Supplemental information

ePTFE reinforced, sulfonated aromatic polymer membranes enable durable, high-temperature operable PEMFCs

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Scheme S1. Synthesis of SPP-TP-f copolymer. Related to Figure 1 (A).
Figure S1. NMR spectra of TP-f monomer in CDCl$_3$-d at r.t. Related to STAR Methods.

(a)$^1$H and (b) $^{19}$F NMR spectra
Figure S2. NMR spectra of SPP-TP-f 3.1 polymer in DMSO-\textit{d}_6 at 80 °C. Related to STAR Methods. (a) $^1$H and (b) $^{19}$F NMR spectra.
Figure S3. Tensile curve of ePTFE in longitudinal-direction at 80 °C and 60% RH. Related to Figure 1 (A).
Figure S4. Water uptake of membranes. Related to Figure 2. Relative humidity dependence of number of water molecules per sulfonic acid groups at (a) 80 °, (b) 100 ° and (c) 120 °.
Figure S5. Proton conductivity of membranes. Related to Figure 2. Proton conductivity as a function of number of water molecules per sulfonic acid group at (a) 80 °C, (b) 100 °C and (c) 120 °C.
Figure S6. Tensile curves of SPP-TP-f 5.1/DPTFE in the vertical and horizontal directions under ambient condition. Related to Figure 3(C).
Figure S7. Linear sweep voltammograms (LSVs) of fuel cells with Nafion NRE 211, SPP-TP 4.1 and SPP-TP-f 5.1/DPTFE membranes at 80 °C and 30% RH. Pure hydrogen and nitrogen were supplied to the anode and cathode, respectively. Related to Figure 4.
Figure S8. Fuel cell performance of Nafion 211, SPP-TP-f 4.1 and SPP-TP-f 5.1/DPTFE without back pressure under condition of high gas utilization (70% for anode and 40% for cathode). Related to Figure 4. Polarization curves at (a) 80 °C and 100% RH and (b) 100 °C and 53% RH; power density as a function of the current density at (c) 80 °C and 100% RH and (d) 100 °C and 53% RH.
Figure S9. Temperature dependence of IR-included voltage 1.0 A cm\(^{-2}\) under 30% RH. Related to Figure 4.
Figure S10. Changes in OCV and ohmic resistance in each hydration regime for SPP-TP-f 5.1/DPTFE membrane during the combined chemical and mechanical durability test. Related to Figure 4.
Figure S11. NMR spectra of SPP-TP-f 5.1/DPTFE extracted in DMSO-d$_6$ at 80 °C after the combined chemical and mechanical durability test. Related to Figure 4. (a) $^1$H and (b) $^{19}$F NMR spectra at 80 °C.
Figure S12. $^1$H NMR spectrum of SPP-TP-f 5.1/DPTFE extracted in DMSO-$d_6$ at 80 °C after the durability test at a constant current density (0.15A cm$^{-2}$) at 120 °C and 30% RH for 240 h. Related to Figure 4.