A Solid Oxide Cell Yielding High Power Density Below 600^{o}C

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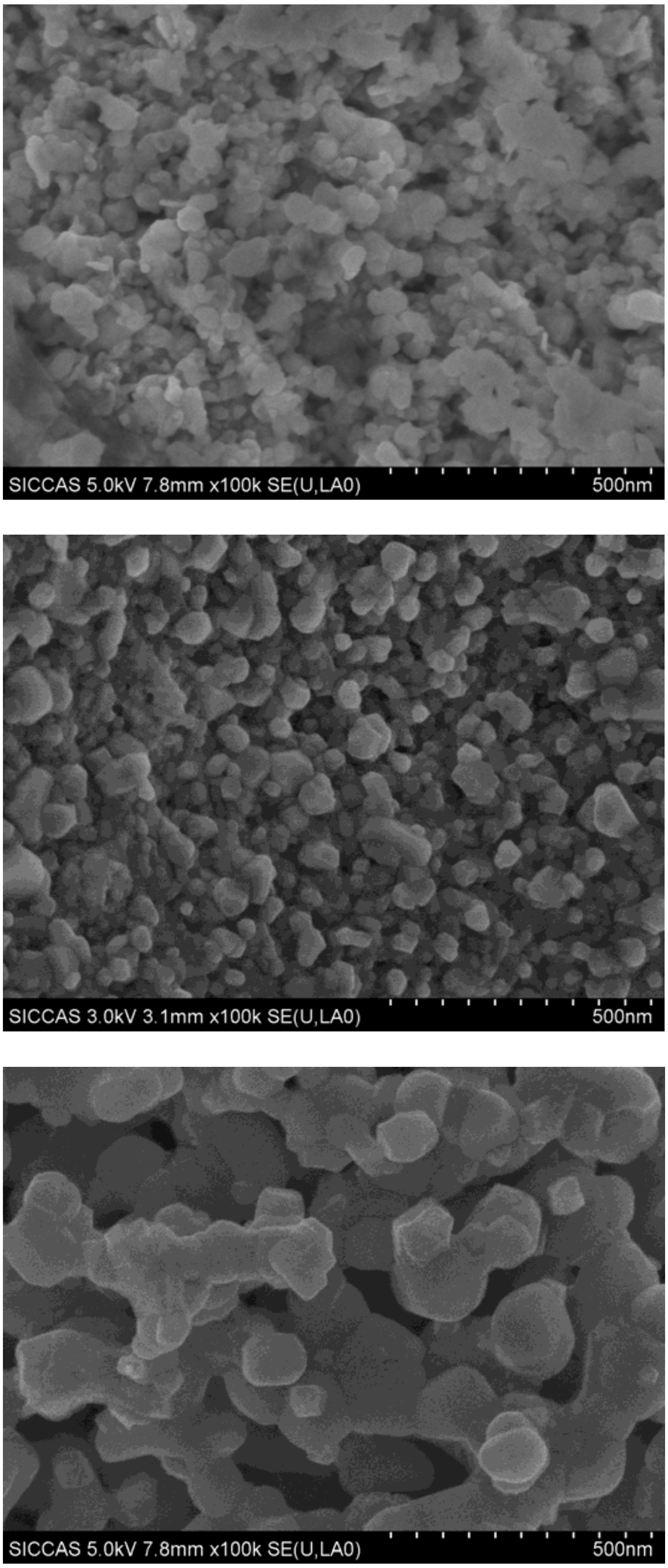

Fig. S1 SEM images showing the nanoporous electrode coatings: (a) Ni anodes at $V = 7.2\%$, (b) SSC-SDC cathodes at $V = 12.9\%$, and (c) SSC cathodes at $V = 12.9\%$.

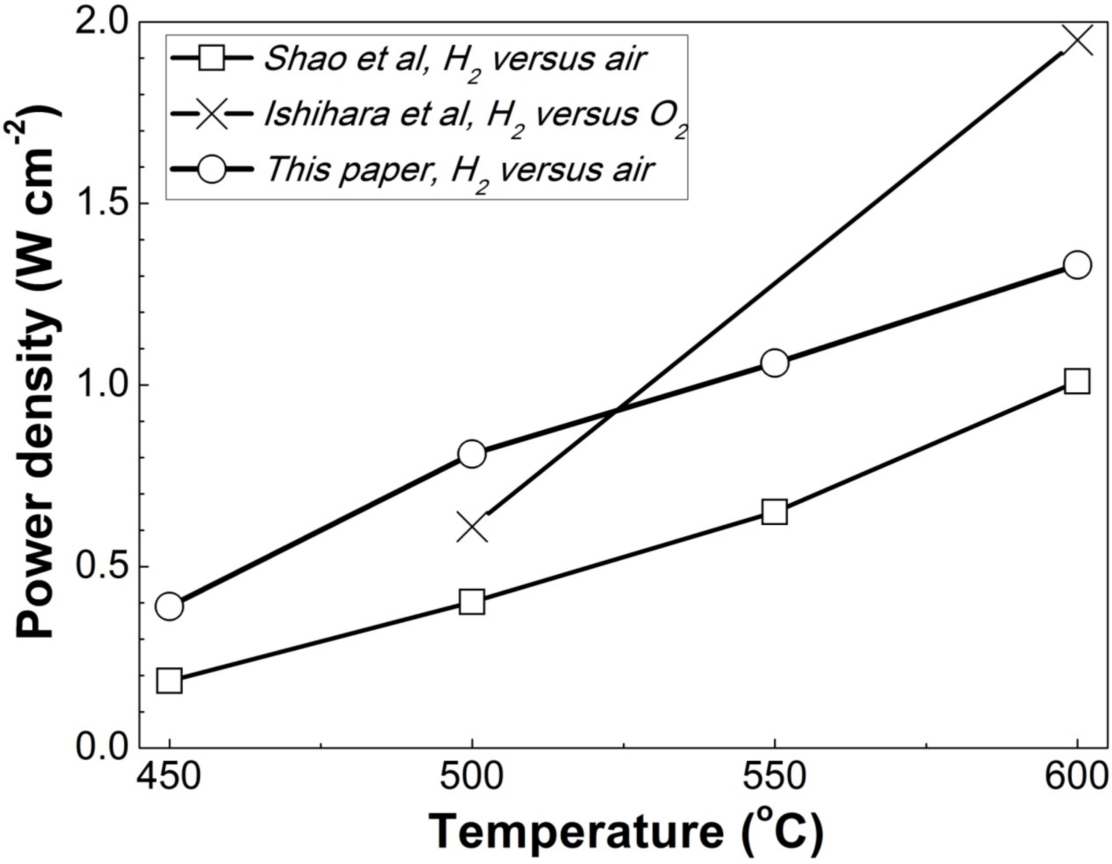

Fig. S2 Maximum power densities as a function of temperature for different low-temperature fuel cells. Under similar operating conditions, the present thin LSGM electrolyte fuel cells yielded much higher power densities than thin Sm-doped Ceria (SDC) electrolyte fuel cells reported by Shao *et al*[1], which can be ascribed to higher catalytic activities of the present dual-scale cathode structure that yields lower R_p, *e.g.*, 0.075 Ω cm^2 for the present SSC-SDC cathodes versus 0.2 Ω cm^2 for $(Ba,Sr)(Co,Fe)O_3$ cathodes at 550°C[1]. Note that these SDC electrolyte cells also yielded relatively low open-circuit potentials. The present cells yielded higher power density than the pulsed laser deposited LSGM/SDC bi-layer electrolyte cells reported by Yan *et al*, except at 600°C[2,3]. However, their high power density resulted from the use of oxygen as the oxidant, which invariably enhances cathode performance, compared to air; when the present cells were tested with oxygen, a comparable maximum power density of 1.85 W cm^{-2} at 600°C was achieved.

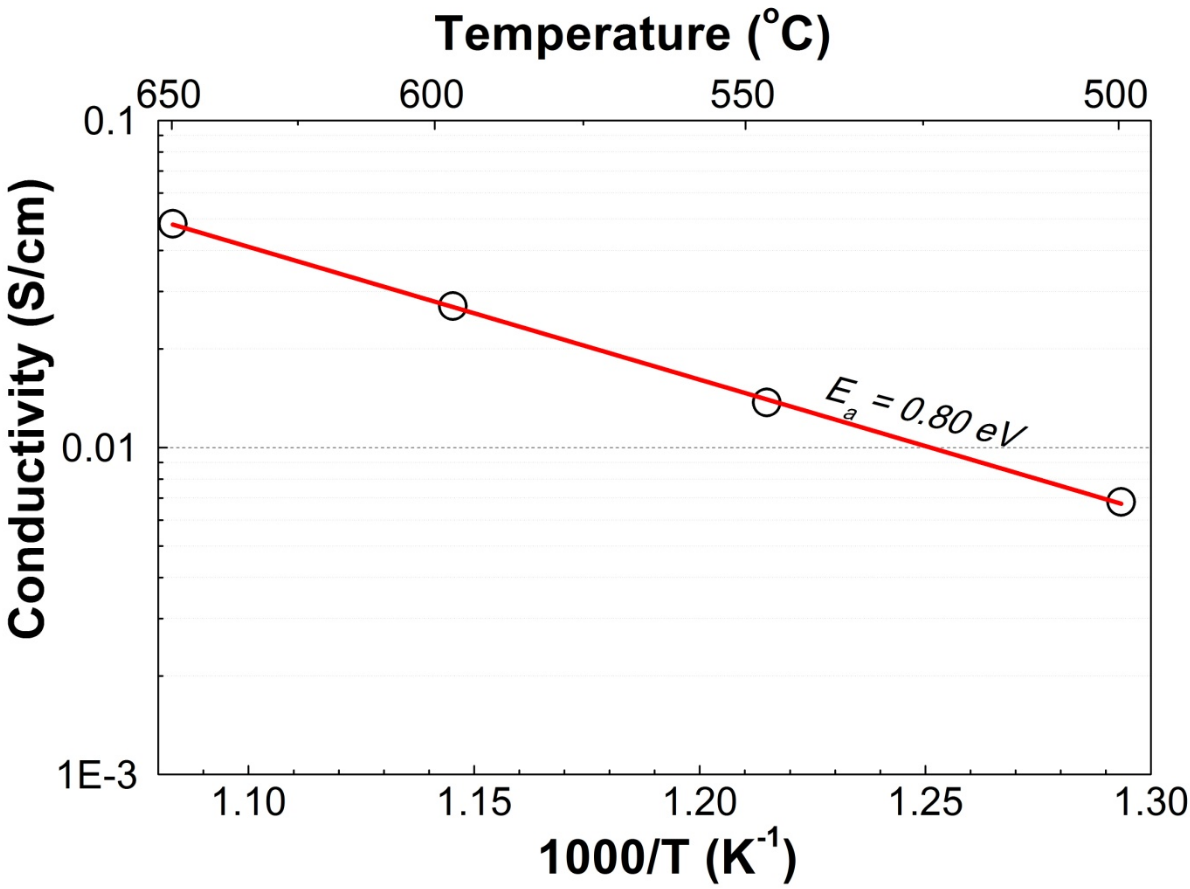

Fig. S3 Conductivity of a bulk LSGM electrolyte versus inverse temperature. The activation energy for the oxide ion conduction was estimated to be 0.80 eV.

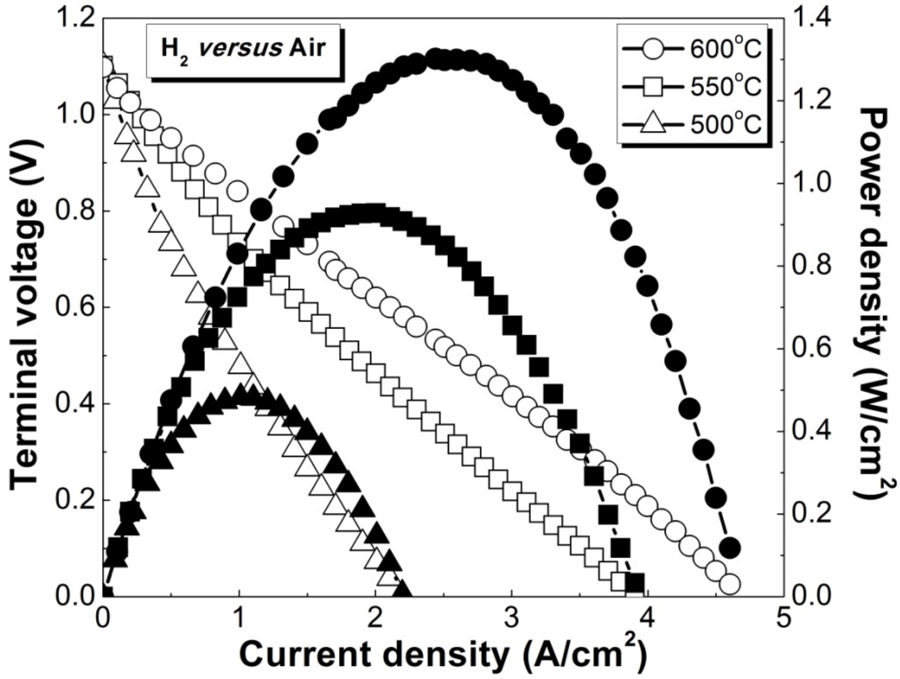

Fig. S4 Current-voltage characteristics of a thin LSGM electrolyte fuel cell with V_{Ni} = 7.2% and V_{SSC} = 12.9%, operated on humidifed hydrogen and ambient air at 500-600°C.

References

1 Shao, Z. P. & Haile, S. M. A high-performance cathode for the next generation of solid-oxide fuel cells. *Nature* **431**, 170-173 (2004).

2 Yan, J., Matsumoto, H., Akbay, T., Yamada, T. & Ishihara, T. Preparation of $LaGaO_3$-based perovskite oxide film by a pulsed-laser ablation method and application as a solid oxide fuel cell electrolyte. *Journal of Power Sources* **157**, 714-719 (2006).

3 Yan, J. W., Matsumoto, H., Enoki, M. & Ishihara, T. High-power SOFC using $La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O_{3-\delta}/Ce_{0.8}Sm_{0.2}O_{2-\delta}$ composite film. *Electrochem Solid St* **8**, A389-A391 (2005).