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Supplementary information for

Quaternized Aryl Ether-Free Polyaromatics for Alkaline Membrane Fuel Cells: Synthesis, Properties, and Performance – A Topical Review

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Table S1. Water uptake and hydroxide conductivity of AEMs with 1.8-2.2 meq./g IEC under room temperature, published since Jan. 2014.

Sample name	IEC (meq./g)	Water uptake (wt.%)	Hydroxide conductivity (mS/cm)	Temp. (°C)	ref
Aryl ether-free polyaromatics					
QPAF-3 (5)	1.92	170	65	rt/30	1
QPAF-4 (4)	1.84	185	45	rt/30	2
BPN1-65	1.94	102	41	30	3
p-TPN1	2.16	43	43	30	3
m-TPN1	2.18	44	54	30	3
PTPipQ6	2.08	44	48	20	4
PTPipQ8	1.98	33	29	20	4
PTDAMPB	1.98	25	47	40	5
Aryl ether-containing polyaromatics					
B-135-PSU-NMe_3	2.02	75	33	rt	6
C-100-PSU-NMe_3	1.90	218	37	rt	6
QPE-bl-9	2.0	70	74	rt/30	7
6QA-3	2.01	40	21	rt	8
PDApip4	2.02	36	51	rt	9
ImPESN-19-22	2.07	18	3	30	10
30PPOFC6N	1.84	63	25	rt	11
40PPOFC6N	2.05	85	32	rt	11
50PPOFC6N	2.16	102	37	rt	11
50PPOFC6NC6	1.89	97	42	rt	11
60PPOFC6NC6	1.93	116	46	rt	11
NC_3Q-PPO-40	2.17	61	18	rt	12
NC_5Q-PPO-40	2.03	50	25	rt	12
QC_6-PPO-40	2.13	39	24	rt	12
BTMA-30	2.03	66	26	20	13
CQA-40	1.98	29	30	20	13
SCCQA4-40	1.83	44	15	20	13
D20NC6NC6	1.94	61	30	rt	14
T15NC6NC5N	2.10	65	53	rt	14
QBPES-60	1.86	43	28	20	15
QRPES-60	1.89	47	20	20	15
Polyolefins					
SEBS-TMA	2.19	211	45	30	16
SEBS-DMP	1.96	249	19	30	16
SEBS-TMHA	1.95	236	39	30	16
SEBS-DMHA	1.91	194	28	30	16
PMP-TMA-41	1.92	29	43	20	17
QA-(PS_{140}-$PDVPPA_{90}$-PS_{140})	2.11	44	46	20	18
QA-(PS_{140}-$PDVPPA_{60}$-PS_{140})	1.81	35	41	20	18
x-QA-(PS_{140}-$PDVPPA_{90}$-PS_{140})-18	1.84	29	31	20	18

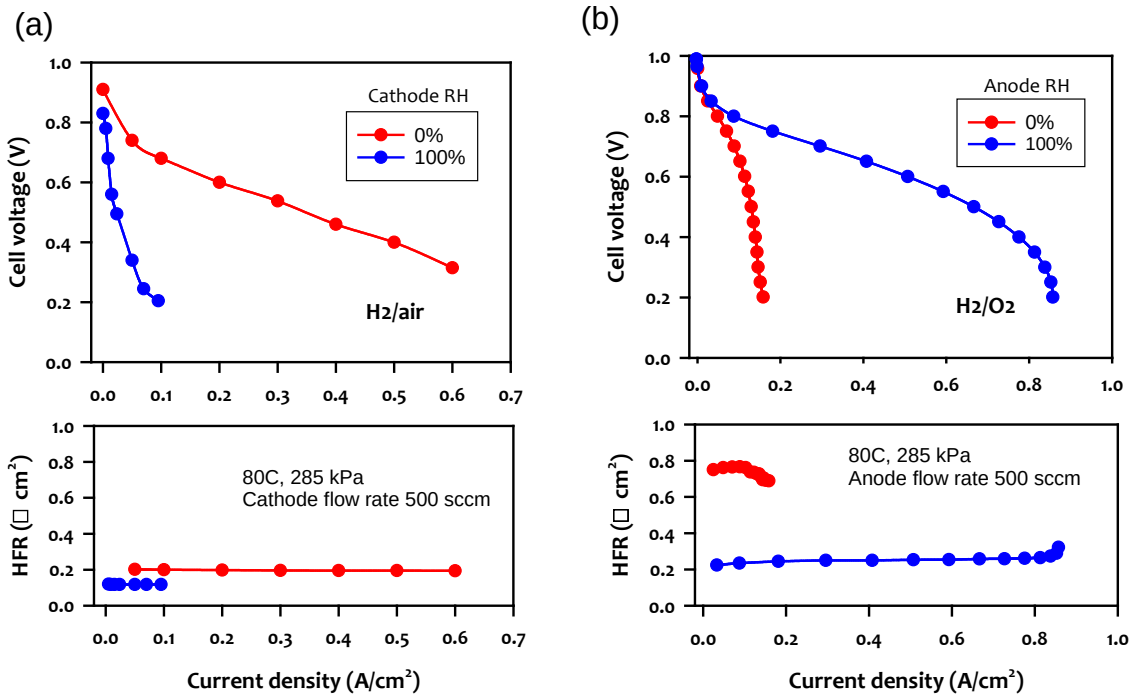

Fig. S1 Impact of electrode humidification on performance of (a) PEMFC and (b) AMFC. For PEMFC, sulfonated Diels-Alder poly(phenylene) (IEC 2.0 meq./g) was used as cathode ionomer. For AMFC, quaternized Diels-Alder poly(phenylene) (IEC 2.1 meq./g) was used as anode ionomer. The fuel cell performance was measured at 80 °C, 285 kPa backpressure.

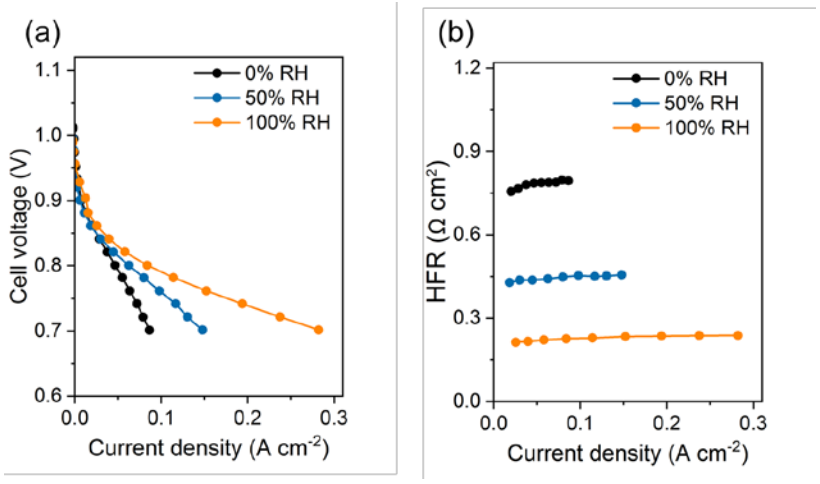

Fig. S2 Humidity dependence of (a) fuel cell performance and (b) high frequency resistance of TMAC6PP membrane. The AMFC performance was measured at 80°C, 285 kPa backpressure under fully humidified conditions.

References

1. H. Ono, J. Miyake and K. Miyatake, *Journal of Polymer Science Part A: Polymer Chemistry*, 2017, **55**, 1442-1450.
2. H. Ono, T. Kimura, A. Takano, K. Asazawa, J. Miyake, J. Inukai and K. Miyatake, *Journal of Materials Chemistry A*, 2017, **5**, 24804-24812.
3. W.-H. Lee, E. J. Park, J. Han, D. W. Shin, Y. S. Kim and C. Bae, *ACS Macro Letters*, 2017, **6**, 566-570.
4. J. S. Olsson, T. H. Pham and P. Jannasch, *Advanced Functional Materials*, 2018, **28**, 1702758.
5. G. S. Sailaja, S. Miyanishi and T. Yamaguchi, *Polymer Chemistry*, 2015, **6**, 7964-7973.
6. A. D. Mohanty, Y.-B. Lee, L. Zhu, M. A. Hickner and C. Bae, *Macromolecules*, 2014, **47**, 1973-1980.
7. N. Yokota, M. Shimada, H. Ono, R. Akiyama, E. Nishino, K. Asazawa, J. Miyake, M. Watanabe and K. Miyatake, *Macromolecules*, 2014, **47**, 8238-8246.
8. Y. He, X. Ge, X. Liang, J. Zhang, M. A. Shehzad, Y. Zhu, Z. Yang, L. Wu and T. Xu, *Journal of Materials Chemistry A*, 2018, **6**, 5993-5998.
9. D. J. Strasser, B. J. Graziano and D. M. Knauss, *Journal of Materials Chemistry A*, 2017, **5**, 9627-9640.
10. A. N. Lai, L. S. Wang, C. X. Lin, Y. Z. Zhuo, Q. G. Zhang, A. M. Zhu and Q. L. Liu, *ACS Applied Materials & Interfaces*, 2015, **7**, 8284-8292.
11. L. Zhu, J. Pan, C. M. Christensen, B. Lin and M. A. Hickner, *Macromolecules*, 2016, **49**, 3300-3309.
12. J. Pan, J. Han, L. Zhu and M. A. Hickner, *Chemistry of Materials*, 2017, **29**, 5321-5330.
13. L. Liu, X. Chu, J. Liao, Y. Huang, Y. Li, Z. Ge, M. A. Hickner and N. Li, *Energy & Environmental Science*, 2018, **11**, 435-446.
14. L. Zhu, J. Pan, Y. Wang, J. Han, L. Zhuang and M. A. Hickner, *Macromolecules*, 2016, **49**, 815-824.
15. X. Dong, S. Hou, H. Mao, J. Zheng and S. Zhang, *Journal of Membrane Science*, 2016, **518**, 31-39.
16. A. D. Mohanty, C. Y. Ryu, Y. S. Kim and C. Bae, *Macromolecules*, 2015, **48**, 7085-7095.
17. M. Zhang, C. Shan, L. Liu, J. Liao, Q. Chen, M. Zhu, Y. Wang, L. An and N. Li, *ACS applied materials & interfaces*, 2016, **8**, 23321-23330.
18. M. Zhu, M. Zhang, Q. Chen, Y. Su, Z. Zhang, L. Liu, Y. Wang, L. An and N. Li, *Polymer Chemistry*, 2017, **8**, 2074-2086.