Supporting Information

Title: Pd and GDC Co-infiltrated LSCM Cathode for High-temperature CO_2 Electrolysis using Solid Oxide Electrolysis Cells

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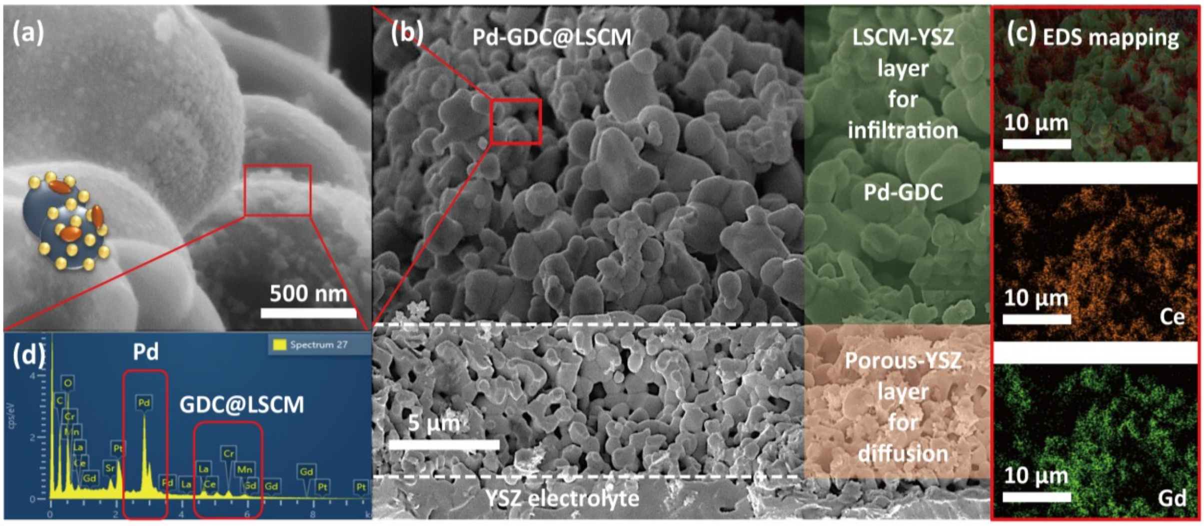

Figure S1. Microstructure images of the Nano-structured Pd-GDC co-infiltrated on LSCM cathode; (a) high magnification of the surface of Pd-GDC@LSCM to verify nano-sized distribution, (b) cross-section of the cell (Pd-GDC|YSZ-LSCM|YSZ-LSCM|YSZ-LSCF|LSCF), (c) EDS point analysis of Pd on the surface, and (d) the distribution of ceia on the LSCM surface.

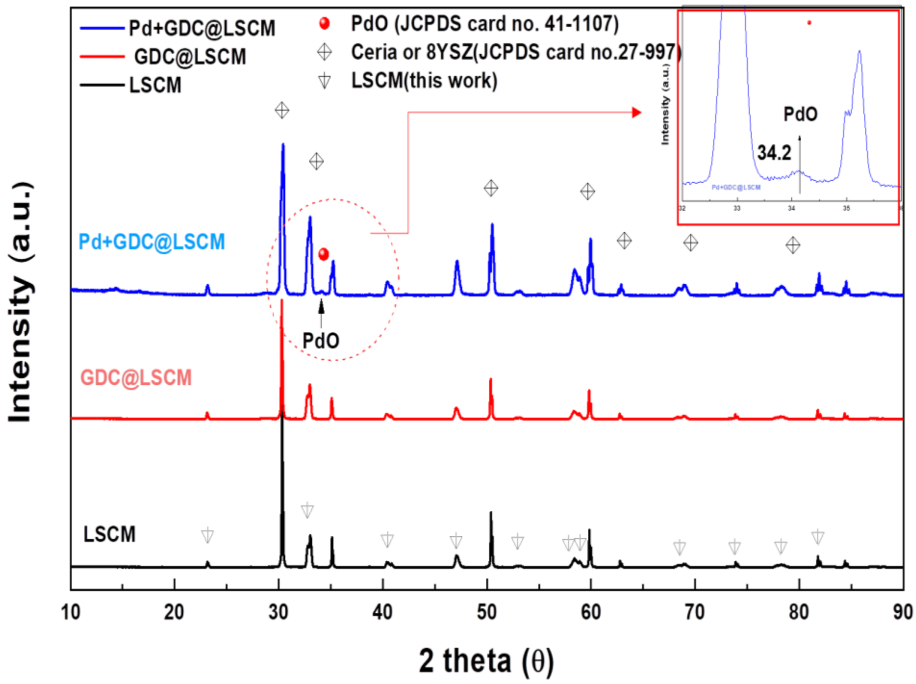

Figure S2. XRD pattern of the cathode electrode of Pd-GDC@LSCM on YSZ SOC cells, compared with that of GDC@LSCM and LSCM. The PdO XRD peak was observed on the Pd-GDC co-infiltrated LSCM cathode.

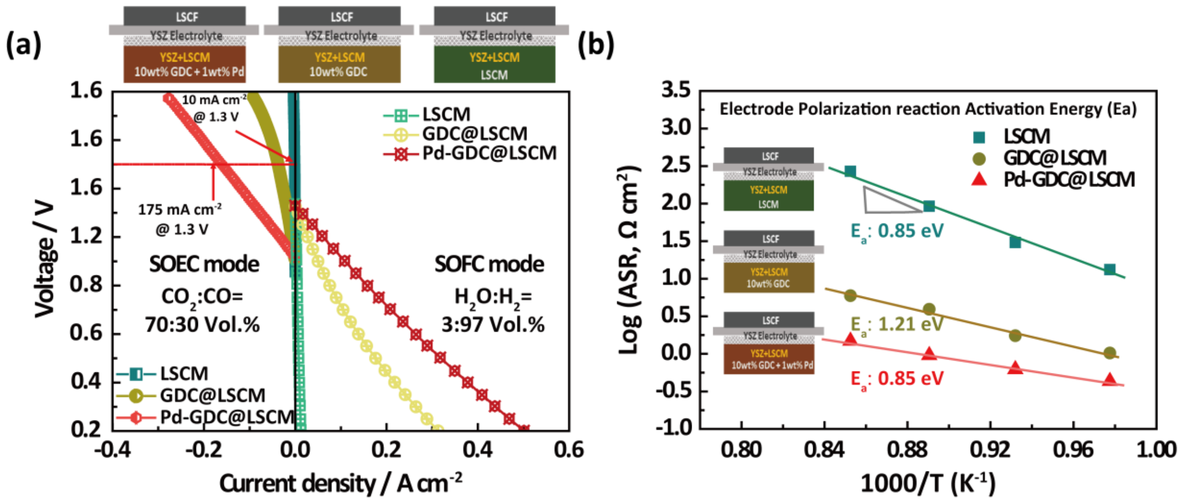

Figure S3. The comparison of Pd-GDC co-infiltrated on LSCM cathode with LSCM cathode; (a) the I-V curves of Pd-GDC@LSCM, GDC@LSCM and LCM in CO_2 electrolysis as well as SOFC mode in H_2, (b) activation energy from the slop of the temperature-dependent ASR curve, calculated from impedance analysis of each different cathode.

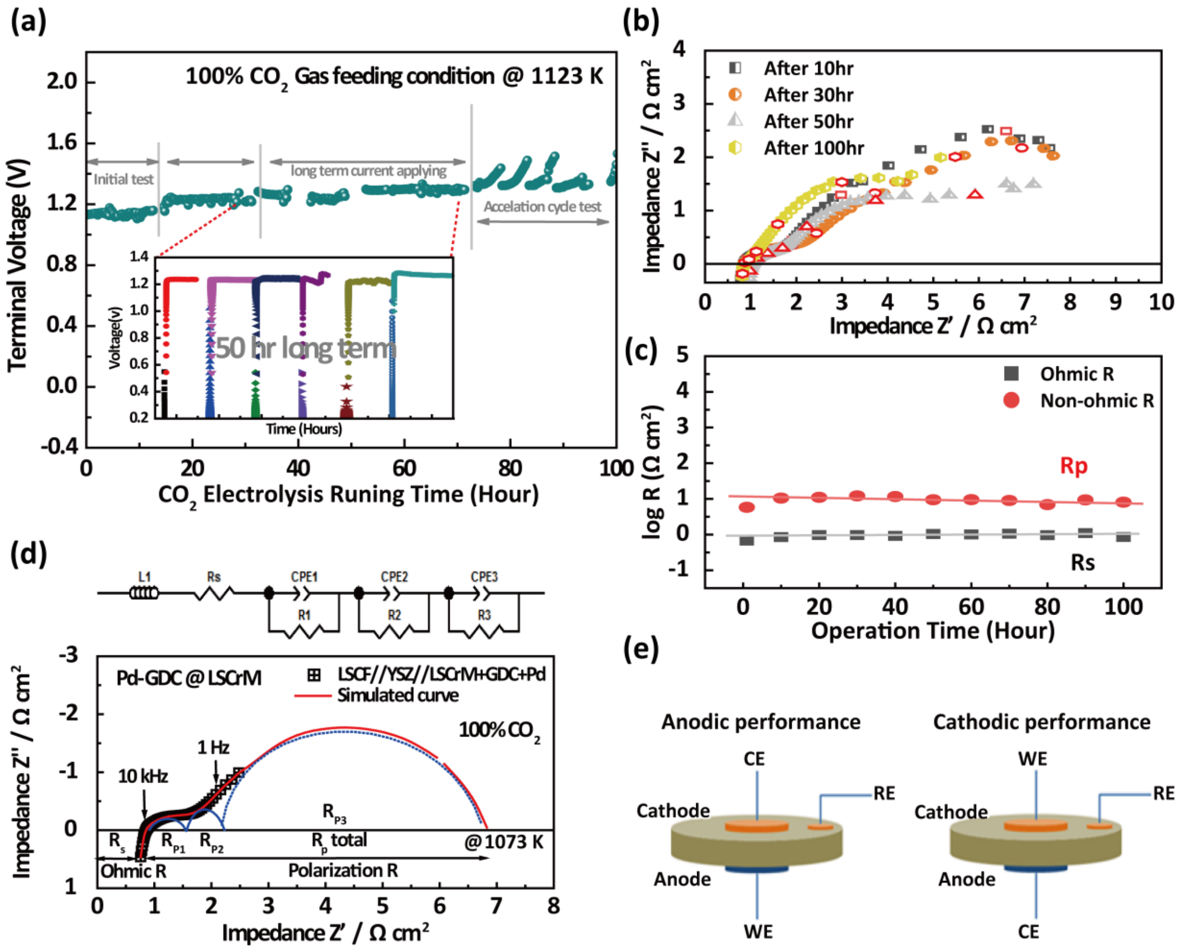

Figure S4. Long term test at 1073 K in 100% CO_2 gas; (a) Running time-dependent terminal voltage curve with applying constant current during CO_2 electrolysis, (b) Impedance spectra as dependent operating time under CO_2 gas, (c) Resistance different with operation running time. (d) Impedance analysis and fitting simulate the model for separating between ohmic & non-ohmic parts. (e) 3-probe method and position of reference electrode and configuration.

Faradaic efficiency calculation

Faradaic efficiency (FE) is calculated according to Equation S1:

$$FE = \frac{Q_{\mathrm{CO}}}{Q_{\mathrm{total}}} = \frac{n_{\mathrm{CO}} z_{\mathrm{CO}} F}{It} \tag{S1}$$

where Q_{CO} and Qtotal represent the quantity of electricity consumed in CO production and the whole CO_2 electrolysis process, respectively. n_{CO} denotes the molar quantities of CO produced in CO_2 electrolysis, z_{CO} is the number of electrons transferred for a CO molecule production, F is the Faraday constant (96485 C mol^{-1}), I denote the total current in the CO_2 electrolysis process and t is the time.