EFFECT OF SWIFT HEAVY ION IRRADIATION ON THE OPTICAL PROPERTIES OF ION IMPLANTED POLYETHYLENE TEREPHTHALATE

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The surface modification of polymer thin films with heavy ion beams irradiation always induces irreversible changes of the materials through cross-linking, chain scission, mass losses, and irreversible bond cleavages for specific customizations. We report here on structural and optical characteristics of ion implanted polyethylene terephthalate (PET) films measured through ion beam elemental depth profiling and UV-Vis optical spectroscopy measurements, respectively. The samples were implanted with 150 keV Ag^{+} ions to different ion fluences of 1.00×10^{16}, 5.00×10^{16} and 1.00×10^{17}ions/cm^2, and thereafter irradiated with 30 MeV Au^{7+}-ions for fluences ranging between 7.00×10^{13} to 2.50×10^{14} ions/cm^2. The immediately observable effect of the implantation was the darkening of the initially transparent PET films, with the degree of darkening increasing with implantation ion fluence. The elemental depth profiles showed considerable atomic depletion of hydrogen from 36% down to below 1%, and oxygen from 18% to about 6% for the highest implantation ion fluence, whereas the proportion of carbon increased from 46% up to over 90% with increasing ion fluence. Optical characterisation results showed notable changes in the UV-Vis absorption spectra of the implanted, as well as the implanted-and-irradiated samples. The optical band-gap was found to decrease with increasing implantation ion fluence, and decreased even further on irradiation after implantation. Consequently, the number of carbon atoms in beam induced carbon clusters is also seen to increase with the implantation ion fluence, and as well after irradiation. These results suggest that the same materials modification effects in polymers that are normally only achievable through high fluence implantation, can still be realized through a combination of low fluence implantation followed by low fluence swift heavy ion irradiation.