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Supporting information

Protonic ceramic electrochemical cells for hydrogen production from seawater electrolysis

Zhiwei Du[1], Wenjie Gong[1], Kang Xu, Feng Zhu, Xirui Zhang, and Yu Chen*

School of Environment and Energy, South China University of Technology, Guangzhou 510006, China
E-mail: eschenyu@scut.edu.cn

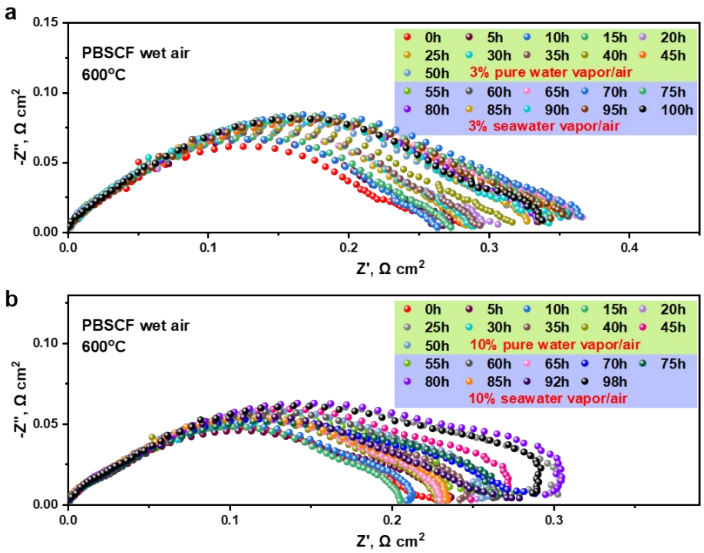

Fig. S1. The EIS curves for stability testing of PBSCF air electrode under **(a)** 3% vapor/air **(b)** 10%vapor/air conditions at 600 °C.

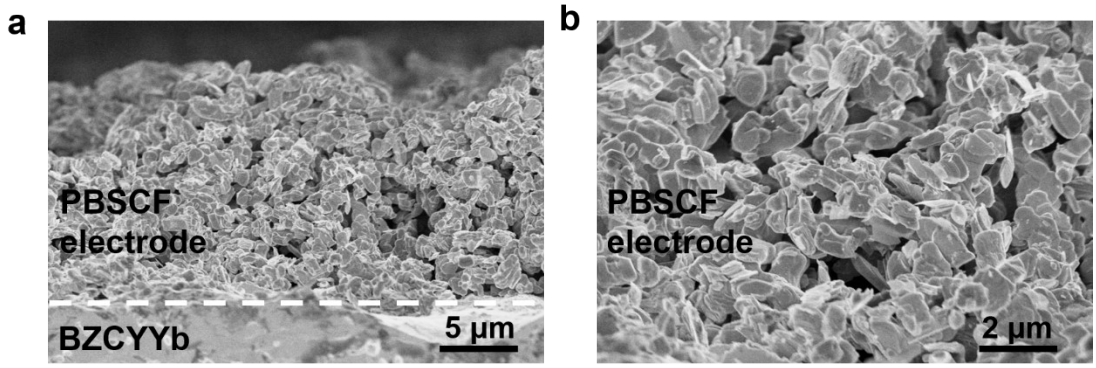

Fig. S2. (a) SEM image of PBSCF symmetrical cell after the 50h durability test in 3% seawater vapor/air conditions at 600 °C; (b) Magnified SEM image of the PBSCF electrode.

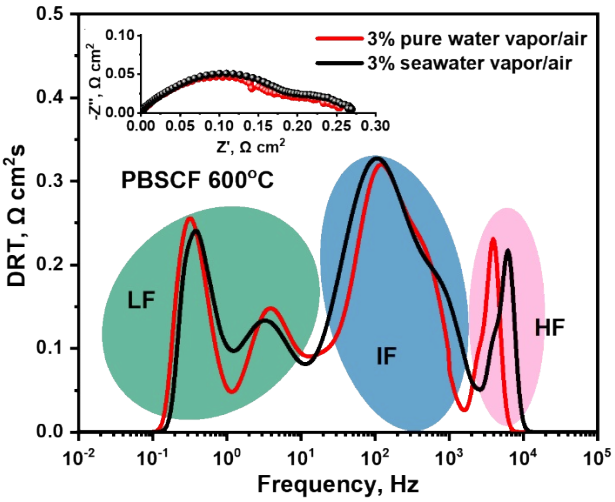

Fig. S3. DRT analysis of PBSCF air electrode measured at 3% pure water vapor/air and 3% seawater vapor/air conditions; inset are the corresponding EIS curves at 600 °C.

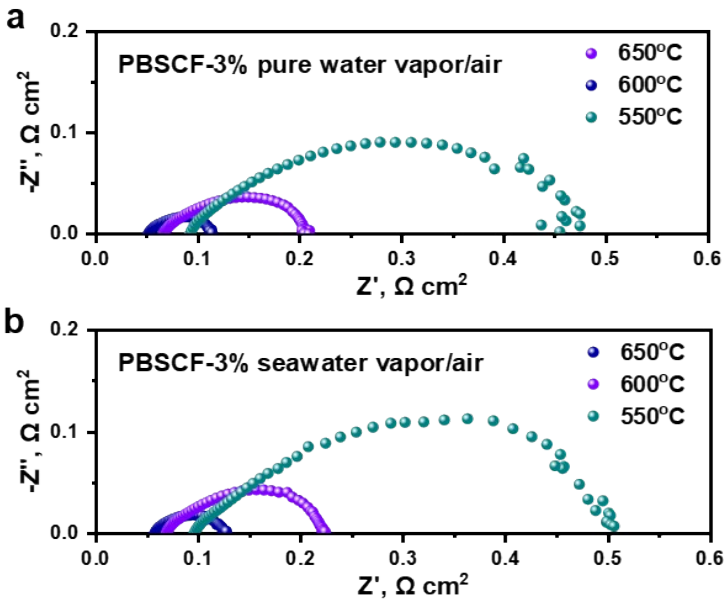

Fig. S4. Typical EIS of the PBSCF single cells tested in **(a)** 3% pure water vapor/air conditions and **(b)** 3% seawater vapor/air conditions from 550-650 °C.

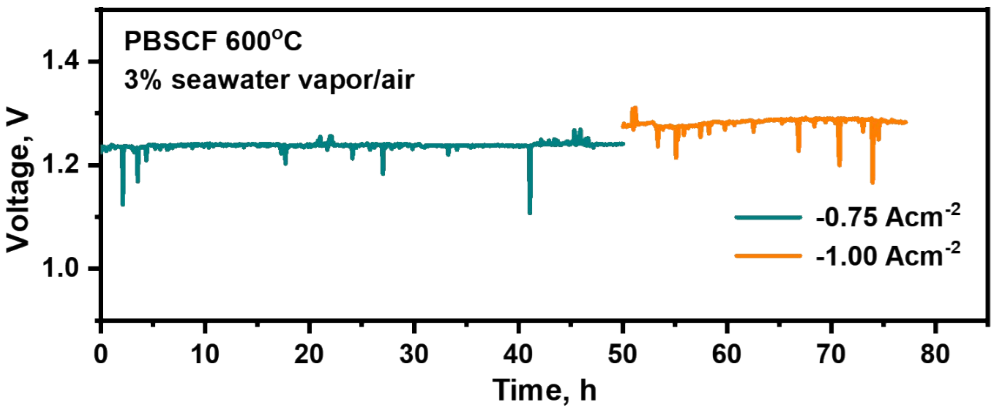

Fig. S5. Short-term electrolytic durability tested in 3% seawater vapor/air at current densities of -0.5 A cm^{-2} and -1.00 A cm^{-2} at 600 °C.

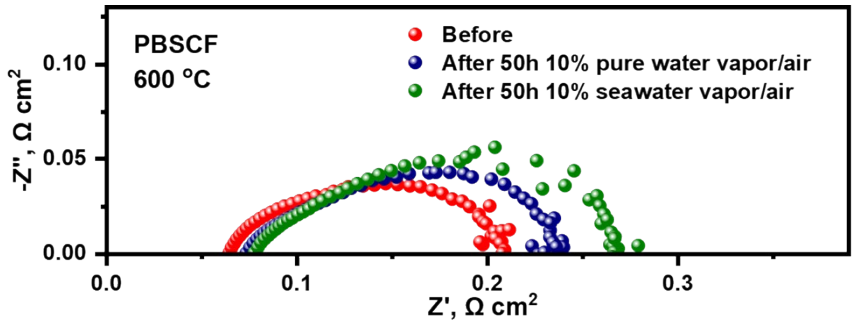

Fig S6. EIS of PCEC with PBSCF electrode before and after 100h stability test in EC mode at 600 °C.

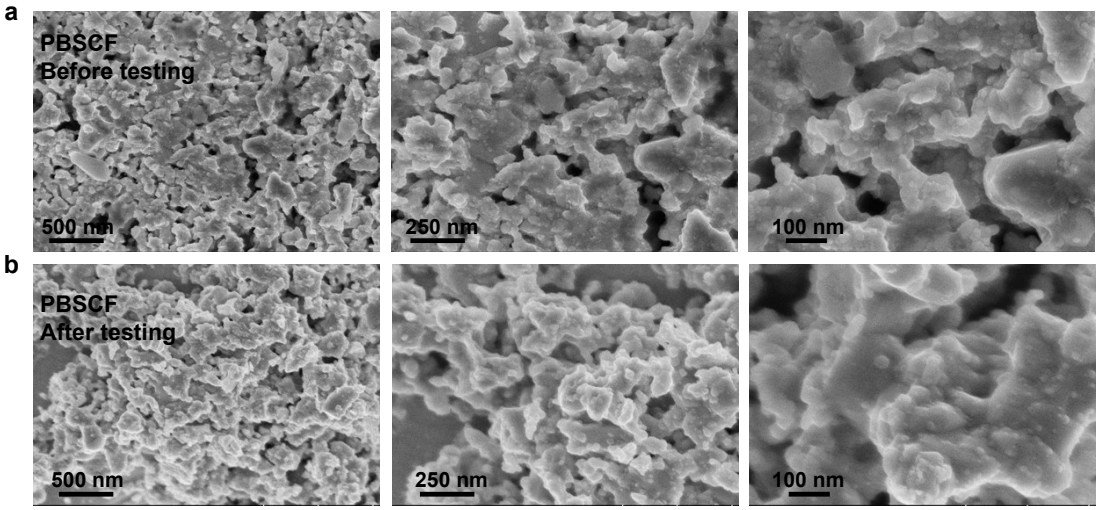

Fig. S7. SEM images of PBSCF electrodes on single cells before **(a)** and after **(b)** electrolytic stability test in 3% seawater vapor/air conditions for 50 h at 600 ^{o}C.

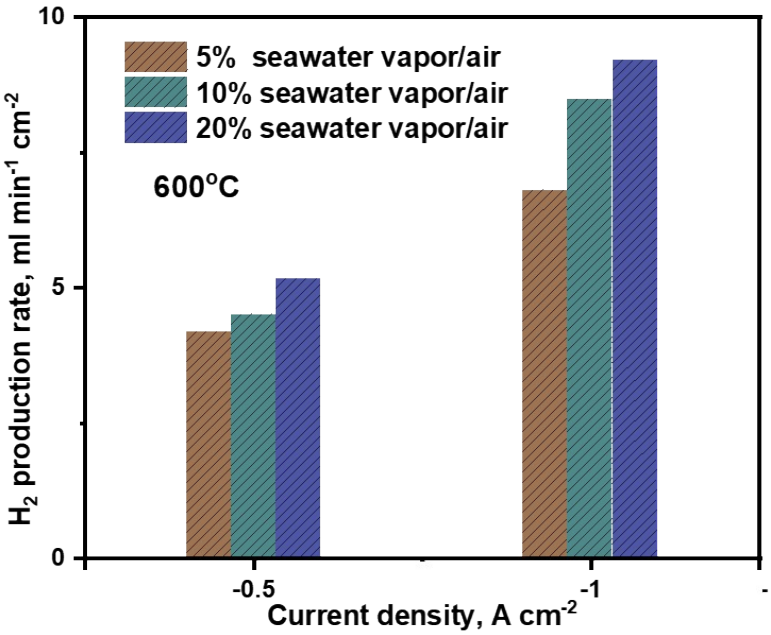

Fig. S8. The H_2 production rates of the PCEC with PBSCF air electrode at -0.5 and -1 A cm^{-2} in wet air with 5, 10, and 20 vol.% seawater vapor/air at 600 °C.

Table S1. The ASRs of PBSCF symmetrical cells tested under 3% pure water and seawater vapor.

	700°C	**650°C**	**600°C**	**550°C**	**500°C**
Pure water-ASR (Ω·cm²)	0.086	0.149	0.254	0.511	1.432
Seawater-ASR (Ω·cm2)	0.087	0.158	0.269	0.554	1.508

Table S2. The single-cell performance, including fuel cell (FC), electrolysis cell (EC), ohmic resistance (R_o), and polarization resistance (R_p) tested at 3% pure water vapor.

3% pure water vapor	PPDs ($W \cdot cm^{-2}$)	Current density ($A \cdot cm^{-2}$)	R_o ($\Omega \cdot cm^2$)	R_p ($\Omega \cdot cm^2$)
650°C	1.732	-3.575	0.052	0.063
600°C	1.429	-2.563	0.068	0.142
550°C	1.059	-1.218	0.093	0.383

Table S3. The single-cell performance, including fuel cell (FC), electrolysis cell (EC), ohmic resistance (R_o), and polarization resistance (R_p) tested at 3% seawater vapor.

3% seawater vapor	PPDs ($W \cdot cm^{-2}$)	Current density ($A \cdot cm^{-2}$)	R_o ($\Omega \cdot cm^2$)	R_p ($\Omega \cdot cm^2$)
650°C	1.658	-3.319	0.058	0.070
600°C	1.388	-2.392	0.070	0.151
550°C	1.025	-1.075	0.097	0.403