Title: A Novel Integrated Stack Approach for Realizing Mechanically Robust Solid Oxide Fuel Cells

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Abstract

This talk will describe a solid oxide fuel cell (SOFC) configuration in which many small devices are interconnected in series on porous planar supports. We term this configuration the "integrated SOFC" based on the analogy with integrated circuits. Using a support that has no electrical function in the SOFC allows for a choice of material with good mechanical properties, e.g. high thermal shock resistance and strength. Predicted electrical losses in these cells will be discussed. For cells < 2 mm in width, the small electrode current paths yield very small ohmic losses even for relatively low thicknesses (20 μm). Compared with conventional planar stacks, resistances associated with pressure contacts between the SOFCs and interconnects are substantially reduced.

Statistically designed experiments were conducted to optimize the porosity and biaxial flexural strength of planar, uniaxially pressed partially stabilized zirconia (PSZ) substrates. The desired combination of approximately 30 vol% porosity (to allow fuel pathways to the anode) and mechanical strength were achieved in this preliminary study by calcining the PSZ powder for 2 hours at 1100°C and adding 15 wt% pore former prior to pressing. Fabrication of integrated SOFCs by screen printing of thin Ni-YSZ anodes, YSZ electrolytes, (La,Sr)MnO_3 or (La,Sr)(Co,Fe)O_3 cathodes, and various interconnects onto porous planar PSZ will be discussed. The support, anode and electrolyte are co-sintered at 1400°C, followed by interconnect and cathode deposition and a second sintering step. Dense YSZ layers were obtained with porous supports and electrodes. Patterned colloidal deposition of YSZ is being used as an alternate electrolyte deposition method. Cell test results will be described.