

## La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> Coated Nickel Cathodes for Molten Carbonate Fuel Cells

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### Introduction

System efficiency and cost of the MCFC is advantageous when compared to other low temperature operating fuel cells. However, solubility of nickel oxide cathode in the electrolyte is one of the important problems facing the commercialization of MCFC technology. Nickel oxide reacts with the dissolved CO<sub>2</sub> in the electrolyte according to an acidic dissolution mechanism and dissolves in the molten carbonate during operation. The cation diffuses to the anode side of the electrolyte and is then reduced in the hydrogen atmosphere to metallic nickel. Precipitates of metallic nickel have been found in the electrolyte tile much closer to the anode and this precipitate acts as a sink for further deposition of nickel particles. This growth of the nickel layer eventually leads to a short circuit between the anode and cathode. The dissolution is accelerated under higher CO<sub>2</sub> partial pressure resulting in a decrease of the operating life of the cell. The dissolution of NiO also results in a decrease of the active surface area available for the oxygen reduction reaction resulting in degradation in the cell performance.

More basic molten carbonate melts such as Li/Na carbonate eutectic does not favor the NiO dissolution process and have been used to decrease the Ni dissolution rate in the melt<sup>1, 2</sup>. Also, alkaline earth metal salts based on Ba or Sr have been used as additives to increase the basicity of the melt. However, using more basic molten carbonate melts only partially solves the problem, since these melts only decrease the NiO dissolution rate by 10 to 15%.

The other approach to counter the nickel dissolution problem is to either modify NiO or to identify alternate cathode materials, which have longer life in the melt. Porous electrodes with good electronic conductivity, chemical stability and proper microstructure therefore offer the excellent choice for MCFC cathodes. Several ceramic materials with small solubility in the melt have been studied as alternatives to NiO. LiFeO<sub>2</sub>, LiCoO<sub>2</sub><sup>3</sup> and La<sub>0.2</sub>Sr<sub>0.8</sub>CoO<sub>3</sub><sup>4</sup> offered initial promise as replacement material for NiO cathodes. LiCoO<sub>2</sub> coated nickel cathodes are reported in literature<sup>5, 6</sup>. Cobalt was coated mechanically onto nickel powder and used as the cathode<sup>7</sup>. LiNiO<sub>2</sub> possess good conductivity and has been studied for high temperature applications. However, lithium loss occurs during heat treatment and the associated stoichiometry changes are undesirable. In this study, we have adopted the coating of La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> perovskite material by a conventional sol-gel method onto the porous nickel electrodes.

### Experimental

La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> precursor gel was prepared by dissolving appropriate amounts of lanthanum acetate, strontium acetate, cobalt acetate, citric acid and ethylene glycol in DI water with constant stirring. The pH of the solution was maintained between 8 and 9. The solution was heated for 10 h at 80° C using a hot plate with constant stirring until it turned into a viscous gel. Nickel electrodes of desired size were dipped in the gel and dried in air for 1 h.

The dipping was repeated several times to have a uniform coating. After drying the electrodes were heat treated at different temperatures varying from 300 to 900° C. La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> formation was confirmed by XRD and the surface morphology was examined using SEM. EDAX analysis showed the percentage of each element present on the surface.

### Results and Discussion

Sintered La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> coated nickel electrode exhibits good pore structure indicating that the material to be a promising cathode material. Figure 1 shows the XRD of La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> on the nickel surface. Detailed characterization and performance evaluation studies will be presented during the conference.

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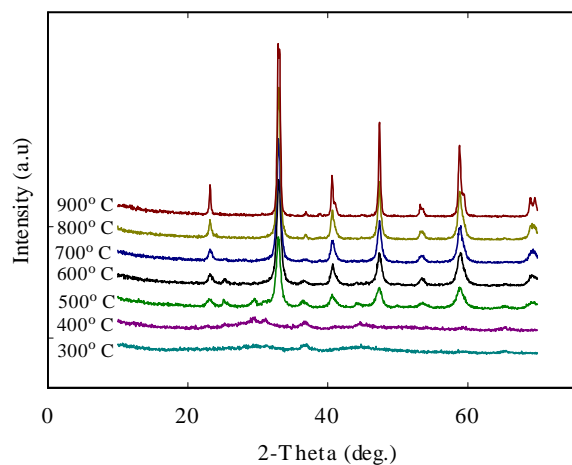


Fig. 1 XRD of La<sub>0.8</sub>Sr<sub>0.2</sub>CoO<sub>3</sub> after heat treatment at different temperature.