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SAXS and SANS characterisation of ion irradiation in polymers

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When exposed to swift heavy ion irradiation a wide range of materials show formation of ion tracks as a result of their interaction with the material's electrons. These tracks are narrow, cylindrical-shaped regions of high defect concentration, only a few nanometres in diameter and up to tens of micrometers in length. Ion-irradiated polymers allow the fabrication of microelectronic devices such as micro-capacitors and as well as nanowires, nano-membranes and sensors. We have previously demonstrated small angle x-ray scattering (SAXS) allows a size characterisation of latent tracks in inorganic materials [1].

Here, we present our recent results on the investigation of ion tracks in polycarbonate. SAXS measurements reveal a diameter of 5 nm for tracks hosted within an organic polymer environment. Complementary small angle neutron scattering (SANS) experiments at ANSTO reveal a similar value. However, probing the relative change in density between the latent track and the host material, SAXS shows significant less defect concentration within the tracks than SANS. Both techniques are sensitive to different elements and allow a comparison of the atom-specific damages of ion irradiation in polycarbonate.

Finally, we present the effects of thermal annealing on ion tracks in polycarbonate: Moderate temperatures (100-200 oC) lead to an increase in track diameter, contrary to our previous results on tracks in crystals [2].

[1] P. Kluth et al., Phys. Rev. Lett. 101 (2011) 175503. [2] D. Schauries et al., J. Appl. Cryst. 46 (2013) 1558.

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Summary

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