

## Supporting Information

### **New Insights into Degradation of Fe-N-C Catalyst Layers: Ionomer Decomposition**

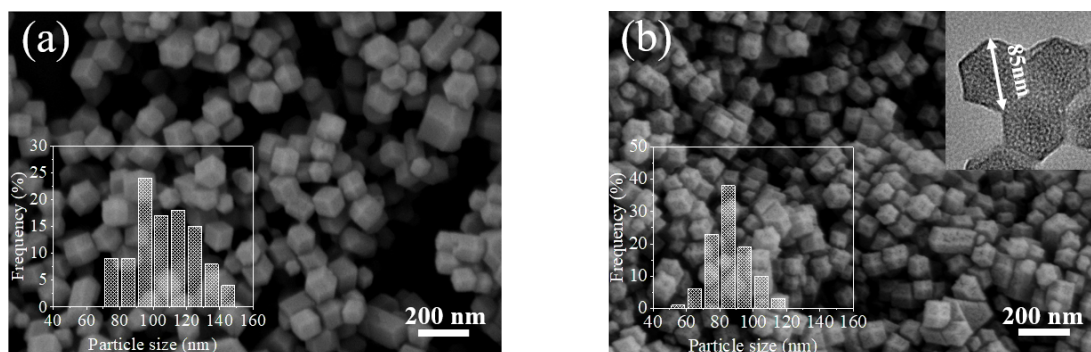
Lu Zhou <sup>b</sup>, Yunqi Li <sup>a\*</sup>, Xiran Chen <sup>b</sup>, Zhi Yang <sup>c</sup>, Shuo Yang <sup>c</sup>, Qian Wang <sup>b</sup>, Xin-Ying Liu <sup>d</sup>, Shanfu Lu <sup>a\*</sup>

<sup>a</sup> *Beijing Key Laboratory of Bio-inspired Energy Materials and Devices, School of Space and Environment, Beihang University, Beijing, China, 100191*

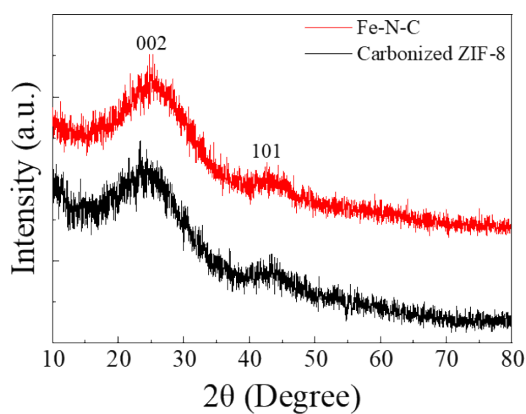
<sup>b</sup> *Department of Automotive Engineering, School of Transportation Science and Engineering, Beihang University, Beijing, China, 100191*

<sup>c</sup> *Key Laboratory of Carbon Materials of Zhejiang Province, Wenzhou University, Wenzhou, China, 325035*

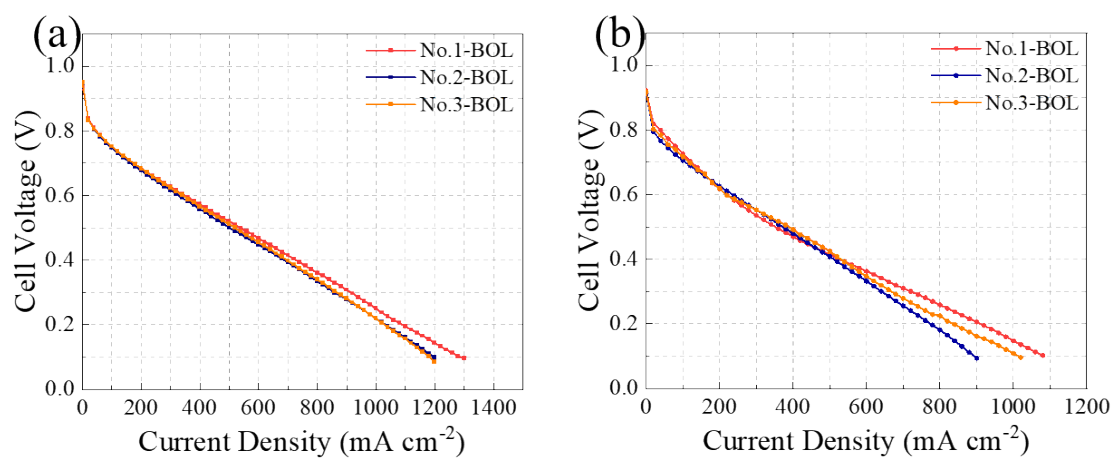
<sup>d</sup> *Department of Chemistry, Tsinghua University, Beijing, China, 100084*



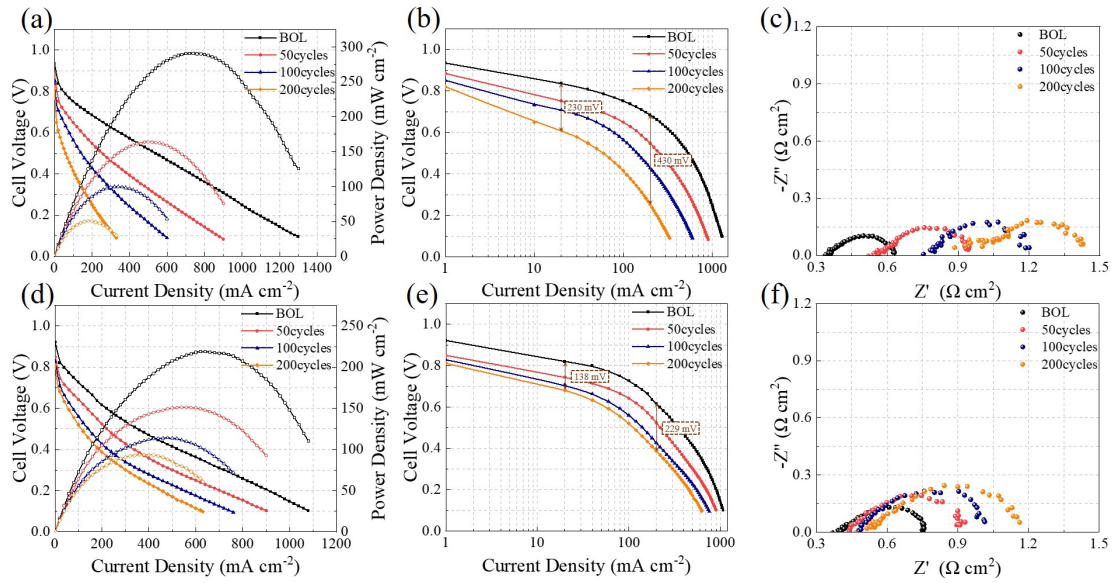
**Fig. S1.** SEM images and particle size distributions of the materials before (a) and after (b) annealing at 1050 °C for 1 h. The inset in (b) shows the TEM image of Fe-N-C catalyst.



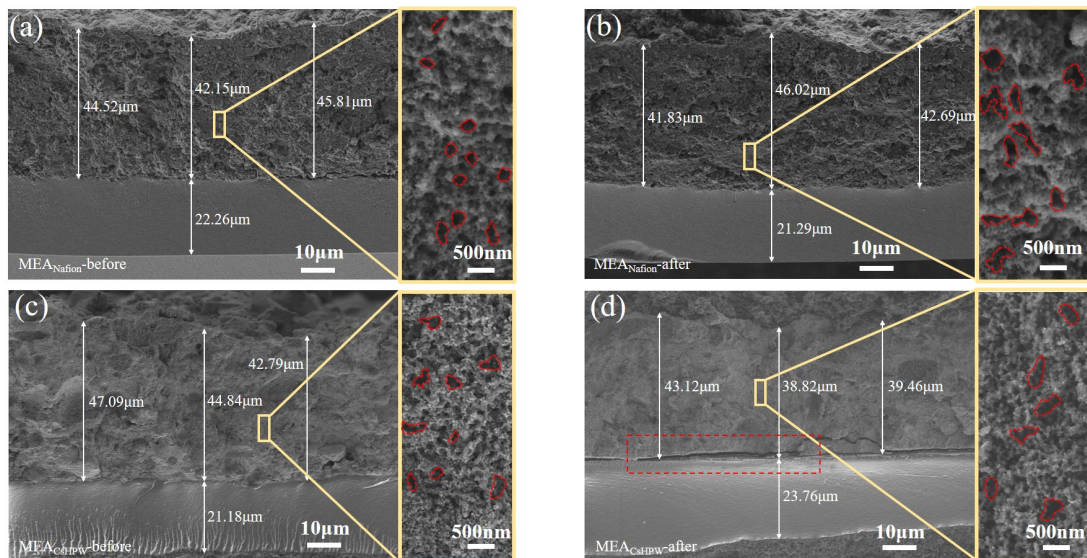
**Fig. S2.** XRD patterns of carbonized ZIF-8 and Fe-N-C catalyst.



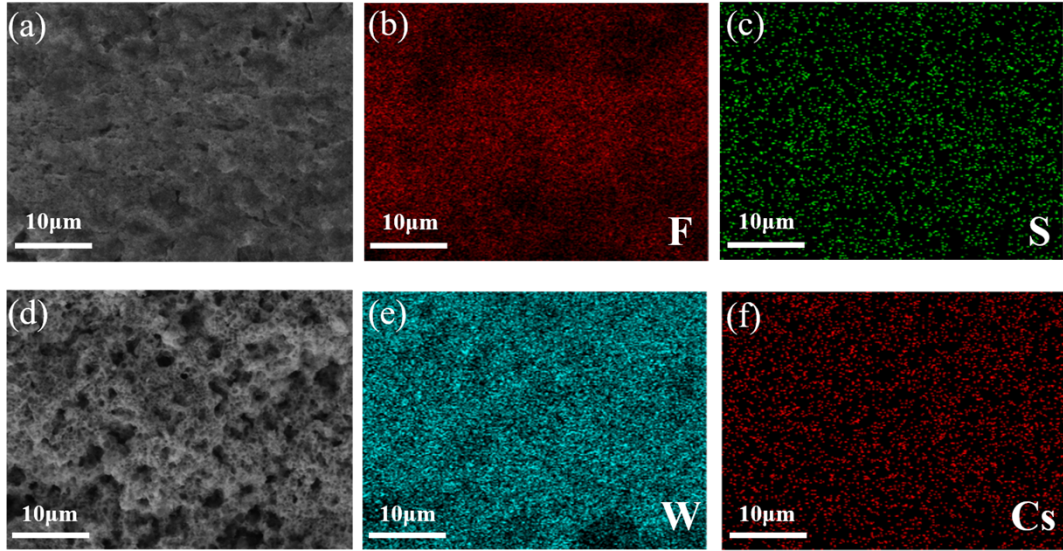
**Fig. S3.** The repeatability of polarization curves for MEA<sub>Nafion</sub> (a) and MEA<sub>CsHPW</sub> (b).



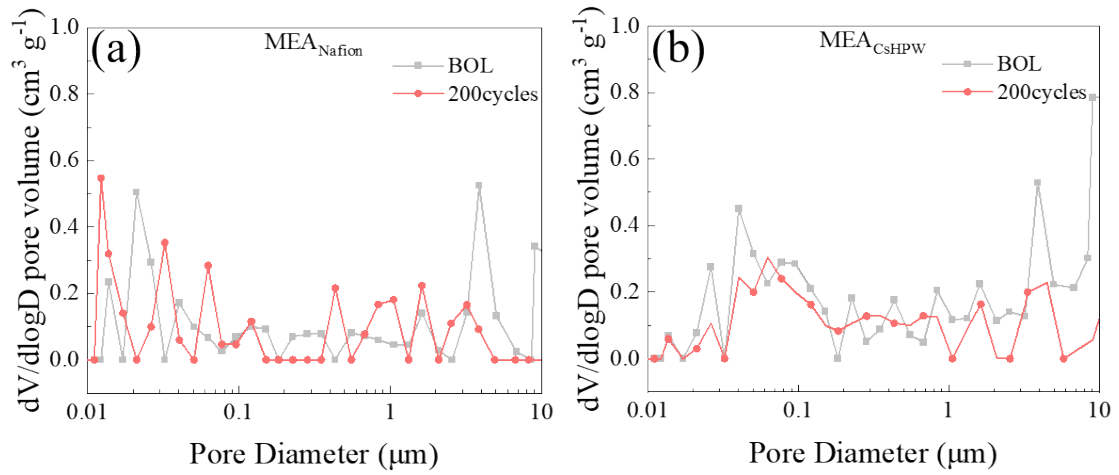
**Fig. S4.** Polarization curves and corresponding Tafel plots for  $\text{MEA}_{\text{Nafion}}$  (a, b) and  $\text{MEA}_{\text{CsHPW}}$  (d, e) measured at 80 °C, 100% RH and without back pressure; electrochemical impedance spectroscopies for  $\text{MEA}_{\text{Nafion}}$  (c) and  $\text{MEA}_{\text{CsHPW}}$  (f) measured at 200  $\text{mA cm}^{-2}$  under  $\text{H}_2/\text{O}_2$  condition during AST test.



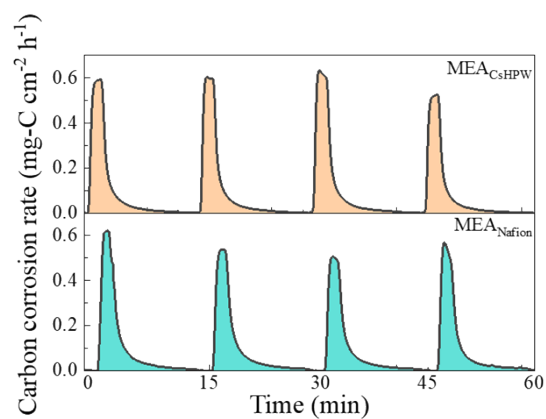
**Fig. S5.** SEM images of cross-section area and corresponding magnified SEM images of CCL before (a, c) and after (b, d) 200 AST cycles for  $\text{MEA}_{\text{Nafion}}$  and  $\text{MEA}_{\text{CsHPW}}$ .



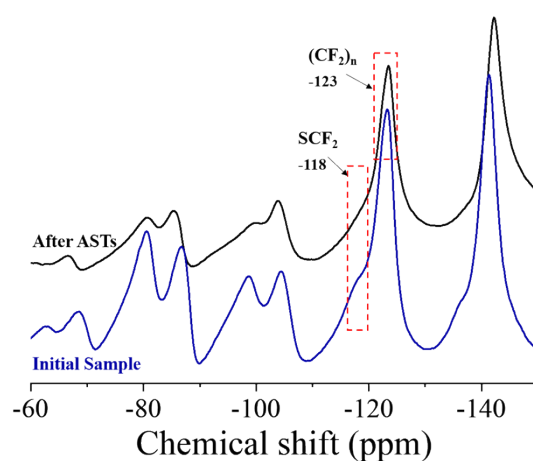
**Fig. S6.** SEM images and EDS mapping of CCL for MEA<sub>Nafion</sub> (a, b, c) and MEA<sub>CsHPW</sub> (d, e, f), respectively.



**Fig. S7.** Pore size distributions of CCL for BOL and after 200 AST cycles by mercury porosimeter method, respectively.



**Fig. S8.** The rate of carbon corrosion rate of MEA<sub>Nafion</sub> and MEA<sub>CsHPW</sub> during AST.



**Fig. S9.** Solid-state <sup>19</sup>F NMR Spectra of CCL before and after AST cycles

**Table S1.** Elemental content of Cs, W and P in prepared cesium phosphotungstic acid measured by ICP tests.

Element	Cs	W	P
Content (%)	7.98	60	1.19