

# La<sub>1-x</sub>Sr<sub>x</sub>CoO<sub>3-δ</sub> (LSC)-Ce<sub>0.8</sub>Sm<sub>0.2</sub>O<sub>2-λ</sub> (SDC) composite cathodes for anode supported, YSZ-SDC bi-electrolyte, thin film, solid oxide fuel cells

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## INTRODUCTION

La(Sr)CoO<sub>3-δ</sub> (LSC) has been reported as a potential cathode for Solid Oxide Fuel Cells (SOFC) (1-4). However, because of its high reactivity with the YSZ electrolyte, and its much higher thermal expansion coefficient than YSZ, LSC has not been sufficiently studied and explored. In the present communication, LSC + SDC (Ce<sub>0.8</sub>Sm<sub>0.2</sub>O<sub>2</sub>) composite cathodes were deposited on Ni + YSZ anode supported YSZ-SDC bi-electrolyte thin films. Composition, the distribution of the two phases and microstructure of the composite electrodes were varied by varying processing conditions in an attempt to minimize the activation overpotential and mass transport resistance of gases through the porous electrodes.

## EXPERIMENTAL

A circular anode substrate was die-pressed using a NiO + YSZ powder mixture, coated with a slurry of anode interlayer of NiO + YSZ of a smaller particle size and then fired at 1000°C for 1 h (5). The YSZ and SDC layers were applied upon the anode interlayer consecutively using respective YSZ and SDC suspensions in liquids and co-fired in air at a temperature between 1400 and 1500°C for several hours to form a dense YSZ-SDC bi-electrolyte layer. To prepare LSC-SDC composite cathode, LSC (La<sub>1-x</sub>Sr<sub>x</sub>CoO<sub>3-δ</sub>, x = 0.3-0.7) and SDC powders in an equi-weight ratio were mixed in water and suspended by ultrasonic vibration. The pH of the suspension solution was adjusted at different value by adding HNO<sub>3</sub> or NH<sub>4</sub>OH. After drying, the powder was mixed with a binder, applied onto the electrolyte surface and fired at 1050-1300°C for a few hours to form an interlayer. Upon the interlayer a layer of LSC was applied in a similar manner.

## RESULTS AND DISCUSSION

Fig. 1 shows the effect of pH of the suspension of LSC and SDC during mixing on the final cell performance. The best cell performance was obtained at a pH value of 4, at which both LSC and SDC were well-dispersed as evidenced very slow settling. Thus, it is anticipated that LSC and SDC were well mixed. Fig. 2 shows the effect of LSC to SDC ratio in the cathode interlayer on cell performance. In this set of experiments, the powders were mixed directly with a binder. The optimal ratio was 40 wt.% LSC + 60 wt.% SDC, which gave a power density of 1.8 W/cm<sup>2</sup>. Increasing or decreasing the LSC/SDC ratio led to a pronounced decrease in power density or cell performance. Such differences in performance characteristics are expected on the basis of a theoretical model, which relates the effective charge transfer resistance, a measure of activation polarization, to microstructural parameters (6). Stereological study on

the interlayer microstructure is underway on the LSC-SDC composites cathodes, similar to our recent work on LSM + YSZ composite cathodes (7), which facilitated the determination of the intrinsic charge transfer resistivity, a fundamental parameter, exclusive of any structure effect.

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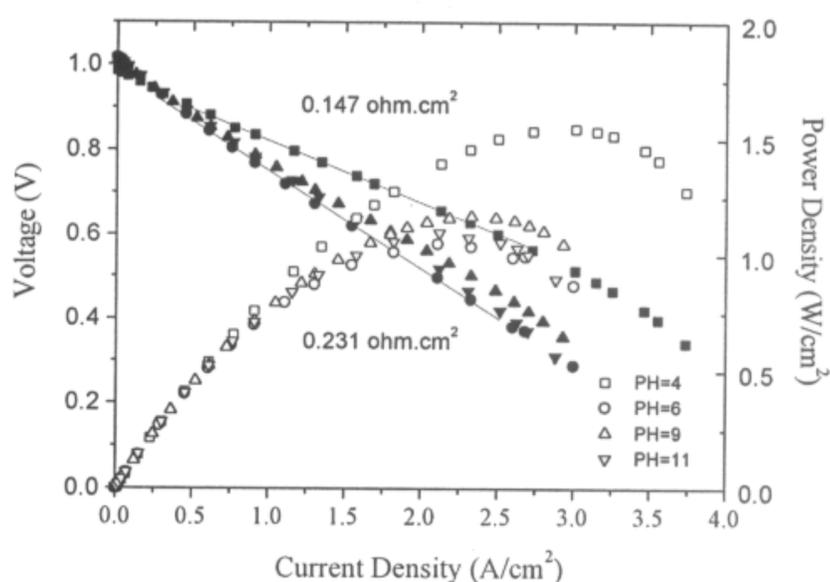


Fig. 1 Effect of pH of 50 wt.% LSC + 50 wt.% SDC suspension solution on cell performance at 800°C, H<sub>2</sub> = 100 ml/min, Air = 600ml/min.

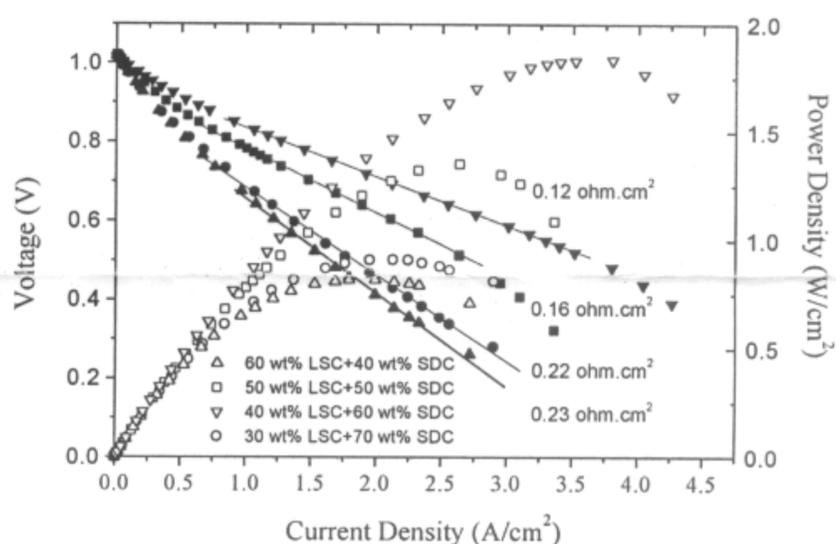


Fig. 2 Effect of the cathode interlayer composition on cell performance, same testing conditions as in Fig. 1.

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