Characterization of novel LSM/GDC composite and electrochemical characterization of LSM/GDC based cathode-supported direct carbon fuel cells

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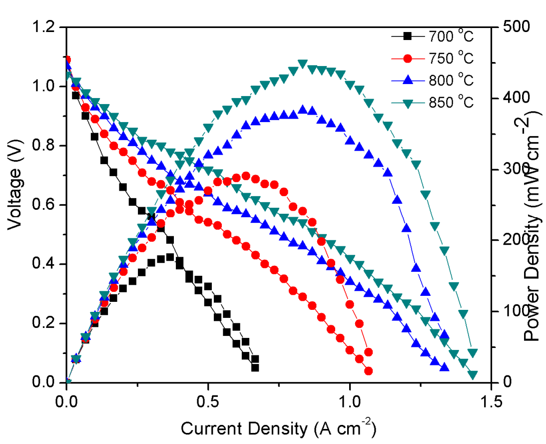
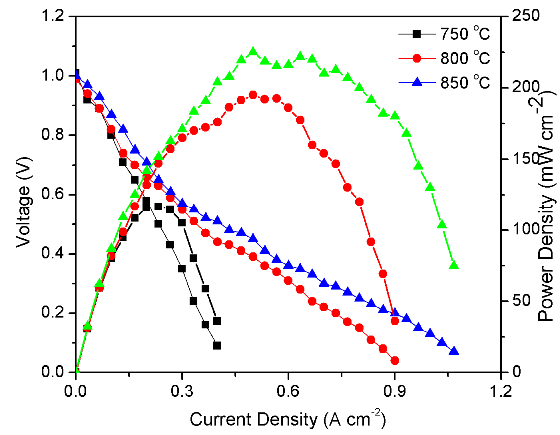
$(La0_{.8}\ Sr_{0.2})_{0.95}\ MnO_3$ (LSM)/ $Gd_{0.1}\ Ce_{0.9}\ O_2$ (Gadolinia doped Ceria, GDC) composite material was developed and characterized in terms of chemical stability, sintering behavior, electrical conductivity, mechanical strengths, and microstructure to assess its feasibility as cathode support applications in cathode-supported fuel cells. A cathode-supported direct carbon fuel cell, comprising of porous LSM/GDC cathode support, GDC and ScSZ bi-layer electrolyte and Ni/ScSZ anode layer, was successfully fabricated via slurry coating and co-firing method. The microstructures of electrodes and electrolyte layers were observed to confirm the desired morphology after co-sintering at 1400 °C. The assembled single cell was electrochemically characterized in SOFC and DCFC mode with ambient air as oxidant. The open circuit voltage (OCV) of the cathode-supported cell was 1.09 V and 1.01 V with hydrogen and molten carbonate fuel, respectively, at 750 °C. In SOFC mode, the peak power densities were 176, 291, 383 and 450 mW cm^{-2} at 700, 750, 800 and 850 °C, respectively. In DCFC mode, the peak power densities were 117, 195 and 225 mW cm^{-2} at 750, 800 and 850 °C, respectively. Electrical impedance spectroscopy implies that electrode polarization resistance is the major limiting factor for the cell performance.



(a)



(b)

Fig. I-V curves of developed fuel cells operated under (a) SOFC mode with hydrogen fuel, and (b) DCFC mode with carbon fuel.

References

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