Tissue Imprints in CR-39 and Lexan to Increase Spatial Resolution of Neutron Autoradiography

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Boron distribution at cellular and tissue level can be addressed through the different approaches of neutron autoradiography. Briefly, this methodology consists on registering the impacts of charged particles on insulating materials (nuclear track detectors, NTD) and correlating this information with the microstructure of the biological sample that contains the particles' emitter (e.g. ^{10}B). In particular, when small regions of a histological section must be delimited, high spatial resolution is required.

We have reported a methodology to produce cell imprints on polycarbonate (chosen as NTD), through UV-C sensitization. The contours generated on the NTD would allow a more precise location of boron in the sample. As tissue structure largely differs from cultured cells, several aspects must be analyzed in order to extend the methodology to study boron microdistribution in tissue sections.

For this purpose, we analyzed polycarbonate (Lexan™) and poly allyl diglycol carbonate (PADC, CR-39) as potential NTDs for the enhanced resolution neutron autoradiography with UV-C. UV transmittance, etching velocities and UV-C effect on etching kinetics were determined. As a fading effect of UV-C on nuclear tracks was observed on polycarbonate, it was analyzed if the same effect occurred in CR-39.

A variety of biological samples were used in this study. Tissue sections obtained by cryosectioning were mounted on the detectors. Evaporation coefficients were determined for each sample by registering the mass loss due to water evaporation after the slicing process. Neutron irradiations were performed on the RA-3 reactor (CNEA) at different fluences, ranging from 10^{11} to 10^{13} n cm^{-2}. Several staining agents (e.g. haematoxylin, eosin) were tested as potential promoters of the imprint formation. Different UV-C exposure times were assayed for each condition. Etching with KOH and NaOH were performed for Lexan and CR-39 respectively, to reveal both imprints and nuclear tracks. In other group of samples the final thickness was determined by contact profilometry. The absorbance spectrum was also analyzed on samples mounted on quartz foils by UV spectrometry.

The response of the detectors was found to be significantly different. While well-defined imprints of samples mounted on Lexan were obtained with only 5 min of UV-C exposure, irradiations of about 6 h were necessary to yield imprints on CR-39, regardless of previous staining. Conversely, fading of nuclear tracks was only observed for Lexan. Both effects (imprint formation and fading) are a consequence of the photodegradation of the polymers' surface. Optimal conditions for each

detector are being studied. Regarding thickness of tissue samples, sections of 10 μm or thinner were found to be appropriate in terms of imprint quality. Due to evaporation, the final thickness is at least three times smaller than the initial thickness, depending on the evaporation characteristic of each sample. As the final value is smaller than the ranges of the alpha and ^{7}Li particles, corrections factors will be necessary to evaluate boron concentration from nuclear track density measurements.

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