ion beam treatment. The further analyses were employed to calculate the free volume and fractional free volume of holes from the obtained values of R and I_3. The AFM studies reveal the surface modifications in the irradiated polymer films. The structural, optical and chemical properties were investigated by X-ray diffraction (XRD), UV-visible (UV-vis) and Fourier transform infrared (FTIR) spectrophotometry. Different