

Electronic Supplementary Information

Optimization of hydrophilic/hydrophobic phase separation in sPEEK membranes by hydrothermal treatments

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Figure S1 compares the SAXS profile of a sPEEK membrane treated in liquid water at 80°C for 200 h, then conditioned in liquid water at room temperature, with the one of the same membrane after an additional two years storage in liquid water at room temperature.

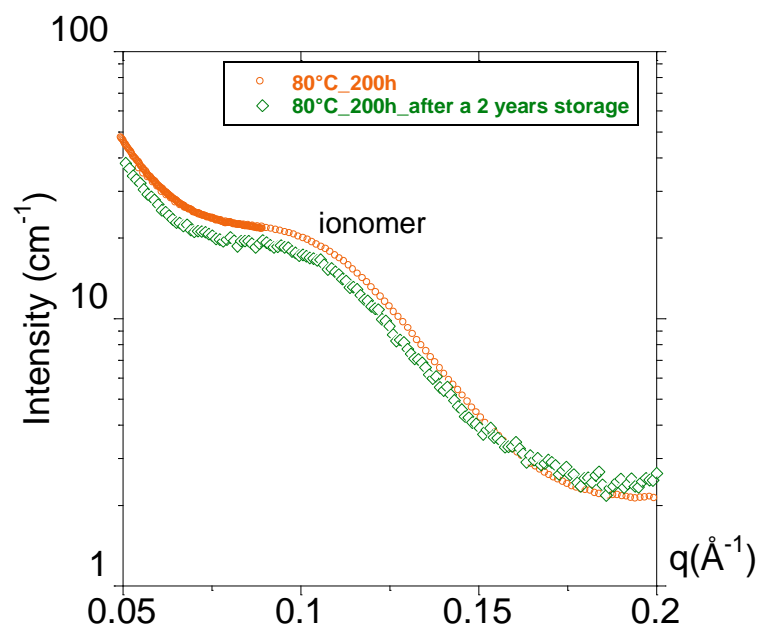


Fig S1. SAXS profiles of water swollen sPEEK membrane (batch 1) at room temperature after hydrothermal treatment in liquid water at 80°C during 200 h, then conditioned in liquid water at room temperature (Cs⁺ form) (○) (ESRF-D2AM; $\lambda=1$ Å-D=1.3 m). The same membrane was measured after an additional two years storage in liquid water at room temperature (◇) (CEA-INAC); $\lambda=1.5418$ Å-D=1.2 m).

The two spectra recorded at a two-year interval are almost superimposed. This observation shows that this storage step did not yield to any additional swelling (the membrane keeps a swelling close to the one reached during the hydrothermal treatment). This long time scale observation confirms that swollen sPEEK is in its glassy state at room temperature.

Figure S2 displays the XRD spectra of sPEEK (IEC of 1.34 meq.g⁻¹) recorded at room temperature and relative humidity, in transmission mode, after 96 h of hydrothermal treatment at 20, 40, 60, 80 and 100°C. All the recorded spectra clearly show a semi-crystalline structure for sPEEK, as a sharp crystalline peak located at about 1.37 Å⁻¹ is observed. This peak is almost

superimposed to an amorphous halo centered around 1.6 \AA^{-1} . We observed that the semi-crystalline structure of sPEEK is quite insensitive to the hydrothermal treatment temperature.

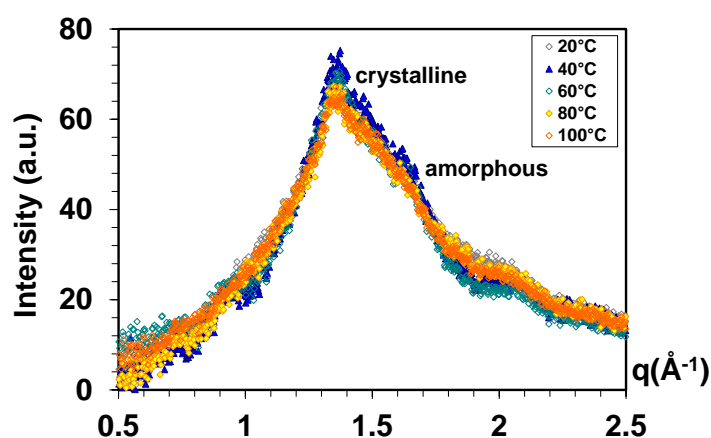


Fig S2. XRD spectra of sPEEK membranes (batch 1) after 96 h of hydrothermal treatment at 20, 40, 60, 80 and 100°C. The spectra were recorded in transmission mode at room temperature and humidity.

Figure S3 displays the SAXS spectra of H^+ exchanged sPEEK membrane equilibrated in liquid water at 20° C. No ionomer peak can be detected. The same observation was made for sPEEK in Cs^+ form (Fig.2 of the article), therefore, the absence of this peak is not related to the nature of the counter-ion or to the associated hydration level, but results from the poor nanophase separation of the pristine membrane.

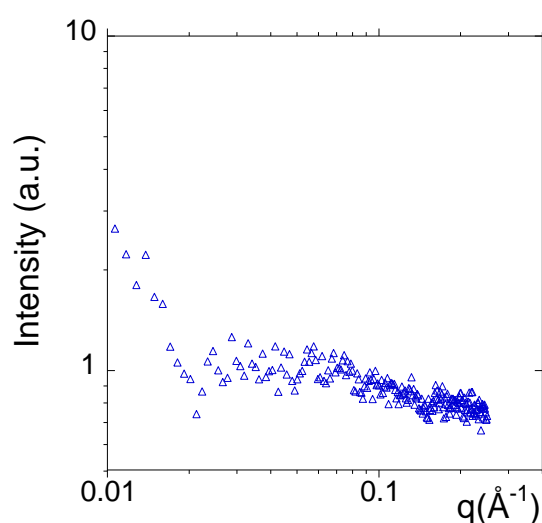


Fig. S3. SAXS spectra of H^+ exchanged sPEEK (batch 2) equilibrated in liquid water at 20° C