PROCESSING AND PROPERTIES OF THIN-FILM CERIA BASED SOFC

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Introduction

Ceria-based electrolytes have gained attention as an interesting alternative for yttria-stabilized zirconia electrolytes for solid oxide fuel cells [1]. Previous studies on cerium oxide have shown that rare earth oxide doped ceria exhibits higher ionic conductivity than undoped ceria and doped zirconia [2,3] making them suitable for low and intermediate temperature SOFC applications. The aim of this work is to study a variety of doped ceria as thin-film electrolytes for solid oxide fuel cell applications with emphasis on reducing the sintering temperature of the doped ceria as well as minimizing the electronic conductivity of the electrolyte.

Experimental

A series of doped ceria-based electrolyte powders were prepared by the glycine-nitrate process producing agglomerates of 2-3 μm particle size, followed by calcination in which the particle was further reduce to ~ 0.5μm. The powder was characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), and Beckman Coulter LS Particle Size Analyzer. The calcined powder was attritor milled with 2% fish oil in isopropal alcohol solvent. The attritor milled powder was ground and sieved (#100 sieve) and one half gram of the sieved powder was pressed at 1800 lbs used for the shrinkage studies. Three grams of each composition powder was pressed into a disk or pellet, and then sintered for the open circuit potential (OCP) and conductivity measurements. The OCP measurements were done on 1 inch diameter disks in H_2/3 vol% H_2O vs. air, and conductivity tests were done on ½ inch diameter thick pellets using AC impedance in air from 400 to 800^oC.

Results

Figure 1 shows the XRD spectra for four different compositions of doped ceria powders after combustion, which exhibited a cubic fluorite structure. Sintering studies shows that calcium, bismuth and lithium doping lowers the sintering temperature of ceria. Figure 2 shows the OCP preliminary results and it is observed that the maximum open circuit potential at 700^oC was 0.84 V for the composition $Ce_{0.8}Y_{0.18}Ca_{0.02}O_{1.9}$ and figure 3 shows that the maximum conductivity was 1.65 x10^{-2} $\Omega^{-1}cm^{-1}$ for $Ce_{0.8}Y_{0.2}O_{1.95}$. The complete obtained results with additional ceria composition, as well as their electrochemical performance as solid electrolyte for thin-film ceria-based solid oxide fuel cell will be presented.

References

[1] H. Inaba, H. Tagawa, *Solid State Ionics,* **83** (1996) 1.
[2] G. B. Balazs, R. S. Glass, *Solid State Ionics,* **76** (1995) 155.
[3] N. Kim, B.-H. Kim, and D. Lee, *J. Power Sources,* **90** (200) 139.

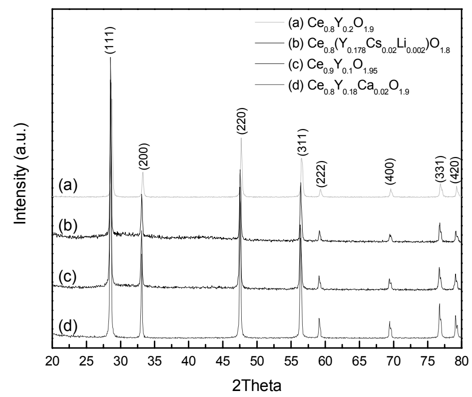

Figure 1. XRD patterns of the ceria powder prepared by glycine-nitrate, calcined and attritor milled.

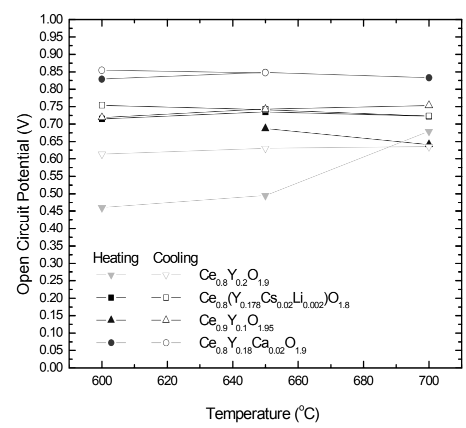

Figure 2. Open circuit potential of ceria-based cells as function of temperature and dopant.

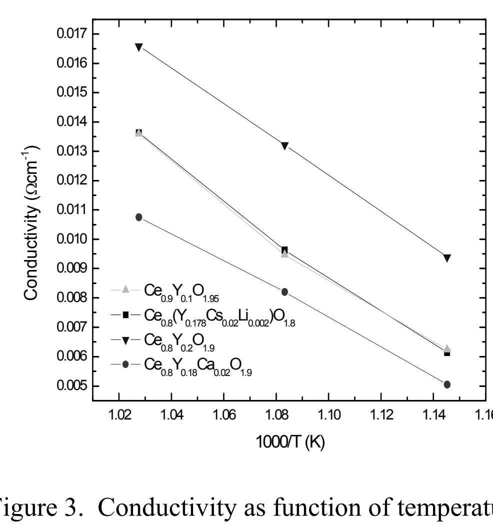

Figure 3. Conductivity as function of temperature.