Supporting Information

Influence of Chemical Composition on Proton Conductivity of Microporous Organic Polymers Entrapped in Nitrilotrimethylphosphonic Acid

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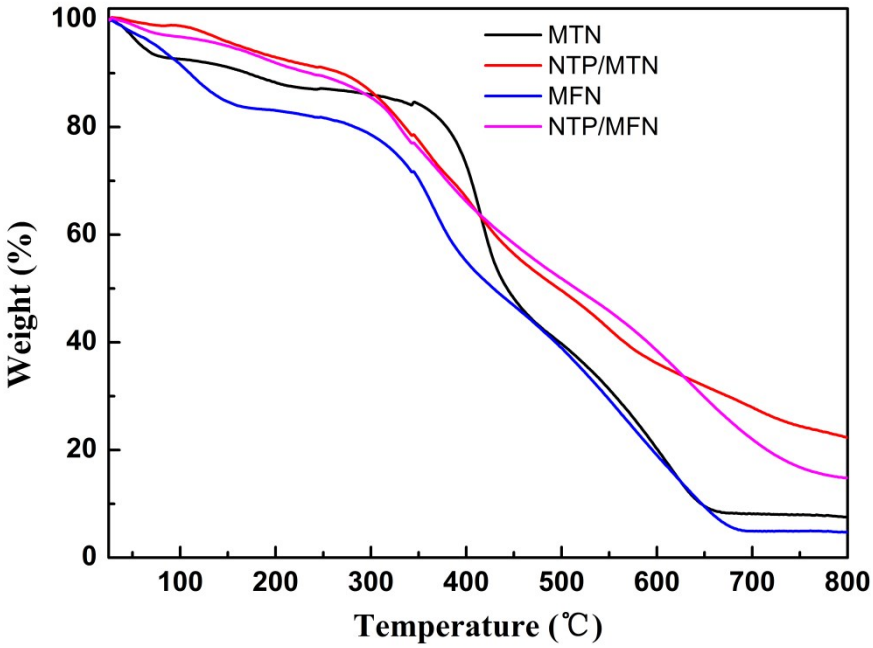

Fig. S1 TGA curves of MTN, MFN, NTP/MTN and NTP/MFN.

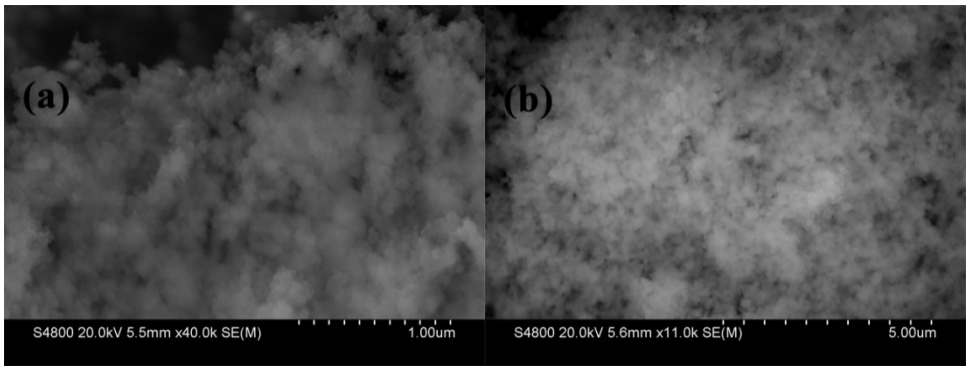

Fig. S2 SEM images of (a) MTN and (b) NTP/MTN.

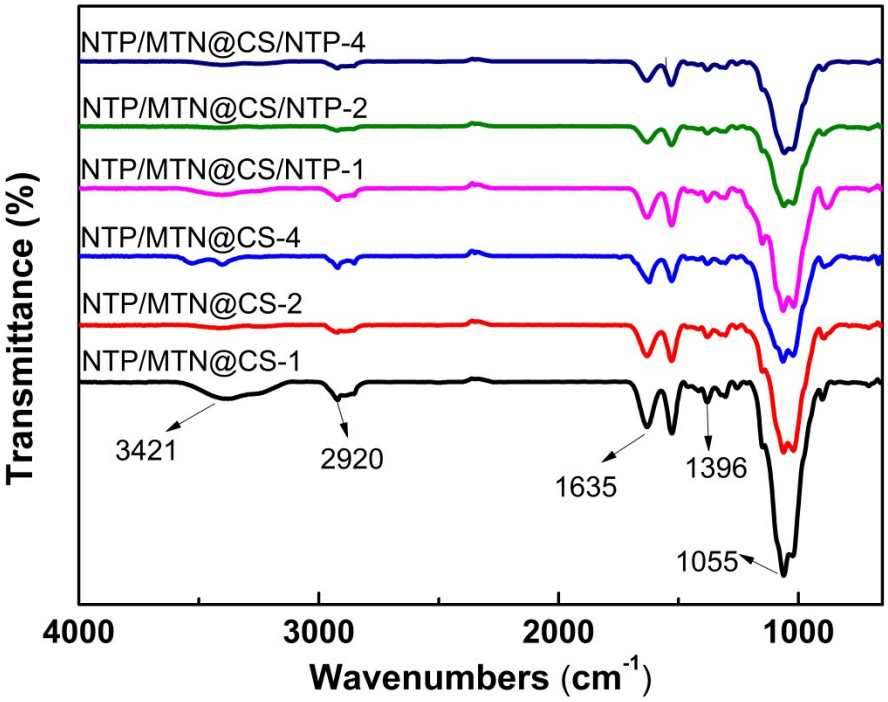

Fig. S3 FT-IR spectra of NTP/MTN membranes.

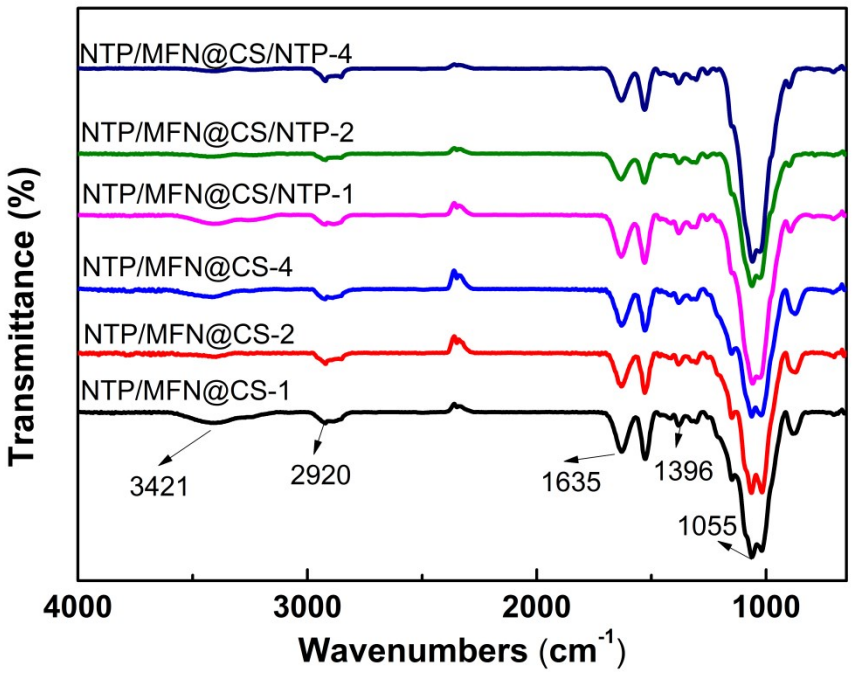

Fig. S4 FT-IR spectra of NTP/MFN membranes.

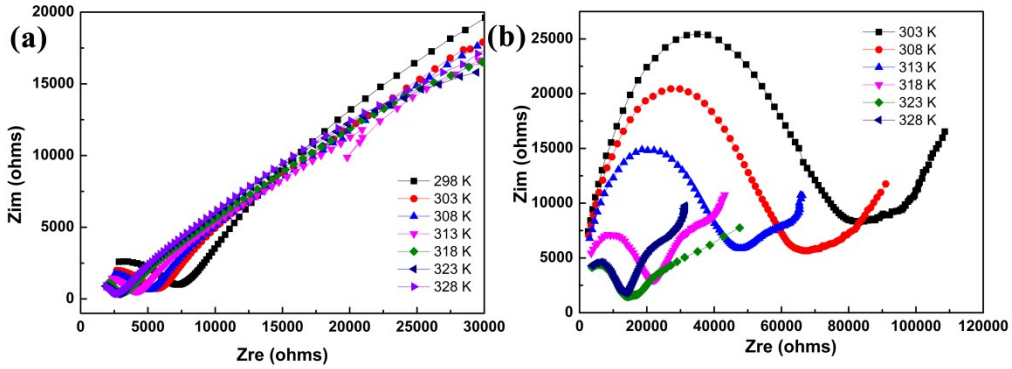

Fig. S5 Nyquist plots of CS membranes at (a) ~98% RH and (b) ~76% RH.

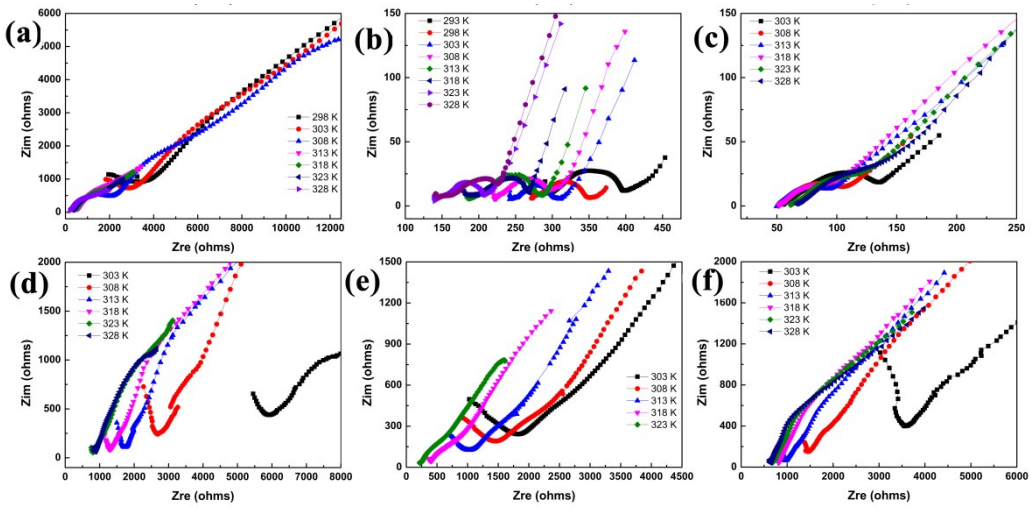

Fig. S6 Nyquist plots of (a) NTP/MFN@CS-1, (b) NTP/MFN@CS-2 and (c) NTP/MFN@CS-4 (d) NTP/MFN@CS/NTP-1, (e) NTP/MFN@CS/NTP-2 and (f) NTP/MFN@CS/NTP-4 at ~98% RH.

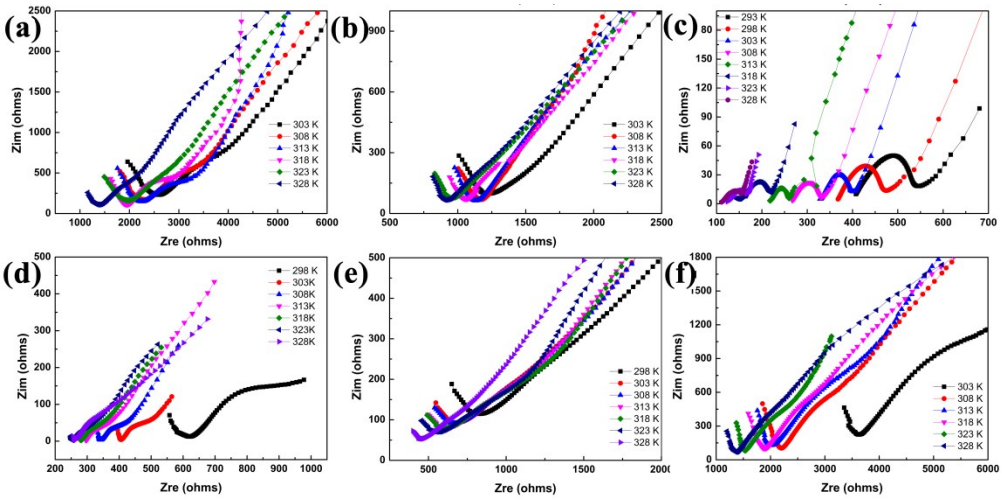

Fig. S7 Nyquist plots of (a) NTP/MTN@CS-1, (b) NTP/MTN@CS-2 and (c) NTP/MTN@CS-4 (d) NTP/MTN@CS/NTP-1, (e) NTP/MTN@CS/NTP-2 and (f) NTP/MTN@CS/NTP-4 at ~98% RH.

Table S1 CHN elemental analysis and ICP of MTN, NTP/MTN, MFN and NTP/MFN.

Samples	C (%)	H (%)	N (%)	S (%)	P (%)
MFN	33.83	4.78	46.13	0	0.0003
NTP/MFN	28.67	4.74	33.83	0	0.085
MTN	45.12	3.33	30.14	4.13	0.0002
NTP/MTN	32.44	3.35	23.62	3.01	0.083

Table S2 Porosity parameters of MTN, NTP/MTN, MFN and NTP/MFN.

Samples	S_{BET} (cm^2 g^{-1})	Pore volume (cm^3 g^{-1})
MFN	230.07	0.38
NTP/MFN	42.33	0.11
MTN	785.09	1.13
NTP/MTN	185.07	0.69

Table S3 Ionic-exchange capability (IEC) and activation energy (E_a) of membranes.

Sample	IEC (meq g^{-1})	E_a (eV)	σ (S cm^{-1})
MFN	0.15	/	/
NTP/MFN	6.58	/	/
MTN	0.045	/	/
NTP/MTN	5.78	/	/
NTP/MFN@CS-1	3.20	0.88	1.9×10^{-2}
NTP/MFN@CS-2	4.40	0.83	4.6×10^{-2}
NTP/MFN@CS-4	3.14	0.20	5.5×10^{-3}
NTP/MFN@CS/NTP-1	0.53	0.70	9.1×10^{-4}
NTP/MFN@CS/NTP-2	0.25	0.98	3.4×10^{-3}
NTP/MFN@CS/NTP-4	0.32	0.58	5.3×10^{-4}
NTP/MTN@CS-1	1.19	0.21	1.1×10^{-3}
NTP/MTN@CS-2	1.25	0.14	1.3×10^{-3}
NTP/MTN@CS-4	0.95	0.35	3.4×10^{-3}
NTP/MTN@CS/NTP-1	1.19	0.21	9.2×10^{-3}
NTP/MTN@CS/NTP-2	0.56	0.18	1.1×10^{-3}
NTP/MTN@CS/NTP-4	0.34	0.48	3.8×10^{-4}
CS	0.20	0.32	1.1×10^{-4}

Table S4 Proton conductivity of COF and membranes under ambient conditions.

Materials	Condition	σ/S cm^{-1}	Reference
I	55 °C, 99% RH	6.17×10^{-2}	[1]
SZrTi	90°C, 100% RH	2.9×10^{-3}	[2]
Fe-NH_3-72h	80 °C, 95% RH	1.8×10^{-3}	[3]
c-PBI-30	200 °C, 100% RH	2.53×10^{-1}	[4]
FJU-80	80 °C, 98% RH	1.05×10^{-4}	[5]
COF-1-Li	40 °C, 98% RH	2.7×10^{-2}	[6]
COF-1-Na	40 °C, 98% RH	2.5×10^{-2}	[6]
NH_4PO_3/MO_2	175 °C, 99% RH	8.5×10^{-3}	[7]
$BaCe_{(0.85-x)}Co_xGd_{0.15}O_{3-\delta}$	200 °C, 99% RH	4.81×10^{-3}	[8]
Nafion/BP3-1.0	50 °C, 80% RH	8.5×10^{-2}	[9]
SPS/POM-BC-30	25 °C, 100% RH	5.3×10^{-2}	[10]
FJU-106	70 °C, 99% RH	1.8×10^{-2}	[11]
h-BN	55 °C, 99% RH	6.17×10^{-2}	[12]
Am3-sNCC-5	40 °C, 100% RH	4.3×10^{-2}	[13]
NUS-10(R)@PVDF-50	25 °C, 100% RH	5.16×10^{-3}	[14]
NTP/MFN@CS-2	50 °C, 98% RH	4.6×10^{-2}	This work

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