

## **Electrode Development For Reversible Solid Oxide Fuel Cells**

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A reversible solid oxide fuel cell is capable of generating electricity from hydrogen and hydrocarbon fuels when operating in the normal fuel cell mode (SOFC), and of generating hydrogen from electricity and heat when operated in the reverse electrolyzer mode (SOEC). A reversible fuel cell can take advantage of excess electrical grid capacity during off-peak hours to produce hydrogen fuel, to be utilized later during periods of high electrical demand. High temperatures required for SOFC/SOEC operation lead to a lower theoretical decomposition temperature for steam and lower electrode polarization losses compared to those associated with liquid water. Steam electrolysis is an endothermic process and thus can take advantage of waste heat that may be available.

This paper discusses the development of anodes and cathodes for the reversible SOFC. The anode comprises of lanthanum-doped strontium titanate/donor-doped ceria ceramic composites. The cathode is strontium-doped lanthanum ferrite (LSF) and copper-substituted LSF. Electrical, electrocatalytic and thermal properties of both electrodes are studied and presented.

In particular, an electrocatalytic activity of electrodes is analyzed using a DC current interrupt technique. It is found that titanate/ceria composite fuel electrodes perform substantially better than Ni/YSZ in the electrolysis mode, and the two electrodes perform similarly in the fuel cell mode. Higher operating temperatures result in lower polarization losses for titanate/ceria composite electrodes in both electrolyzer and fuel cell modes. Air electrodes are turned out to be less active in the electrolysis than fuel cell modes. LSF air electrodes typically provide lower overpotential losses in SOFC and SOEC modes than copper-substituted LSF. Changes in the defect chemistry of electrode materials under cathodic and anodic polarization are discussed.