

INVESTIGATION OF PES MEMBRANE VOLUME MORPHOLOGY FOR FILTRATION USING AUTOMATED IN-SITU ULTRAMICROTOMY IN SEM AND 3D RECONSTRUCTION

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Direct quantitative revelation of three dimension morphology is of great importance in understanding the inner microstructure and properties of polymer materials for filtration applications. By integrating an in-situ ultramicrotomy and electron microscopy, we provide a fully automated workflow which allows the acquisition of high resolution spatial SEM micrographs during serial sectioning using the microtome. The method is also known as serial block face SEM (SBFSEM). With the subsequent 3D reconstruction of the micrograph stacks, we can recover the comprehensive volume information of the polymer materials.

A commercially available PES0.45 filter membrane was selected for testing. The sample was embedded in epoxy resin for further examination. The SBFSEM experiment was conducted in ThermoFisher Apreo VolumeScope which combines hardware and software components into one integrated system and is designed for fully automatic data acquisition on soft materials samples. An entire volume of 100 μ m x 50 μ m x 12.5 μ m was acquired and the data was collected by physical slicing at LoVac (50 Pa) to suppress charging. The block-face was imaged in BSE mode at 1.5 kV accelerating voltage, pixel size of 50 nm x 50 nm; nominal thickness of a physical cut was 50 nm. Data was subsequently processed and visualised using AmiraTM 3D reconstruction software. The overall porosity of this filter membrane sample is 71.5%.

The work principle and set up of Apreo VolumeScope is depicted in Figure 1. The complete dataset shows the density and size of pores in the entire PES membrane volume with intrinsic compositional contrast of the membrane materials, see Figure 2.