

## An efficient hierarchical nanostructured $\text{Pr}_6\text{O}_{11}$ electrode for solid oxide fuel cells

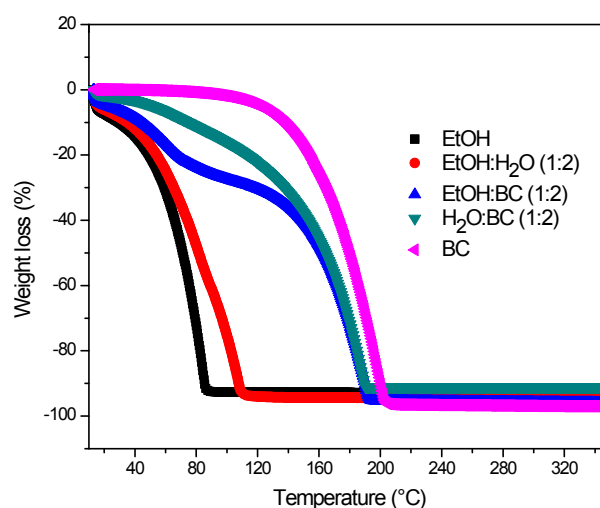
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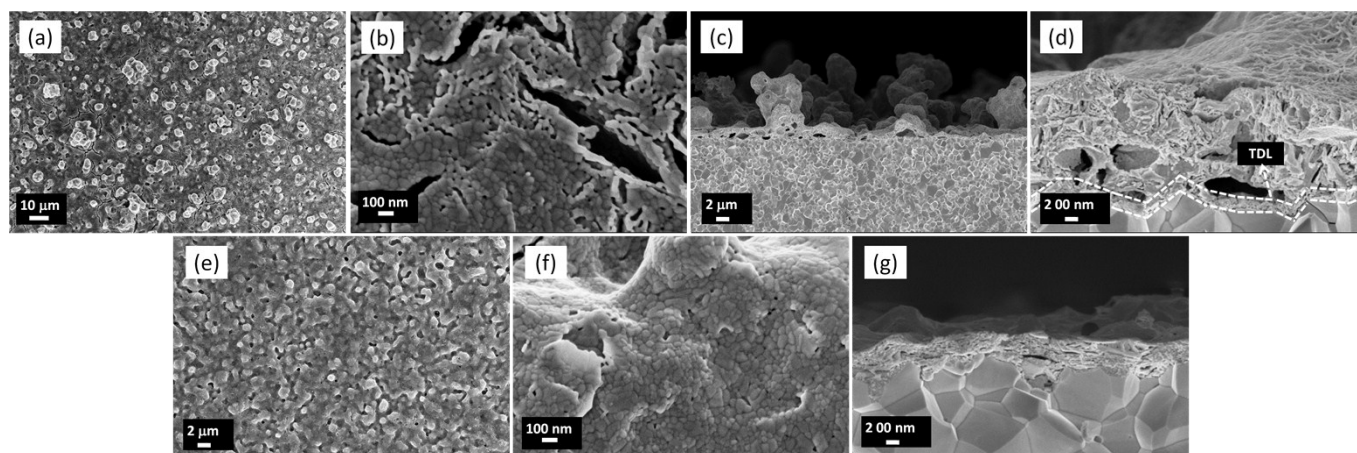
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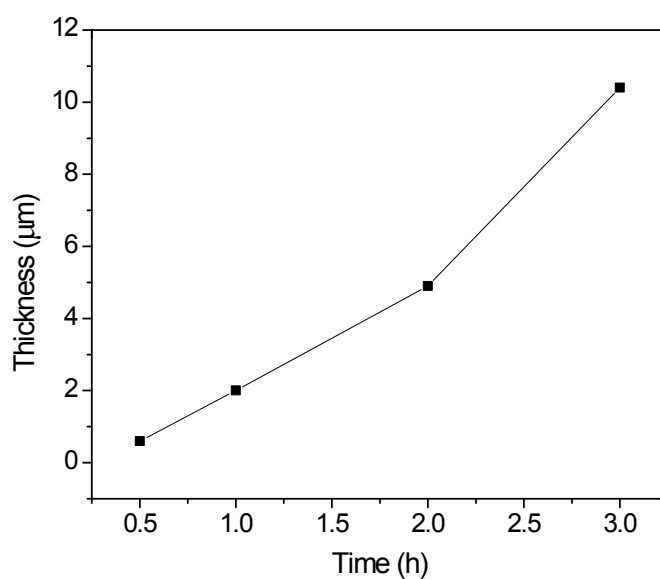
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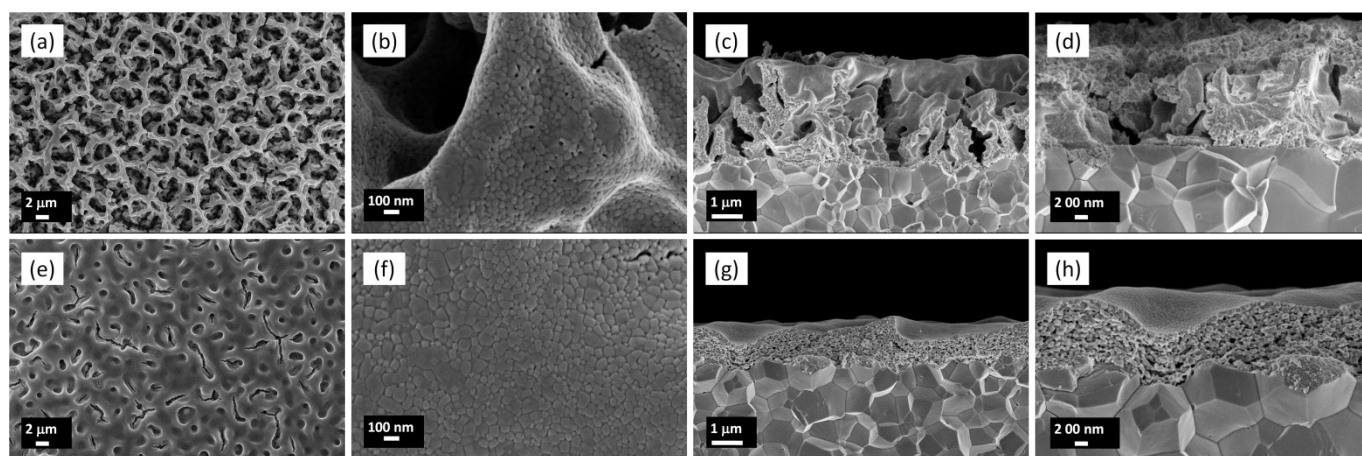
**Fig. S1** TGA analysis of 0.02M precursor solution prepared in different solvents.



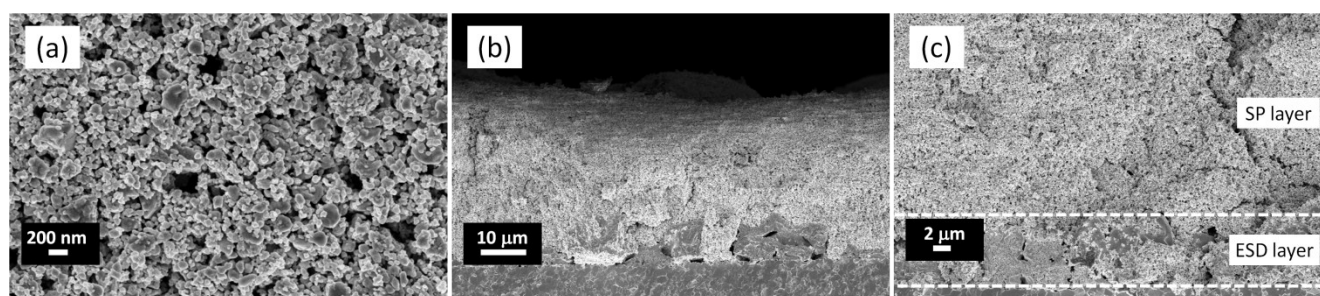
**Fig. S2** SEM micrographs of calcined  $\text{Pr}_6\text{O}_{11}$  ESD films (700 °C for 2 h in air) obtained with different solutions such as EtOH: (a, b) surface, (c) cross section, (d) interface; EtOH:H<sub>2</sub>O (1:2): (e, f) surface, (g) cross section, with a solution concentration of 0.02 M at 350 °C for a nozzle to substrate distance of 50 mm, a flow rate of 1.5 mL h<sup>-1</sup> and deposition time of 3 h.



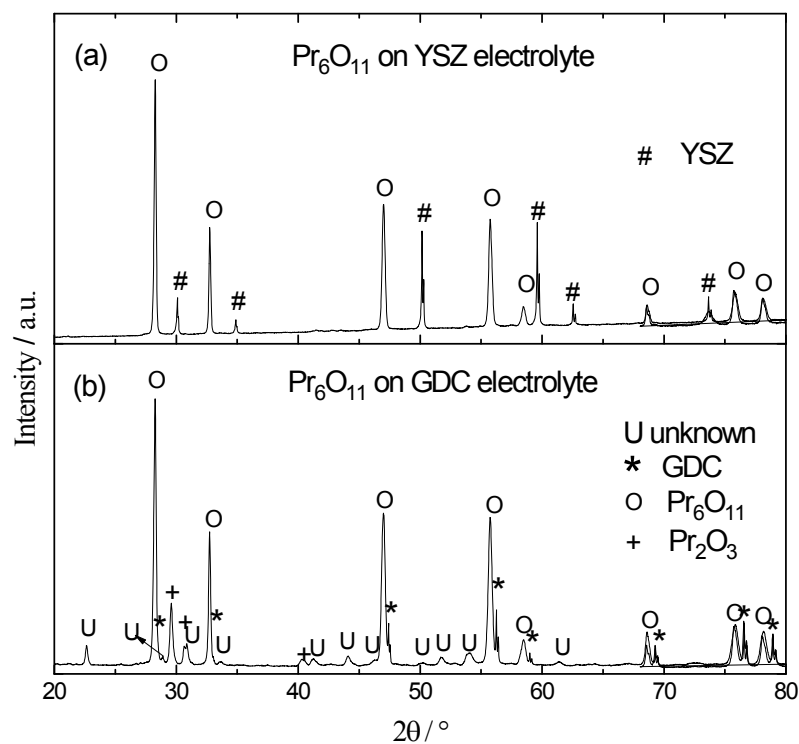
**Fig. S3**  $\text{Pr}_6\text{O}_{11}$  film growth rate



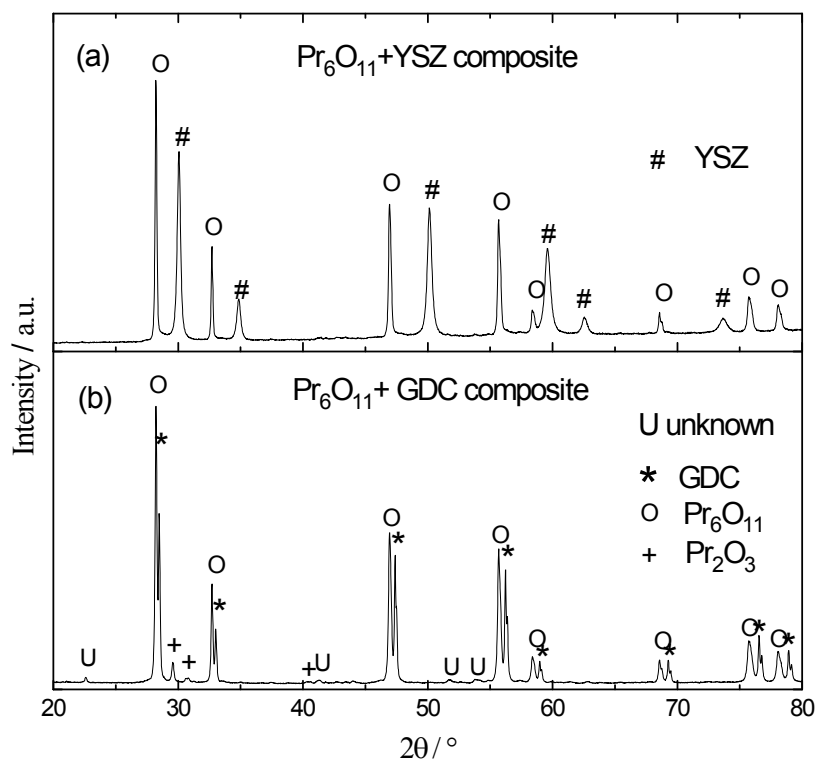
**Fig. S4** SEM micrographs of calcined  $\text{Pr}_6\text{O}_{11}$  ESD films ( $700\text{ }^\circ\text{C}$  for 2 h in air) obtained with a pure BC solution for  $D = 20\text{ mm}$ : (a, b) surface, (c) cross section, (d) interface;  $D = 30\text{ mm}$ : (e, f) surface, (g) cross section, (h) interface with a solution concentration of  $0.02\text{ M}$  at  $300\text{ }^\circ\text{C}$  for a deposition time and a flow rate of 3 h and  $0.5\text{ mL h}^{-1}$ , respectively.



**Fig S5** SEM micrographs of double layer (ESD+SP)  $\text{Pr}_6\text{O}_{11}$  films (sample 11) calcined at  $600\text{ }^\circ\text{C}$  for 2 h in the air after SP layer: (a) surface, (b, c) cross section. ESD films obtained with a solution:  $\text{H}_2\text{O}:\text{BC}$  (1:2) solution of  $0.02\text{ M}$  concentration at  $300\text{ }^\circ\text{C}$ ,  $D = 20\text{ mm}$  for a flow rate of  $1.5\text{ mL h}^{-1}$  and deposition time of 3 h and calcined ( $700\text{ }^\circ\text{C}$  for 2 h in air).



**Fig. S6** XRD patterns of the  $\text{Pr}_6\text{O}_{11}$  film prepared by ESD on (a) YSZ and (b) GDC after heat treatment for 10 days at  $900^\circ\text{C}$ .



**Fig. S7** XRD patterns of composite pellet: (a) ( $\text{Pr}_6\text{O}_{11}$ +YSZ) and (b) ( $\text{Pr}_6\text{O}_{11}$ +GDC) after heat treatment for 10 days at  $900^\circ\text{C}$ .