Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Micropatterned electrode/electrolyte interface fabricated by soft lithography for facile oxygen reduction in solid oxide fuel cells

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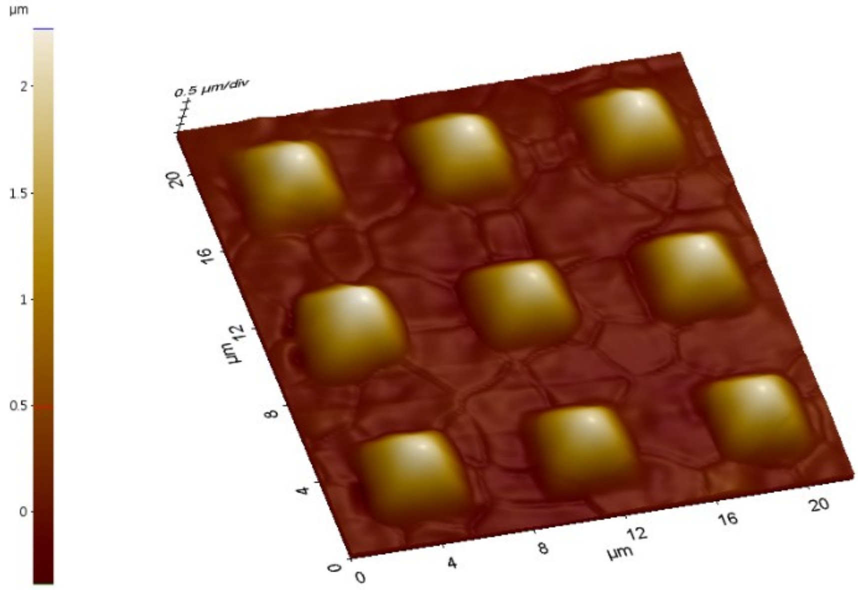
Table S1.

	Surface area increase ratio [%]		
	Pyramid	Prism	Line
AFM	116.8	126.2	N/A
SEM	117.2	128.5	183.1

Table S1. Increase ratios for surface areas of patterned cells with respect to that of reference flat cell, measured by AFM and SEM. (Note that the AFM was not able to examine the surface of the line patterned cell.)

Figure S1.

(a)



(b)

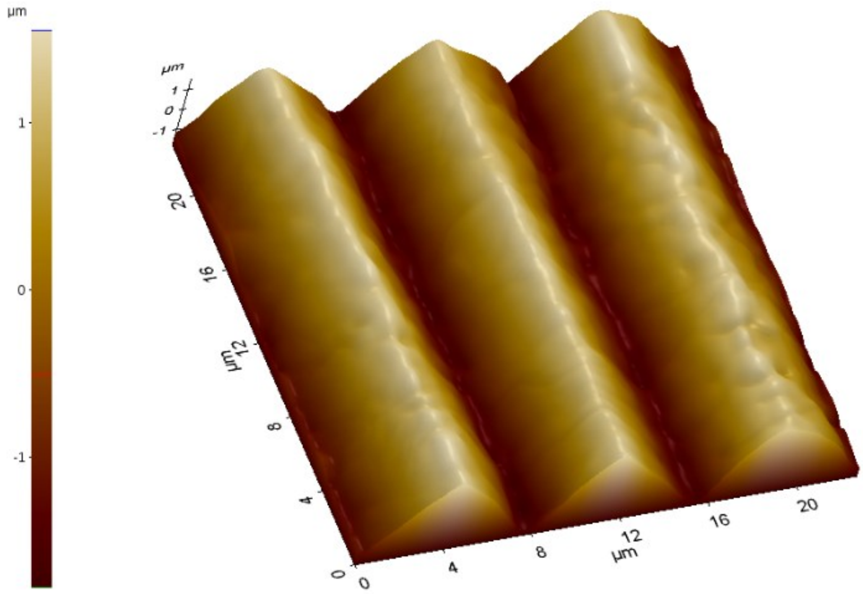


Figure S1. 3D profiles of (a) pyramid and (b) prism patterned electrolyte surfaces examined by AFM in non-contact mode.

Figure S2.

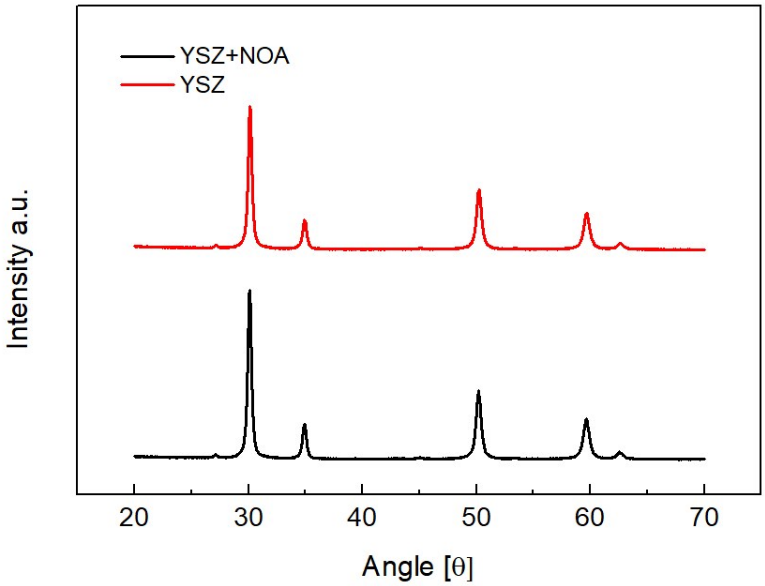


Figure S2. X-ray diffraction patterns (XRD) of pestled powder samples: sintered UV-curable slurry composed of YSZ and NOA 76, and pure YSZ

Figure S3.

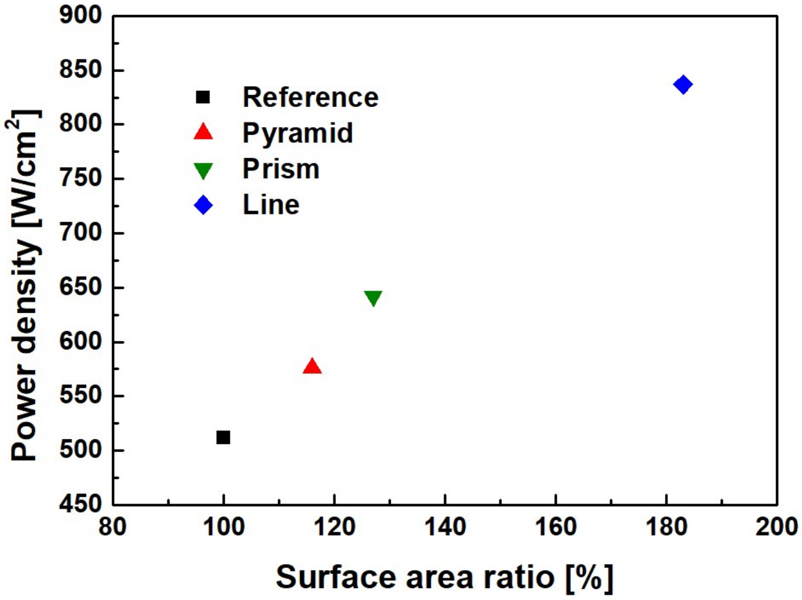
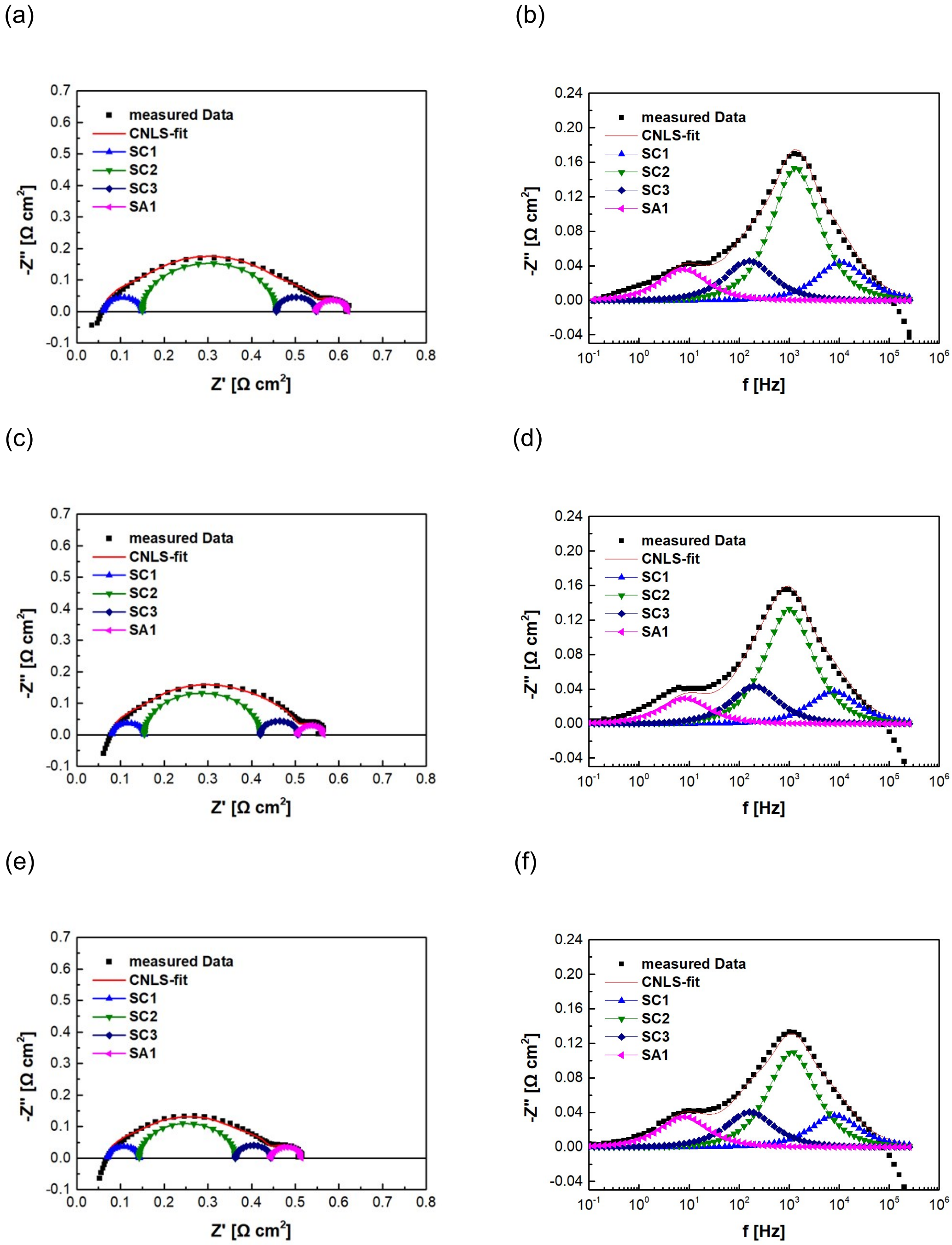


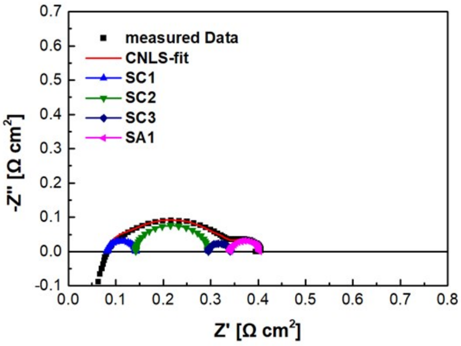
Figure S3. Power densities of patterned cells and reference cell as a function of surface area ratios with respect to that of reference cell.

Figure S4.



(a)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
Z' [Ω cm²]
(b)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
f [Hz]
(c)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
Z' [Ω cm²]
(d)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
f [Hz]
(e)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
Z' [Ω cm²]
(f)
measured Data
CNLS-fit
SC1
SC2
SC3
SA1
-Z'' [Ω cm²]
f [Hz]

(g) (h)



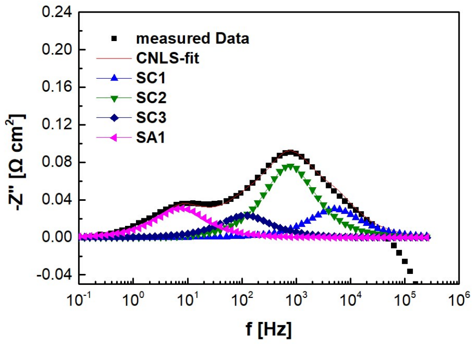


Figure S4. CNLS fits and corresponding Bode plots from impedance spectra of the reference cell (a, b) and patterned cells (pyramid (c, d), prism (e, f), line (g, h)) at 0.8V of cathodic potential and operating temperature of 800 °C.

Figure S5.

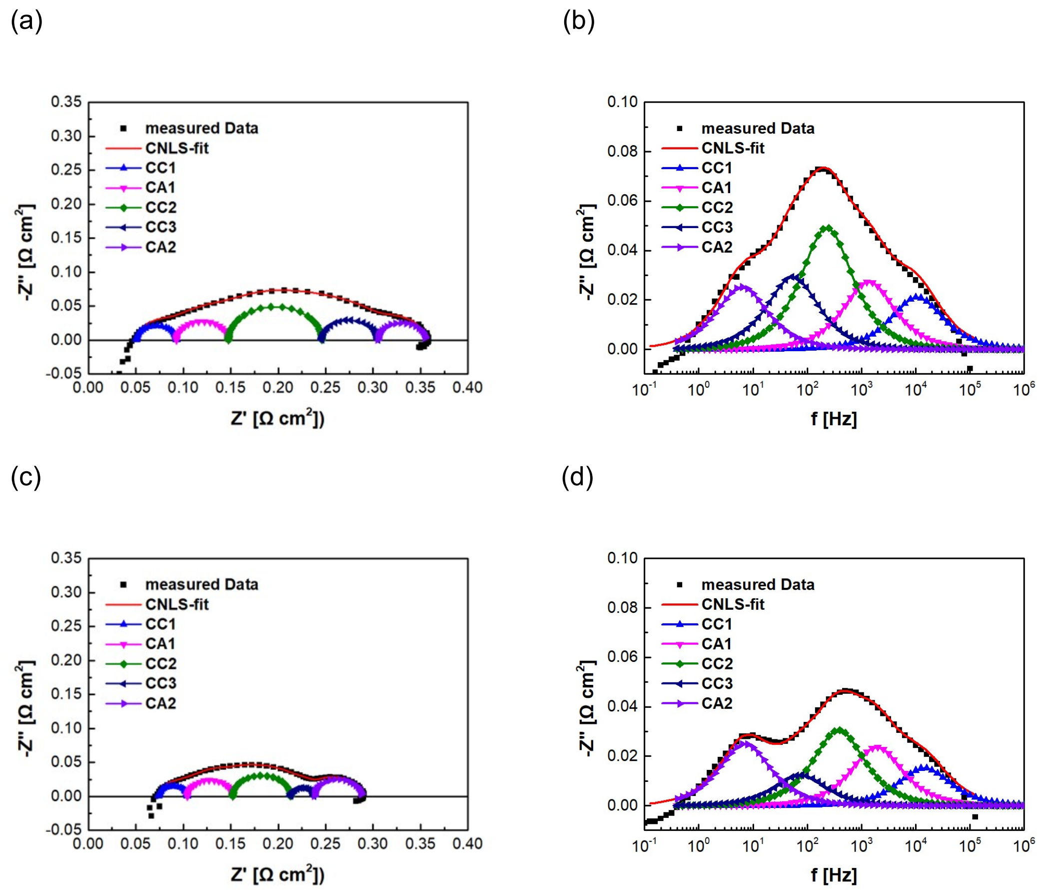


Figure S5. CNLS fits and corresponding Bode plots from impedance spectra of the reference cell (a, b) and line patterned cells (c, d) at 0.6V of cathodic potential and operating temperature of 800 °C.

Figure S6.

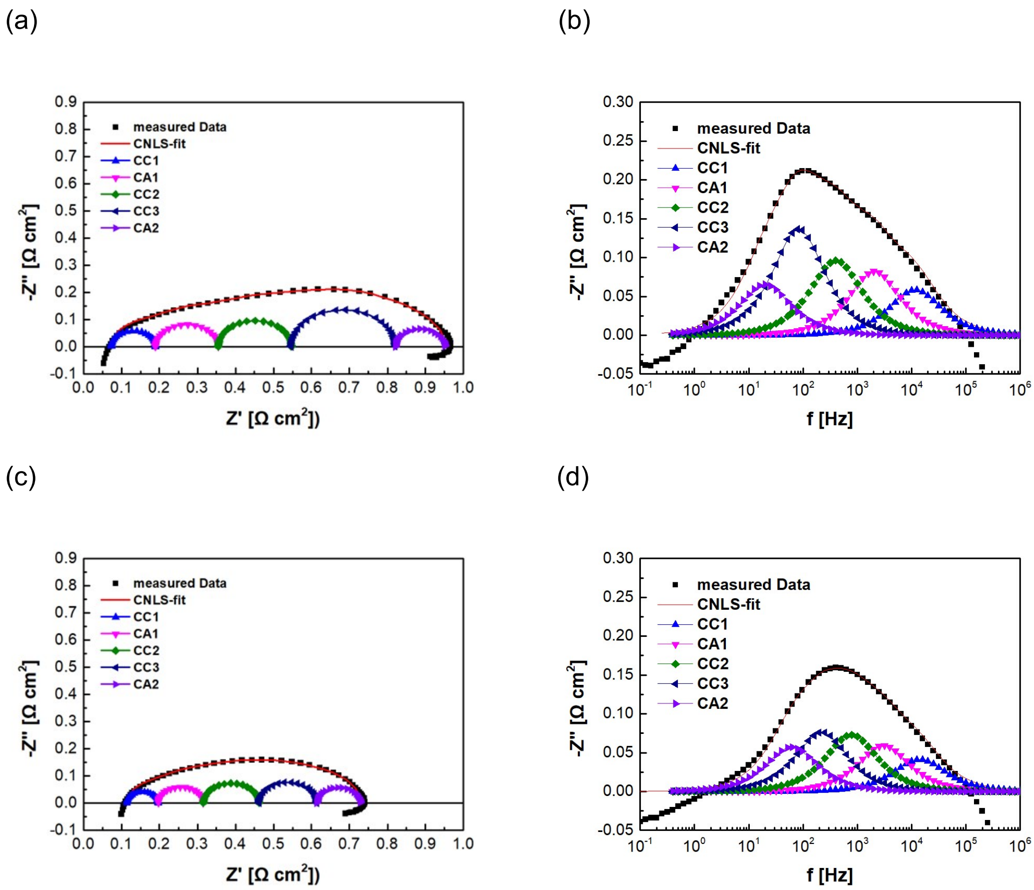


Figure S6. CNLS fits and corresponding Bode plots from impedance spectra of the reference cell (a, b) and line patterned cells (c, d) at 0.6V of cathodic potential and operating temperature of 700 °C.

Figure S7

(a) (b)

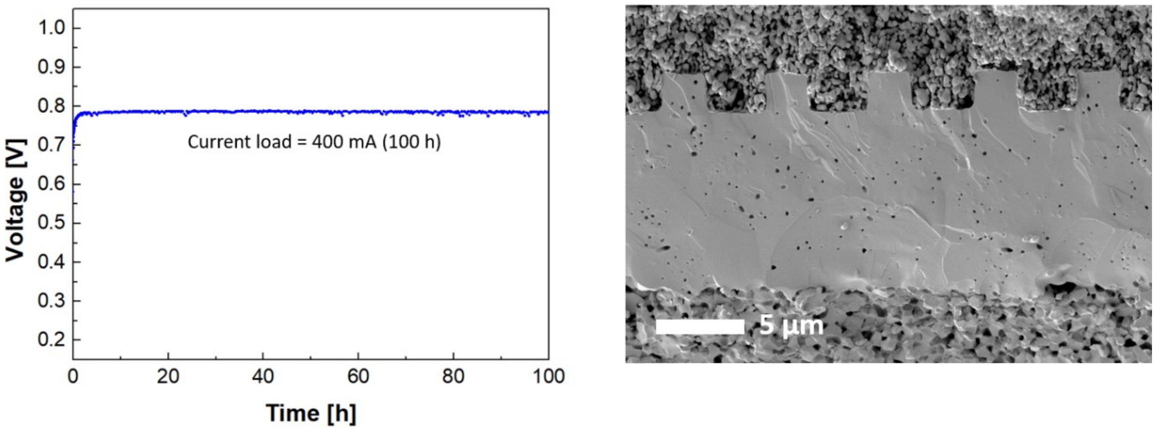


Figure S7. (a) A long-term stability test result of a line-patterned cell with LSM-YSZ composite cathode at a constant current load of 400 mA for 100 h at 700 °C. (b) SEM image of the line patterned cell after lone-term stability test.

For the durability test of the patterned interface structures, the line-patterned cell, which exhibits the largest increase of interface areas, was tested with LSM-YSZ composite cathode under constant current (400 mA) at 700 °C. During the long-term performance evaluation for more than 100 hours, there was no obvious indication of performance degradation. Since we utilized the LSM-YSZ composite cathode, which is well-known for superior compatibility with YSZ electrolyte, the cathode degradation rate seems to be negligible. Figure S7 (b) shows SEM image of the fractured cross-section of the tested line-patterned cell. The interface structures were maintained without any delamination of the cathode or any fractures of patterns. As confirmed by SEM and result from long-term performance evaluation, the patterned interface structures are considered to have reliable stability.