Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Phosphonated Phenol-formaldehyde Based High-temperature Proton Exchange Membrane with Intrinsic Protonic Conductors and Proton Transport Channels

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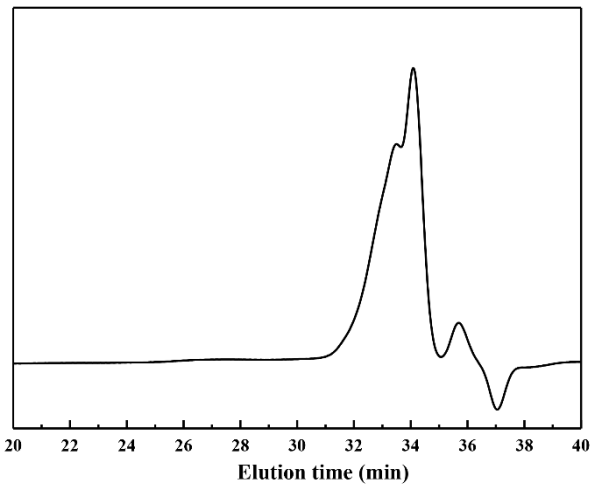

Fig. S1 GPC chart of phenol-formaldehyde oligomer.

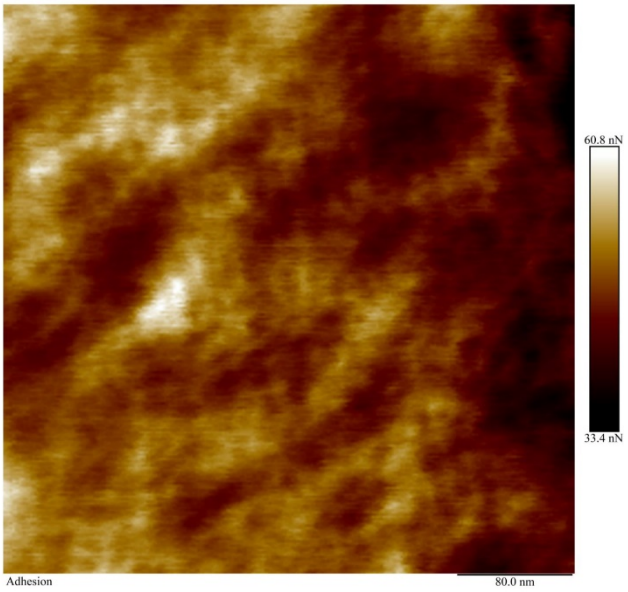

Fig. S2. AFM images of 40PPF-Na/PBI membrane

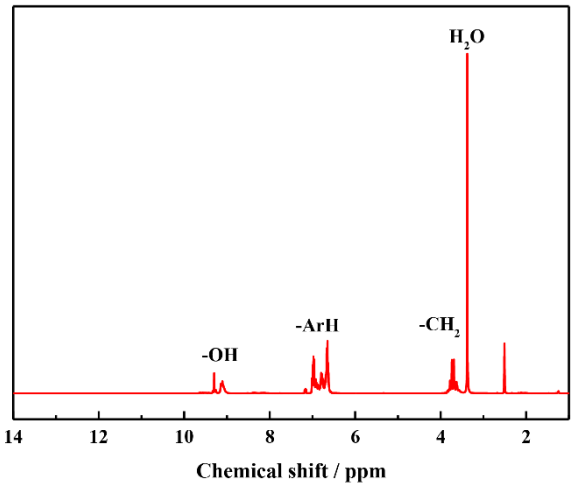

Fig. S3. ^{1}H-NMR spectrum of phenol-formaldehyde oligomer in DMSO-*d*6.

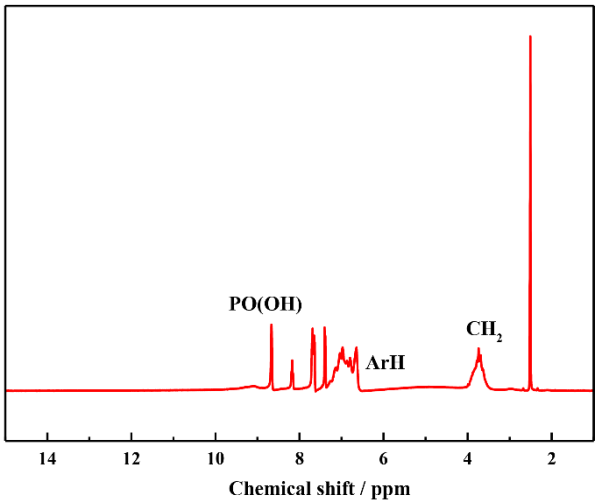

Fig. S4. ^{1}H-NMR spectrum of phosphonated phenol-formaldehyde oligomer in DMSO-*d*6.

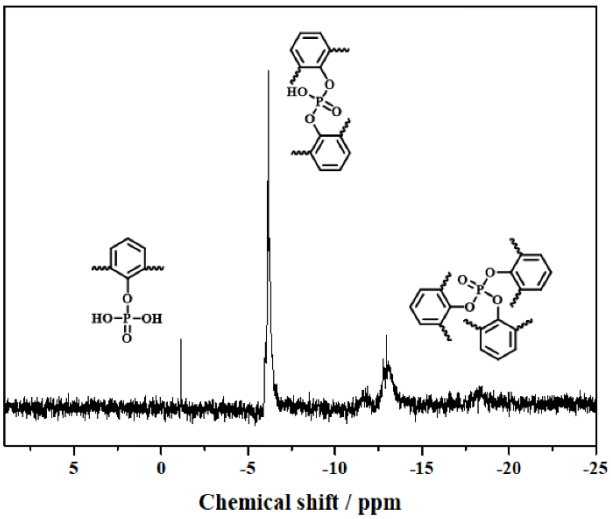

Fig. S5 ^{31}P-NMR spectrum of phosphonated phenol-formaldehyde oligomer in DMSO-*d*6

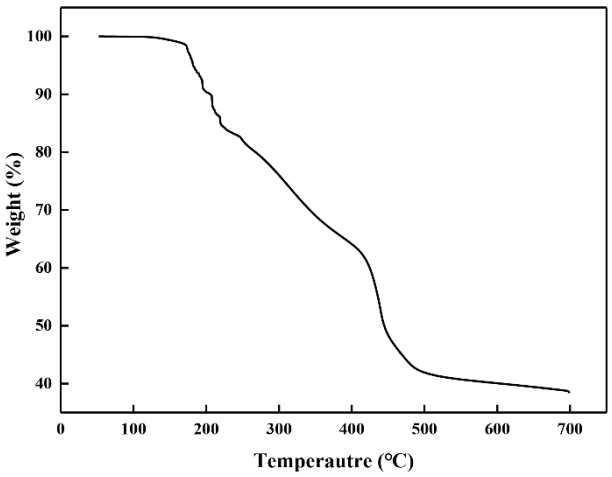

Fig. S6 Thermogravimetric curve of phosphonated phenol-formaldehyde oligomer in N_2 atmosphere.

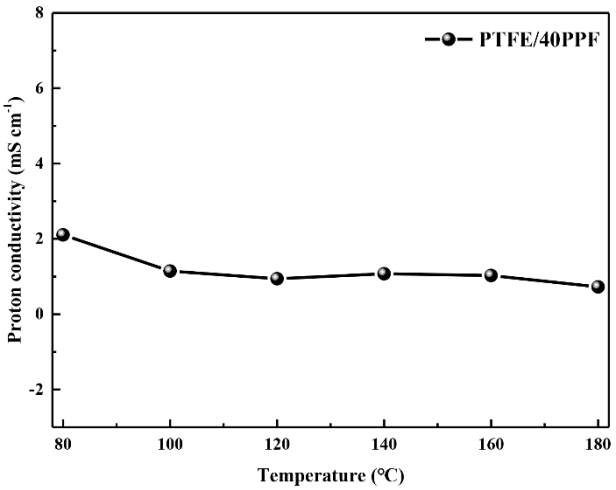

Fig. S7 Proton conductivity of PTFE/40PPF.

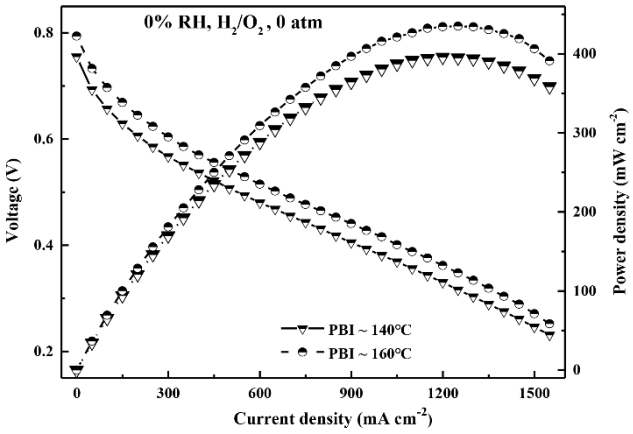

Fig. S8 Single cell performance of PBI membrane at 140℃ and 160℃ without humidification.