SUPPLEMENTAL
INFORMATION

Highly Stable Poly(ethylene glycol)-Grafting Alkaline Anion Exchange Membranes

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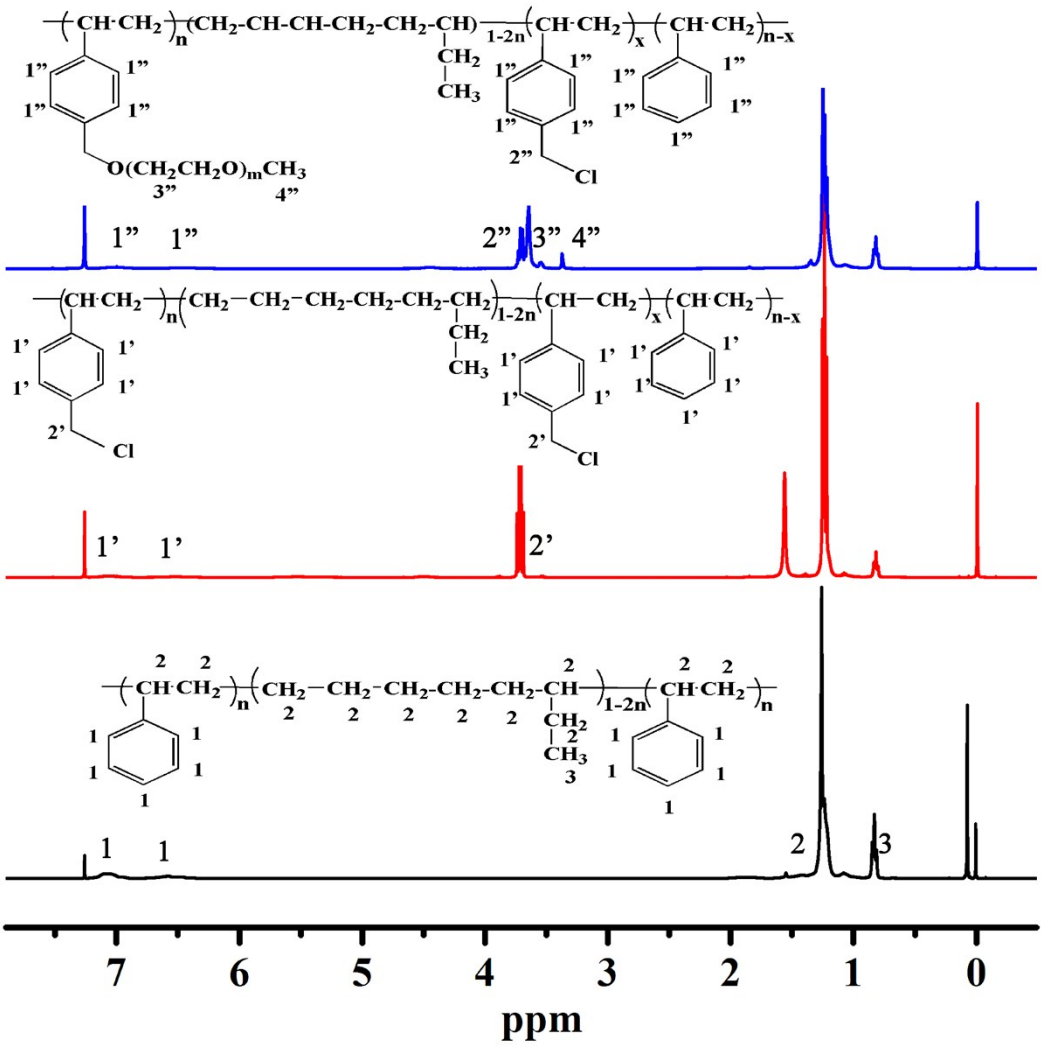

Figure S1 ^{1}H NMR spectra of SEBS, CMSEBS and SEBSx-g-PEGy-M.

Alkaline Stability of QA-SEBS$_{0.15}$-G-PEG$_{y}$-1000

From Figure S2, it can be seen that the conductivity and IEC values of this membrane didn't obviously change after being treated in 1 M KOH at 60 ^{o}C. The dimension enlarged at the beginning and then kept basically unchangeable, which might be due to the swelling of the membrane at elevated temperature at the beginning and then saturation. The test results indicated that the QA-SEBS$_{0.15}$-g-PEG$_{0.15}$-1000 would be stable enough in 1 M KOH at 60 ^{o}C.

Table S1 Ion conductivities and alkaline stability of AAEMs studied in the references.

AAEMs	σ[a]/ mS cm^{-1}	Treated condition	Stability
QA-SEBS$_{0.15}$-g-PEG$_{0.1}$-1000	13.9	60 °C，2.5 M KOH，> 1100 h	Without degradation in conductivity， IEC and dimension
R4-C10	73.0	60 °C，2 M NaOH, 500 h	20% degradation in IEC
pQAPS	55.0	80 °C，1 M NaOH, 720 h	10.9% degradation in IEC
$C_{16}D_{40}$	9.0	80 °C，1 M NaOH, 2000 h	20% degradation in conductivity

[a]Tested at 60 °C.

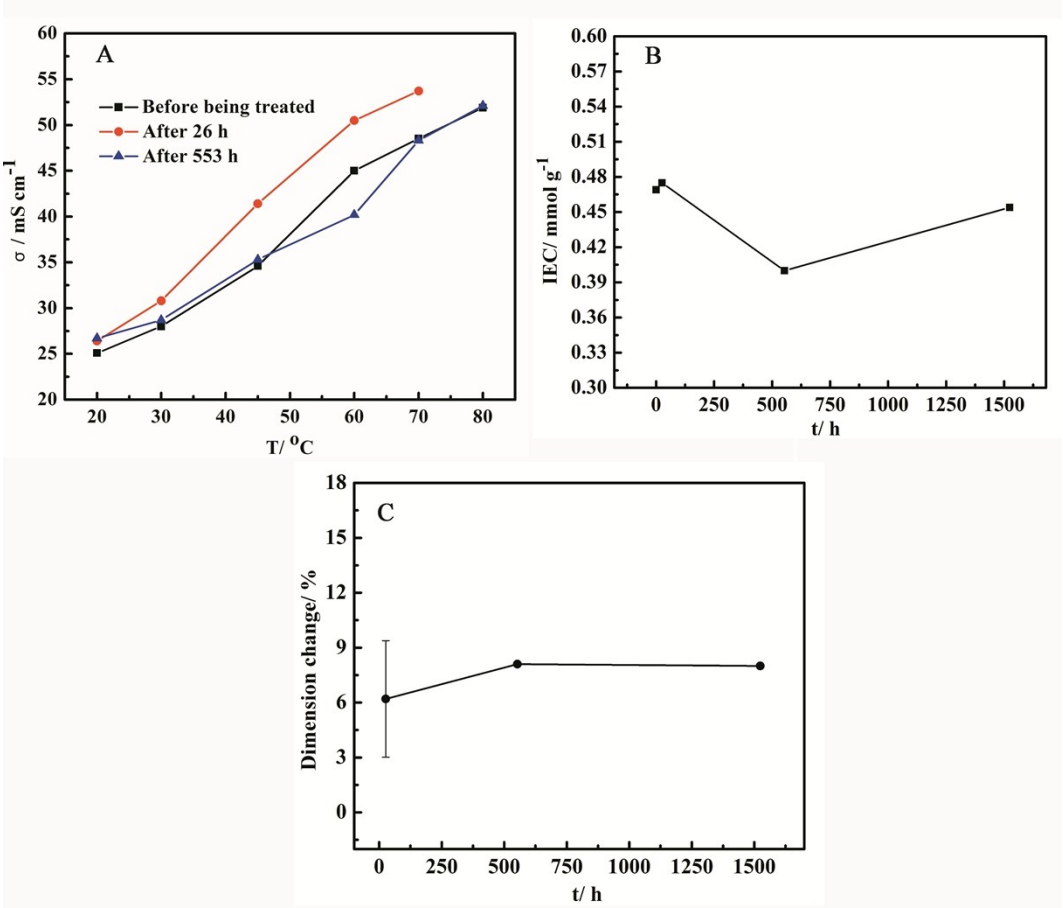

Figure S2 Changes of conductivity, IEC and dimension in width of QA-SEBS$_{0.15}$-g-PEG$_{0.15}$-1000 after exposure to 1 M KOH at 60 °C for different time.

Performance of the fuel cell using SEBS-based AAEM

Strangely, it is found that there is a large property gap between the fuel cells using the ionmers in OH or Cl form respectively, confirmed in Figure S3. The peak power density of 146 mW cm^{-2} is obtained at a current density of 332 mA cm^{-2} for the fuel cell using OH form ionmer, but the peak power density of the fuel cell using Cl form ionmer is only 75 mW cm^{-2} at a current density of 173 mA cm^{-2}. What makes the differences between the two fuel cells? Is the poisoning effect of Cl^- on Pt or the resistance effect? To clarify the effect factor on the performances of the fuel cells, the influence of the ionmer in Cl form on the activity of Pt catalyzing oxygen reduction reaction (ORR) and the conductivities of the membranes in Cl and OH are investigated in detail. Figure S4 shows the ORR polarization curves of commercial 60 wt% Pt/C with Nafion® and quaternary ammonium functionalized ionmer in Cl form. The loading of the ionmer is 20 wt%, which is the same to that in the fuel cells. The half-wave potential of the ORR polarization curves are almost same, indicating that the activity of Pt isn't evidently influenced by the Cl^-. From the conductivities of QA-$SEBS_{0.20}$ in Cl and OH form (Figure S5), it can be found that the conductivity of the membrane in Cl form is much lower than that of the membrane in OH form. Consequently, the ionmer in Cl form possesses lower ion-conducting ability and larger resistance, resulting in the larger resistance polarization (increase from 80 mΩ to nearly 160 mΩ) and the poorer performance of the fuel cell. Though there is a self-purging in the fuel cell working condition, the change of Cl^- in the ionmer into OH^- is still slowly and the larger resistance would severely reduce the performance of the fuel cell. So we consider that it should adopt the ionmer in OH form rather than in Cl form to prepare MEAs.

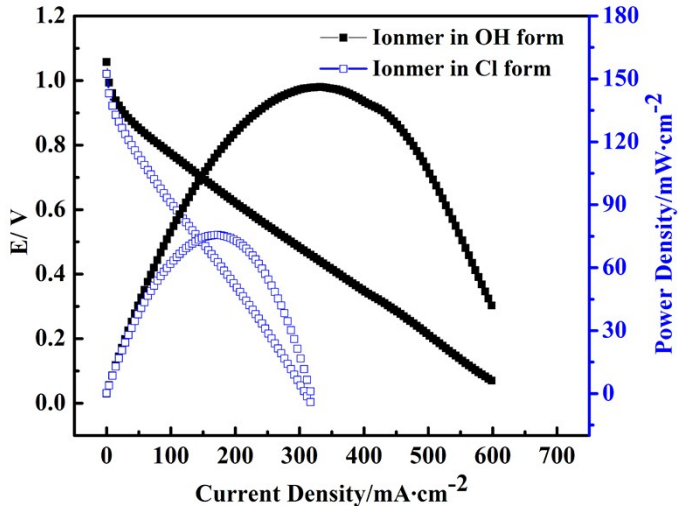

Figure S3 Polarization and power density curves of AAEMFCs assembled using QA-SEBS$_{0.20}$ as AAEMs with ionmer in Cl (hollow blue curve) or OH (solid black curve) form. The test temperature was 50 ^{o}C.

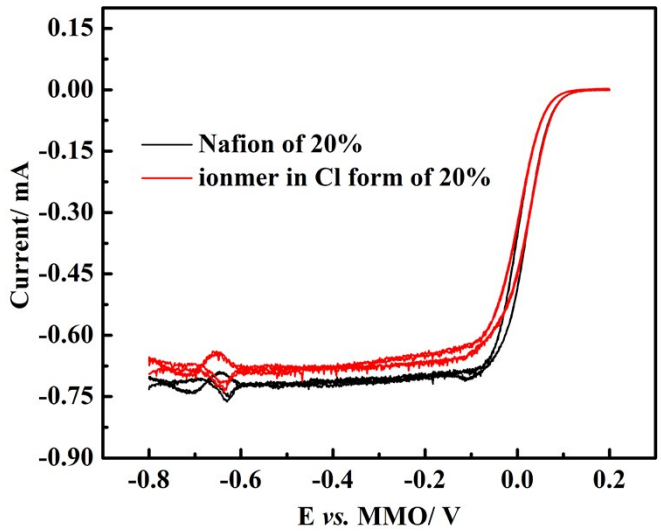

Figure S4 ORR polarization curves of commercial 60wt% Pt/C with Nafion® or quaternary ammonium functionalized ionmer in Cl form (loading of 20 wt%).

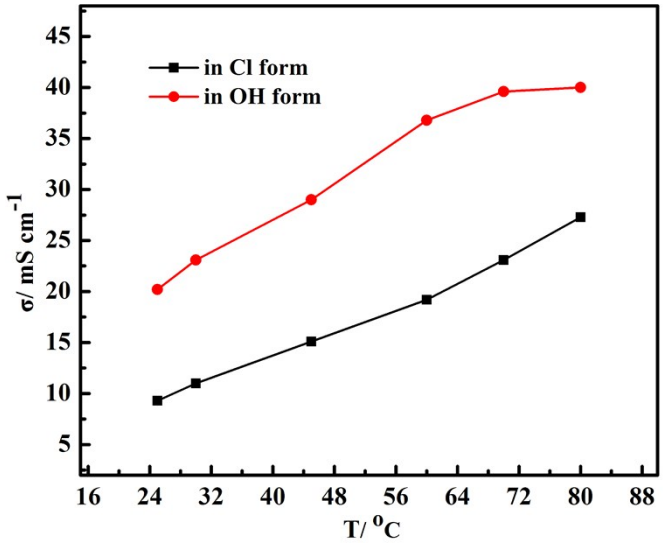

Figure S5. Conductivities of QA-SEBS$_{0.20}$ in Cl and OH form as a function of temperature, respectively.