Supporting Information

Sulfonated NanoBamboo Fiber-Reinforced Quaternary Ammonia Poly(ether ether ketone) Membranes for Alkaline Polymer Electrolyte Fuel Cells

Yanqiu Peng,[†] Ying Wang,[‡] Xing Wei,[†] Jinping Zhou,[†] Hanqing Peng,[†] Li Xiao,[†,*] Juntao Lu,[†] and Lin Zhuang[†,‡,*]

[†] *College of Chemistry and Molecular Sciences, Hubei Key Lab of Electrochemical Power Sources, Wuhan University, Wuhan 430072, China*

[‡] *The Institute for Advanced Studies, Wuhan University, Wuhan 430072, China*

E-mails: chem.lily@whu.edu.cn, lzhuang@whu.edu.cn

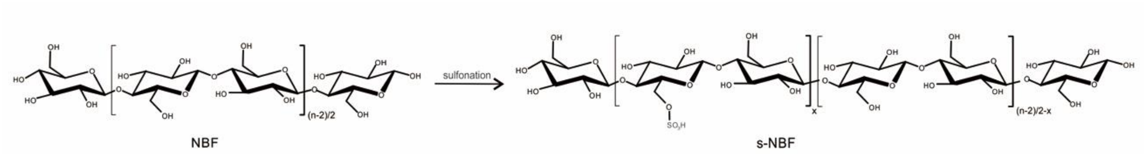

Figure S1 Chemical structure of the NBF† and s-NBF.

†In essence, nano bamboo fiber (NBF) is cellulose. After sulfonating of NBF, some of the hydroxyl groups turned into sulfonic acid group, as proved by FTIR spectra (Figure 2).

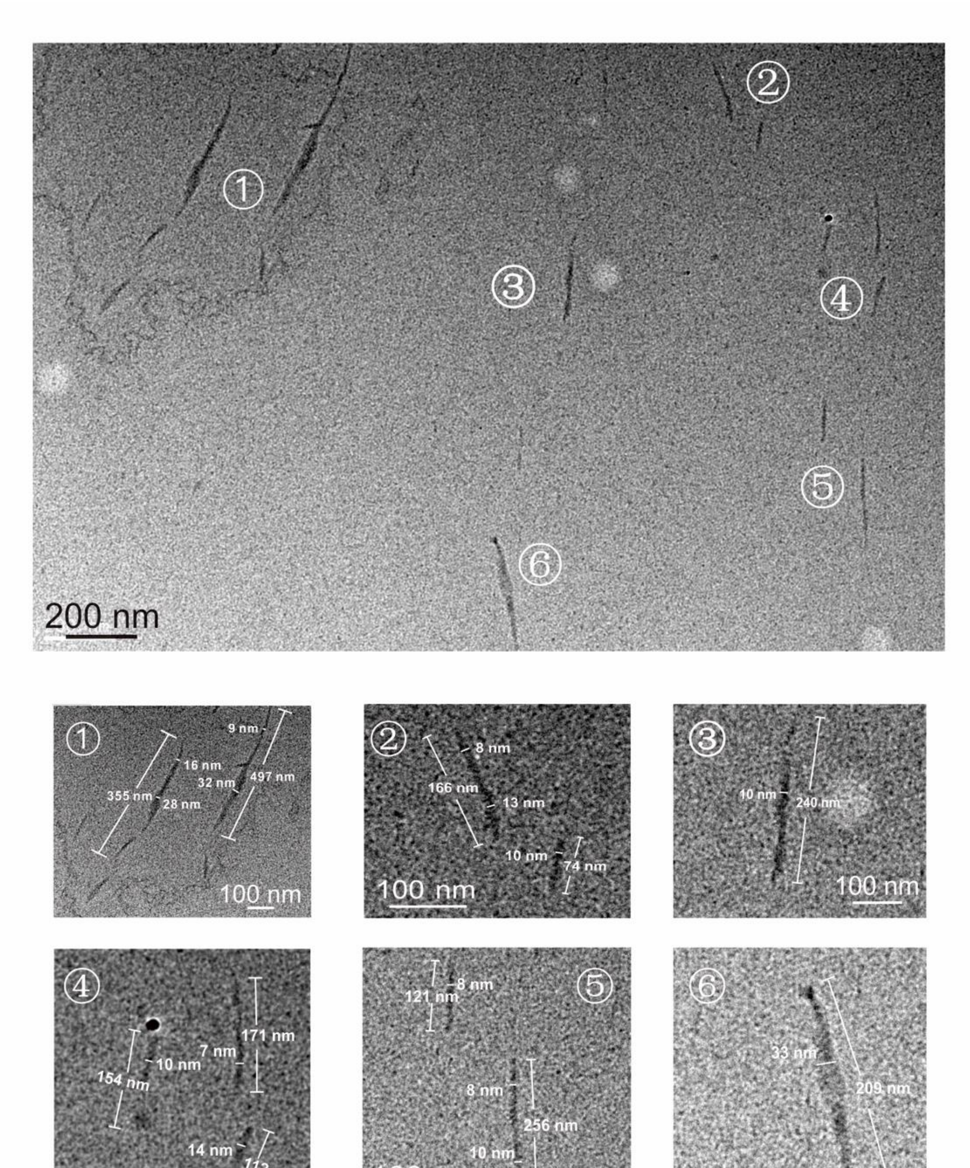

Figure S2 TEM image of the s-NBF†.

†In order to identify the s-NBF in composite membrane (Figure 4), measurement of the size of s-NBF was carried out. The length of s-NBFs was between 100 nm and 500 nm, and the diameter was less than 40 nm. The fibers with same size were observed in the QAPEEK/s-NBF composite membrane.

Table S1 Membrane properties of composite membrane with different filler contents.

Sample	Thickness (μm)	IEC (mmol/g)	SD%		WU%		IC(mS/cm)	
			30℃	80℃	30℃	80℃	30℃	80℃
QAPEEK	27	1.59	25%	30%	99%	167%	20.5	81.1
QAPEEK/s-NBF	28	1.53	12.5%	12.5%	70%	89%	17.7	71.6
QAPSF	32	1.26	20%	20%	61%	80%	16.1	56.3
QAPSF/s-NBF	33	1.20	10%	10%	53%	67%	13.8	58.2
QAPPO	32	1.69	17.5%	20%	105%	117%	16.7	59.7
QAPPO/s-NBF	32	1.57	10%	10%	64%	64%	21.2	54.5

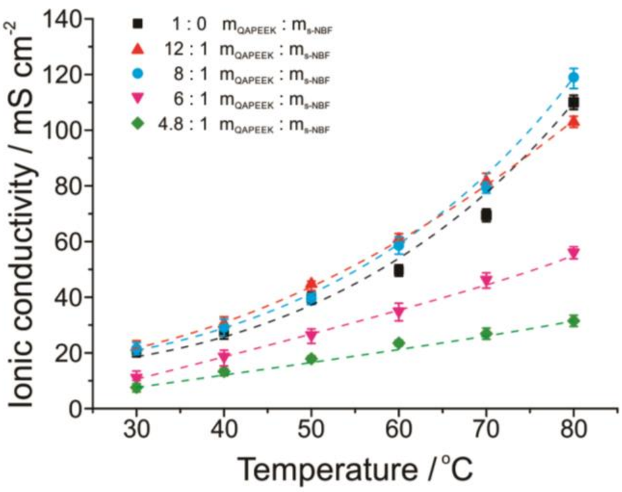

Figure S3 The temperature dependence of the ionic conductivity of QAPEEK/s-NBF composite membrane.

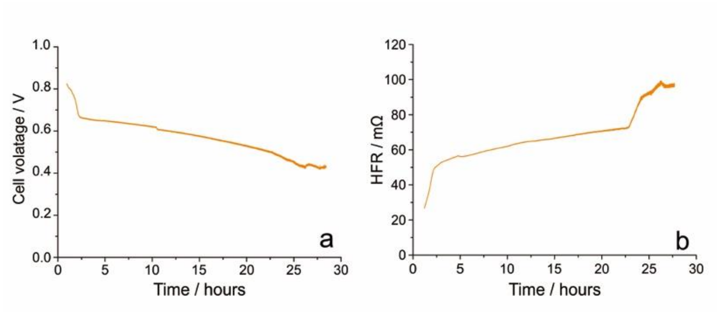

Figure S4 APEFC stability test using QAPEEK membrane and QAPEEK ionomer at 200 mA/cm^2. Operating conditions were mostly the same as fuel cell performance test. The cell was tested at 60^{o}C with a flow rate of 400 mL/min.

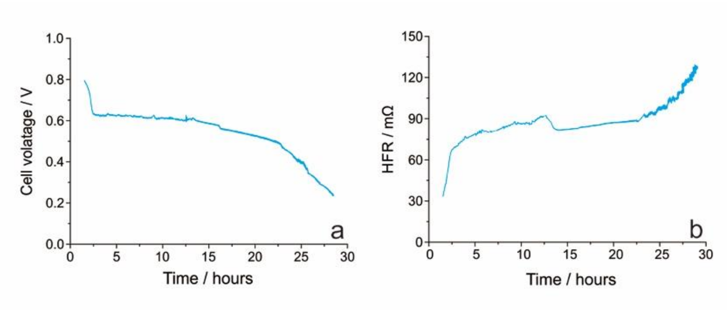

Figure S5 APEFC stability test using QAPEEK/s-NBF composite membrane and QAPEEK ionomer at 200 mA/cm^2. Operating conditions were mostly the same as fuel cell performance test. The cell was tested at 60^{o}C with a flow rate of 400 mL/min.

The stability of APEFC is currently a challenge, which is not only related to the membrane, but also to the catalyst, the MEA structure, and the water management. Sine the subject of this paper is about the physicochemical properties of the APEM, an in-depth analysis on the fuel cell stability is beyond the scope of this paper.

However, we provide these APEFC stability data, in addition to the alkaline stability of the membranes (Figure 8), for readers' reference. The performance of the tested APEFC does degrade gradually, with the reason remaining for future studies.