SWIFT HEAVY ION MODIFIED MATERIALS: APPLICATIONS AND CHARACTERISATION USING SYNCHROTRON SMALL ANGLE X-RAY SCATTERING

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When highly energetic heavy ions pass through a target material, the high electronic excitations can generate long cylindrical damaged regions termed 'ion tracks'. Ion tracks have many interesting applications across a variety of scientific areas such as materials science and engineering, nanotechnology, geology, archaeology, nuclear physics, and interplanetary science. Ion track damage often exhibits preferential chemical etching over the undamaged material. This etch-anisotropy can be used to create pores of up to tens of microns in length, with pore diameters as small as several nanometres. Membranes formed by this method are ideal for many advanced applications including ultra-filtration, bio- and medical sensing, nano-fluidics, and nano-electronic devices. One major advantage of the technique is the ability to generate arrays of pores that are highly parallel with extremely narrow size distributions.

Small angle X-ray scattering (SAXS) provides an interesting tool to study the structure of ion tracks and track-etched nanopores, as it is sensitive density changes on the nanometre length scale [1-5]. It is non-destructive and can yields high precision measurements of the track and pore structure in many materials. Short acquisition times associated with the high photon flux at 3rd generation synchrotron facilities enable *in situ* studies.

The presentation will give an overview of our recent results on the development of functional nanopore membranes in polymers and inorganic materials using ion track etching. This will include fabrication of conical pores in SiO_2 and their application in nanofluidic diodes, separation membranes and biosensors. A particular focus will be put on the characterisation of ion tracks and nanopores using SAXS which ultimately enables precise fabrication of the nanopores. Results include the determination of the detailed morphology and etching kinetics of nanopores in polymers [1,2] as well as the annealing kinetics of ion tracks in diamond anvil cells to investigate track stability under high pressure conditions [5].

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