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**High conductivity solid oxide electrolyte composite-laminates utilizing Scandia/Ceria co-doped Zirconia core with Yttria Stabilized Zirconia outer skins**

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Increasing the conductivity of electrolytes in lower temperature Solid Oxide Fuel Cells (SOFC) is of great importance. However, there are several challenges that are to be addressed, which include phase stability of electrolyte's crystal structure, chemical stability in both oxidizing and reducing environments, and maintaining mechanical integrity and high ionic conductivity over time.

Scandia-Ceria-Zirconia $(Sc_2O_3)_{0.10}(CeO_2)_{0.01}(ZrO_2)_{0.89}$– (10Sc1CeSZ) is an excellent lower temperature SOFC electrolyte. The phase stability of 10Sc1CeSZ was studied in [1,2] and it was found that the cubic phase is stable across room to operation temperatures when not dwelling at ~350-400°C for several hours, where the β rhombohedral phase of 10Sc1CeSZ becomes a stable structure. However, chemical stability with "aging" has been of concern and recent studies by S. Omar, et al. [3], exemplify the degradation. Yttria Stabilized Zirconia (YSZ) has lower conductivity than ScSZ, but is widely accepted as a more stable electrolyte material.

The authors have fabricated laminated composites of Scandia/Ceria co-doped Zirconium Oxide (ScCeSZ) and Yttria Stabilized Zirconia (YSZ) produced by tape casting techniques. Green tapes of individual 10Sc1CeSZ and 8 mol% (8YSZ) electrolytes were first produced. Laminates of 3, 4, and 6 layer electrolytes tapes were laminated and then fired. In the composite laminated electrolytes, the 8YSZ was used as the outer-layers and the 10Sc1CeSZ was used as core layers. The conductivity and aging behavior of the laminate electrolytes were studied.

Conductivity testing of the laminated electrolytes using Electrochemical Impedance Spectroscopy (EIS) was carried out in a temperature range of 500-800°C. Impedance results on electrolyte samples have clearly resolved the bulk resistance through Nyquist plots. Arrhenius plots of each design of the electrolyte were constructed from the temperature profiles. The data shows consistent conductivity performance groupings of the base materials (8YSZ and 10Sc1CeSZ) in 3, 4, and 6 layer configurations (Figure 1). When utilizing 3, 4, and 6 layer composite laminations (outer-core-outer layers of YSZ-ScCeSZ-YSZ, respectively), there appears to be good correlation of conductivity with laminate volumetric content (Figure 2).

Aging experiment of the composite electrolyte was also conducted in different gas environments. The results of conductivity and the "aging" studies and the degree that composite laminate lay-ups of YSZ-ScCeSZ-YSZ will mitigate degradation will be discussed.

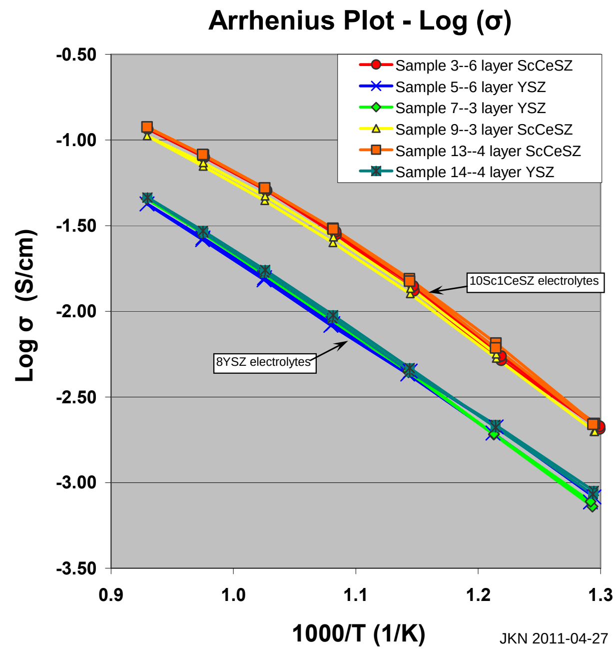


Figure 1: Laminate comparisons for 3, 4, & 6 layers of 8YSZ and 10Sc1CeSZ.

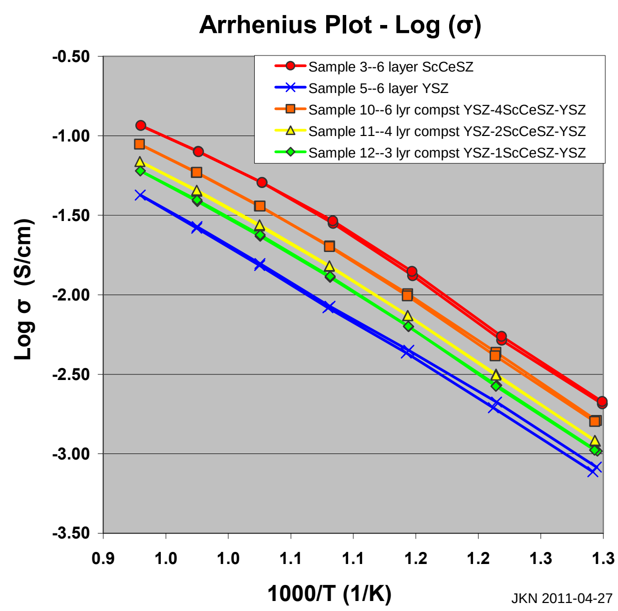


Figure 2: YSZ-ScCeSZ-YSZ Composite Laminate comparisons for 3, 4, & 6 layers with 6 layer 8YSZ and 10Sc1CeSZ.

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