

Study of the effect of γ -ray irradiation on the optical properties of polyethylene terephthalate polymer

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Abstract : The effect of γ -ray irradiation on optical properties of polyethylene terephthalate (PET) has been studied using UV-Visible spectrophotometry technique. γ -ray irradiations were performed, using ^{60}Co source with mean energy of 1.25 MeV, at Nuclear Research Centre of Algiers, Algeria. The dose rate was about 1.3 kGy/h as measured using the Frick dosimeter. Several PET samples with a thickness of 6 μm were irradiated at room temperature in air atmosphere at dose range 0.05 - 5 MGy. After irradiation, the colour of the PET thin film, which is initially transparent, becomes slightly yellowish at high γ -ray dose. The UV-Visible absorption spectra of pristine and irradiated PET polymer have been obtained by a double beam Cintra 40 spectrophotometer in the range 200 900 nm. The absorption measurements show a large absorption band extended from 310 to 355 nm assigned to the formation of extended systems of conjugate bonds with the creation of carbon clusters. The optical absorbance in this range increases linearly with the ray dose. An empirical relation is established to estimate gamma dose from this correlation. Both direct and indirect energy gaps deduced from the Tauc relation are found to decrease with increasing γ -ray dose indicating the appearance of new electronic transitions. Moreover, it is also observed that the Urbach energy increases with the γ -ray dose. This indicates the disorganization of the PET structure after irradiation. Moreover, the linear behavior of the absorption band versus γ -ray dose observed in the present study suggests the potentiality of using PET polymer as gamma dosimeter.

Keywords : polyethylene terephthalate, UV-visible, optical properties, γ -ray