

Chemical degradation of polyimide and polysulfone films under the irradiation with heavy ions of several hundred MeV

Steckenreiter T, Balanzat E, Fuess H, Trautmann C

JOURNAL OF POLYMER SCIENCE PART A- POLYMER CHEMISTRY 37 (1999) 4318-4329

Degradation processes in polyimide and polysulfone irradiated with energetic Kr (720 MeV) and Mo (515 MeV) ions were studied by infrared and mass spectroscopy. Most notable is the creation of alkynes, cyanates, and acetylene. The formation of such triple-bonded species within a radius of 3-4 nm around the ion trajectory seems to be a unique process attributed to the extremely high energy deposition of heavy ions. We also found other degradation products well known for low ionizing radiation, but they are created in a larger halo region around the ion path, and they are strongly enhanced if the irradiation takes place in an oxygen atmosphere. The complementing observation of various bulk and volatile degradation products allows us to give a detailed description of the underlying decomposition mechanisms. A remarkable analogy is found between degradation products created under ion irradiation and during pyrolysis. The thermal stability of alkynes and the observation of sulfur precipitates, instead of outgassing SO₂, suggests that transient temperatures above 1500 K are involved in the track formation process.