DETERMINATION OF NUCLEAR TRACKS PARAMETERS ON SEQUENTIALLY ETCHED PADC DETECTORS

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Polyallyl Diglycol Carbonate (PADC) detectors find many applications in radiation protection. One of them is the cosmic radiation dosimetry, where PADC detectors measure the linear energy transfer (LET) spectra of charged particles (from protons to heavy ions), supplementing TLD detectors in the role of passive dosemeter. Calibration exposures to ions of known LET are required to establish a relation between parameters of track observed on the detector and LET of particle creating this track. PADC TASTRAK nuclear track detectors were exposed to $^{12}\text{C}$ and $^{56}\text{Fe}$ ions of LET in $\text{H}_2\text{O}$ between 10 and 544 keV/$\mu$m. The exposures took place at the Heavy Ion Medical Accelerator (HIMAC) in Chiba, Japan in the frame of the HIMAC research project “Space Radiation Dosimetry–Ground Based Verification of the MATROSHKA Facility” (20P-240). Detectors were etched in water solution of NaOH with three different temperatures and for various etching times to observe the appearance of etched tracks, the evolution of their parameters and the stability of the etching process. The applied etching times (and the solution’s concentrations and temperatures) were: 48, 72, 96, 120 hours (6.25 N NaOH, 50 °C), 20, 40, 60, 80 hours (6.25 N NaOH, 60 °C) and 8, 12, 16, 20 hours (7N NaOH, 70 °C). The analysis of the detectors involved planimetric (2D) measurements of tracks’ entrance ellipses and mechanical measurements of bulk layer thickness. Further track parameters, like angle of
incidence, track length and etch rate ratio were then calculated. For certain tracks, results of planimetric measurements and calculations were also compared with results of optical track profile (3D) measurements, where not only the track’s entrance ellipse but also the location of the track’s tip could be directly measured. All these measurements have been performed with the 2D/3D measurement system at DLR. The collected data allow to create sets of V(LET in H$_2$O) calibration curves suitable for short, intermediate and long etching time and will be use during analysis of detectors exposed on the International Space Station during DOSIS and MATROSHKA experiments.

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