Effect of Samaria-Doped Ceria Cathodic Interlayer on LT-SOFC Kinetics

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Solid oxide fuel cell (SOFC) is an efficient energy conversion device that has been under intense investigation. For the ceramic electrolyte material for SOFC, yttria-stabilized zirconia (YSZ) has been most commonly utilized for its chemical and mechanical stability as well as relatively high oxide ion conductivity. However, its high activation energy (~1eV) for oxide ion transport through the ceramic electrolyte necessitates operation at elevated temperatures (800~1000^{o}C), which poses severe limitations for practical applications in terms of chemical and thermal stability, materials compatibility, and high fabrication and material costs [1-3].

There have been efforts to reduce the operating temperature of SOFCs to below 500^{o}C [4-6]. By developing various thin film deposition techniques, the thickness of the solid electrolyte membrane has been reduced down to sub-micrometer range. This enabled recent achievements of ultra-thin film micro-SOFCs with satisfactory performance. However, in this low temperature regime, large activation loss from slow surface kinetics of mixed ionic electronic conducting oxide cathode materials is a major limitation [2]. For this reason, platinum (Pt) is still the best catalytic cathode material to reduce the activation loss due oxygen reduction reaction. Previously in our laboratory, we have put efforts to improve fuel cell performance by enhancing the cathode kinetics by using doped-ceria interlayers such as gadolinia-doped ceria and yttria-doped ceria.

In this work, we present enhanced fuel cell performance by adopting an ultra-thin interlayer of samaria-dope ceria (SDC) deposited in between the YSZ electrolyte and the Pt cathode. Similar to other doped-ceria materials, SDC exhibits fast cathode kinetics for oxygen reduction and higher oxide ion conductivity than YSZ below 700^{o}C. To confirm this, we deposited SDC thin layers between the YSZ and cathode. By demonstrating the improved fuel cell performance with the interlayer in terms of superior current-voltage (I-V) behavior and lower cathode interfacial resistance extracted from electrochemical impedance spectroscopy data, we confirmed the superior oxygen kinetics of SDC than YSZ in the temperature range of 400~450^{o}C.

References

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