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# 3D imaging of neutron tracks using confocal microscopy

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Neutron detection and neutron flux assessment are important aspects in monitoring nuclear energy production. Neutron flux measurements can also provide information on potential biological damage from exposure. In addition to the applications for neutron measurement in nuclear energy, neutron detection has been proposed as a method of enhancing neutrino detectors and cosmic ray flux has also been assessed using ground-level neutron detectors.

Solid State Nuclear Track Detectors (or SSNTDs) have been used extensively to examine cosmic rays, long-lived radioactive elements, radon concentrations in buildings and the age of geological samples.

Passive SSNTDs consisting of a CR-39 plastic are commonly used to measure radon because they respond to incident charged particles such as alpha particles from radon gas in air. They have a large dynamic range and a linear flux response. We have previously applied confocal microscopy to obtain 3D images of alpha particle tracks in SSNTDs from radon track monitoring (1).

As a charged particle traverses through the polymer it creates an ionisation trail along its path. The trail or track is normally enhanced by chemical etching to better expose radiation damage, as the damaged area is more sensitive to the etchant than the bulk material.

Particle tracks in CR-39 are usually assessed using 2D optical microscopy. In this study 6 detectors were examined using an Olympus OLS4100 LEXT 3D laser scanning confocal microscope (Olympus Corporation, Japan). The detectors had been etched for 2 hours 50 minutes at 85 ºC in 6.25M NaOH. Post etch the plastics had been treated with a 10 minute immersion in a 2% acetic acid stop bath, followed by rinsing in deionised water. The detectors examined had been irradiated with a 2mSv neutron dose from an Am(Be) neutron source (producing roughly 20 tracks per mm2). We were able to successfully acquire 3D images of neutron tracks in the detectors studied. The range of track diameter observed was between 4 and 10 microns. Thus this study suggests that, using confocal microscopy, 3D imaging of neutron tracks in SSNTDs is feasible.

(1) Wertheim D, Gillmore G, Brown L, Petford N. A new method of imaging particle tracks in solid state nuclear track detectors. J Microsc. 2010; 237: 1-6.