

A PERSONNEL NEUTRON DOSIMETRY SYSTEM USING LOW FREQUENCY
ELECTROCHEMICAL ETCHING

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ABSTRACT

We have developed a personnel neutron dosimetry system based on the electrochemical etching of CR-39 plastic at elevated temperatures. We use a three-step etching procedure. Our first etching step is at 60 Hz, 3000 V for five hours in a 60°C oven using 6.5 N KOH. The second etching step consists of an additional 23-minute etch at 60°C, 2.0 kHz, and 3000 V, which increases the track size. The final step is a 15-minute post etch at 60°C, which gives the track a smoother appearance.

The foils are etched in etch chambers that can process up to 24 foils. Several of these chambers can be used simultaneously with a single power supply. These chambers are rugged and have been used daily for over a year.

The sensitivity of the system is about 5 tracks/mrem with a background of about 8 mrem, giving us a lower limit of sensitivity of approximately 10 mrem for the dosimeter (when three foils are used). At 400 mrem the precision of the foil's results has a standard deviation that averages about 5%. The dosimetry system is linear up to about 600 mrem and can be corrected for doses up to 2 rem. The energy dependence is fairly flat from 150 KeV up to 5 MeV, but drops by 42% at 14 MeV. It has no response to thermal or intermediate energy neutrons.

We observe no fading of the latent tracks. The dosimeter has a significant variation in directional response, dropping to about 30% at 90 degrees. We have studied the effect that changes in the etching parameters have on the results. These parameters include KOH normality, high voltage, frequency, etch time, oven temperature, and pre- and post-etch procedures. We are presently studying the relationship between the track size distribution and the incident neutron spectrum.

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