

Measurements of etching rates of ion tracks: comparison of different approaches

N. Sertova¹, E. Balanzat¹, C. Trautmann², M. Toulemonde¹.

¹CIMAP, laboratoire commun CEA-CNRS-ENSICAEN-Université de Caen, BP 5133, 14070 Caen-Cedex 5, France, ²Materialforschung, GSI, Planckstr. 1, 64291 Darmstadt, Germany.

Latent tracks induced by energetic heavy ions in polymers have a complex structure generally described in terms of core and halo regions. Under chemical etching this damage structure is revealed by the nonlinear evolution of the enlargement of the pore: in the initial stage (zero radius), the radial etching velocity, V_r corresponds to the track velocity V_t . In an intermediate zone V_r is determined by the damage in the halo and finally at a radius far from the ion path, the etching process reaches the undamaged matrix and proceeds with the bulk velocity V_b . Although V_r is an important parameter for understanding the damage structure and pore shape, experimental data on V_r are scarce. Microscopic observations (e.g. scanning force or electron microscopy) cannot access the very early stage of pore formation and are typically limited to many pores on the membrane surface. The most direct approach is conductivity measurements on single-tracked membranes but at present there exists only a few data. However, a reliable data for the initial stage of pore growth is missing.

This report proposes the use of simple loss of weight measurements combined with infra-red spectroscopy. Such measurements have the advantage to provide information from the very first moment of the etching process (including even the time before the moment of pore breakthrough). We investigated polycarbonate (PC) films irradiated with ~ 5 -MeV/u Ca and Pb ions at fluences between 2×10^8 and 7×10^9 ions cm^{-2} . The radial etch rate is deduced from the evolution of the weight loss and intensity decrease of specific infrared bands as a function of the etching time. The loss mass was modelled assuming a V_r evolution which is affected by the fluence applied, probably due to overlapping of halo regions of neighbouring tracks. The good agreement between the model and the experiment allows here to present a critical comparison of the potentialities of conductivity and loss of mass methods.