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Shape of nanopores in track-etched polycarbonate membranes

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Small angle X-ray scattering (SAXS) has been used over the past decade for characterizing track etched nanopores in a variety of organic and inorganic materials. In the present study, synchrotron based SAXS was used to study the morphology and size variation of the nanopores in polycarbonate (PC) as a function of the etching time and ion fluence. The shape of the nanopores fabricated through track-etch technology was found to be consistent with cylindrical pores with ends tapering off towards the two polymer surfaces in the last ~1.6 μm. The tapered structure of the nanopores in track-etched PC membranes was first observed more than 40 years ago followed by many other studies suggesting that the shape of nanopores in PC membranes deviates from a perfect cylinder and nanopores narrow towards both membrane surfaces. However, quantification of the shape of nanopores has remained elusive due to inherent difficulties in imaging the pores using microscopy techniques. This study reports on the quantitative measurement of the tapered structure of nanopores using SAXS[1]. Determination of this structure was enabled by obtaining high-quality SAXS data and the development of appropriate form-factor model. The etch rates for both the radius at the polymer surface and the radius of the pore in bulk were calculated. Both etch rates decrease slightly with increasing fluence. This behavior is ascribed to the overlap of track halos which are characterized by cross-linking of the polymer chains. The results enable a better understanding of track-etched membranes and facilitate improved pore design for many applications.

References:
[1] Dutt, S. et al. J. Membr. Sci. 638, 119681 (2021)

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

Yes

Condition of submission

Yes

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