

## Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>/SDCNL Anode for Reduced Temperature Solid Oxide Fuel cell

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In recent years, considerable efforts have been devoted to develop reduced temperature SOFCs [1,2]. Doped Ceria-based electrolytes such as Sm<sub>0.2</sub>Ce<sub>0.8</sub>O<sub>1.9</sub>, Gd<sub>0.2</sub>Ce<sub>0.8</sub>O<sub>1.9</sub> and their composites had been used as electrolytes in place of conventional yttria-stabilized zirconia (YSZ) [3]. To develop cost efficiency and high performance electrode materials is the key task for the development of reduced temperature SOFC. In this study, based on a composite electrolyte Sm<sub>0.2</sub>Ce<sub>0.8</sub>O<sub>1.9</sub>-Na<sub>2</sub>CO<sub>3</sub>-Li<sub>2</sub>CO<sub>3</sub> (SDCNL), Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>-SDCNL was investigated as anode for reduced temperature SOFC.

### Experimental

Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> powder was prepared by oxalate-nitrate method. Stoichiometrical amount of Cu(NO<sub>3</sub>)<sub>2</sub>·2H<sub>2</sub>O (98%) and Fe(NO<sub>3</sub>)<sub>3</sub>·9H<sub>2</sub>O were dissolved in deionized water. Saturated oxalic acid solution was added to form oxalate/nitrate precursor. The precursor solution was heated to evaporate water. The dried precursor was then calcinated in air at 750°C for 2 hours. The product of Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> was grounded in a mortar. The structure of Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> powder was observed with SEM and XRD.

A bilayer pellet of Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>-SDCNL/SDCNL with diameter of 13mm was fabricated by uniformly pressed in a cylindrical die at a load of 3 tons for the measurement of its electrochemical performance. The pellet was sintered at 600°C for 0.5h. Silver paste was painted on the SDCNL surface as cathode. The trial SOFC system was operated at temperature from 500 to 650°C. CuO<sub>x</sub>/SDCNL/Ag cell performance was also measured for comparison.

### Results and discussion

Fig.1 shows the cell performance of Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>-SDCNL/SDCNL/Ag and CuO<sub>x</sub>-SDCNL/SDCNL/Ag using H<sub>2</sub> as fuel and air as the oxidant gas. It can be seen that Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>-SDCNL/SDCNL/Ag shows lower cell OCV with 0.72-0.84V at temperature range from 500 to 650°C, while the cell with CuO<sub>x</sub> anode showed 1.0V at 600°C. However, the electrochemical performance of the Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>-SDCNL/SDCNL/Ag cell was much better, and its polarization was obviously lower than CuO<sub>x</sub>-SDCNL/SDCNL/Ag. As current density increasing, Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> showed much better cell performance than CuO<sub>x</sub> with a maximum power density of 160mW/cm<sup>2</sup> at 650°C. It is also demonstrated that the cell performance of Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub>/SDCNL/Ag was not very sensible to the operating temperature.

The result of XRD analysis indicated that the prepared Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> powder was a mixture of monoclinic CuO and Rhombohedral Fe<sub>2</sub>O<sub>3</sub>. Fig.2 shows the morphology of CuFeO<sub>x</sub> and CuO<sub>x</sub> anode after measurement at 600 °C. In the mixture CuFeO<sub>x</sub> powder, CuO uniformly distributes among Fe<sub>2</sub>O<sub>3</sub> particles. The difference of cell performance between CuFeO<sub>x</sub> and CuO<sub>x</sub> was partly due to the microstructure difference. Fig2 shows the micrograph of anode after cell measurement. The CuFeO<sub>x</sub>-SDCNL anode appeared a high surface area with some small dendriform structure, while CuO<sub>x</sub>-SDCNL anode showed a quite different micrograph with agglomerating characteristic.

According to the result observed before, it can be concluded that doping with Fe can improve the microstructure of copper oxide anode and lead to a higher cell performance with a maximum power density of 160mW/cm<sup>2</sup> at 650°C. Cu<sub>0.7</sub>Fe<sub>0.3</sub>O<sub>x</sub> is a potential anode catalyst for reduced temperature SOFC.

### Acknowledgements

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### Reference

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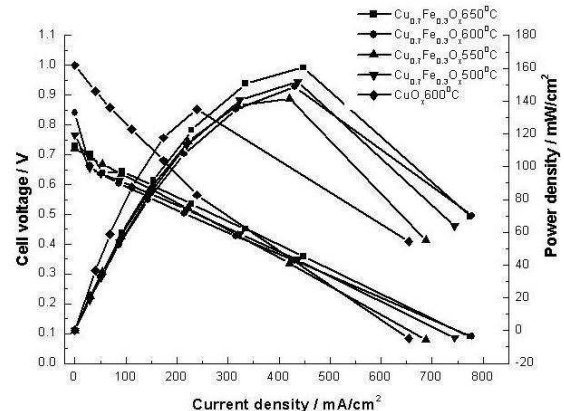


Fig.1 Performance of CuFeO<sub>x</sub>-SDCNL and CuO<sub>x</sub>-SDCNL anode for reduced temperature SOFC system

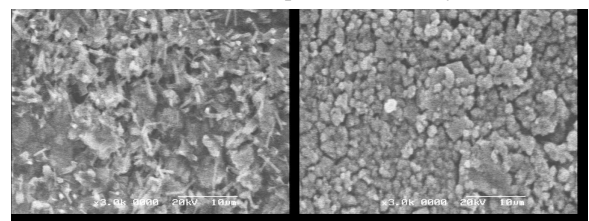


Fig.2 Morphology of CuFeO<sub>x</sub>-SDCNL anode and CuO<sub>x</sub>-SDCNL anode after cell measurement at 600 °C