Novel 3-D imaging of track-etch detectors (Solid State Nuclear Track Detectors).

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Inhalation of radon gas (^{222}Rn) and associated ionizing decay products is known to be a cause of lung cancer in humans. Thus radon monitoring in buildings is routinely undertaken in areas of known risk. Methods of radon gas concentration measurement include activated carbon, electrets and solid state nuclear track-etch detectors (SSNTDs); in the UK CR-39 SSNTDs are usually used and assessed using 2D image analysis. In this technique, heavily ionizing alpha particles form tracks as a result of radiation damage to the detector from interaction between alpha particles and the molecules making up the CR-39 polymer. 3D analysis has the potential to provide additional information such as the angle at which alpha particles impinge on the detector, and also to disentangle multiple hit sequences. In addition, there is an interest in applying such detectors for neutron measurements.

In this study we will utilise a 'LEXT' OLS4000 series confocal laser scanning microscope (Olympus Corporation, Tokyo, Japan) to image tracks on CR-39 detectors. Most of the detectors to be examined will be from the Radon Metrology Laboratory at Kingston University, but we will also access different detectors from other manufacturers / testing laboratories.

Initial studies have shown that from the assessment of the number of clear single and coalescing alpha tracks on the 2D image of one detector, 22 tracks were part of coalescing tracks (16 tracks were part of the 8 coalescing double tracks and 6 part of the two coalescing triple tracks); hence 30 % of the observed tracks were coalescing, highlighting the importance of identifying such tracks.

In this study we will use high resolution confocal microscopy to investigate tracks and patterns of tracks in SSNTDs. Initial observations have suggested that it may be difficult to interpret the appearance of coalescing tracks and distinction from artefact from only 2D analysis. Furthermore the 3D confocal microscopy technique enables identification and quantification of track angle, area and depth and may help in objective characterisation of tracks. The angle of particle strike is likely to be an indicator of alpha particle direction.

Together with area and depth data this may help to give a more comprehensive assessment of tracks.