

Characterization of heavy ion tracks in polymers by transmission electron microscopy

Adla A, Fuess H, Trautmann C

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Ultrathin sections of two polymers - poly(ethylene terephthalate) and polyimide - were irradiated with heavy ions of 11.1 MeV per nucleon. The size and morphology of the latent tracks were examined with transmission electron microscopy. Polymers readily decomposed under the imaging electron beam. Samples were therefore stained with either osmium tetroxide or ruthenium tetroxide before and/or after ion irradiation. This treatment significantly reduced the radiolytic sensitivity. In addition, however, with dynamic video electron imaging, quasi-instantaneous damage processes were observed within seconds of observation, modifying in particular both tracks in the bulk and to a lesser extent those on the two confining surfaces. The staining agent was embedded into amorphous regions of the matrix as metallic nanoparticles. Prestained tracks appeared as bright cylindrical regions with diameters of ~ 6-10 nm. In ultrathin samples, the central track region showed a significant loss of material and even an open hole. Following poststaining, tracks exhibited a dark contrast because of preferential diffusion of the staining agent into the tracks. Poststained tracks were larger than prestained tracks.