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NTN Composite Interconnect Testing

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The objective of the proposed project is to test a novel interconnect material under simulated operating conditions.

Solid Cell has developed an SOFC interconnect material called the NTN. It is a two phase composite (cermet) consisting of Ni as the metal phase and TiO_2-Nb_2O_5 solid solution as the oxide phase. Adjusting the relative mass percent of each phase enables precise control over the coefficient of thermal expansion of the NTN interconnect. Functionally, the oxide phase provides the NTN with mechanical strength and corrosion resistance, while the metal phase promotes electrical conductivity, thermal conductivity, and plasticity. The NTN does not contain any species of Cr, eliminating the need for a Cr barrier layer Ł?? a common problem with standard metallic interconnect materials. On a materials cost basis, it is also less expensive than the popular Plansee CFY interconnect.

To date, the NTN has been tested continuously at Solid Cell for over 1 calendar year (>9000 hours). The results have shown a stable area specific resistance (ASR), excluding a few yet unexplained resistivity spikes. The reported testing has been carried out in an isothermal environment with H_2/N_2 gas mix in the anode simulation chamber and ambient air in the cathode simulation chamber. Ni mesh has been used as the fuel side contact material; Pt mesh as the air side contact material. A similar experiment was conducted by a third party using Au contact material on the air side, but resulted in significant deformation of the interconnect, due to Au diffusion and alloying with the Ni component of the NTN.

The first part of the project is to study the NTN interconnect in contact with real SOFC cathode materials, for which Solid Cell will prepare 5 samples of each of the following:

- NTN + LSM Cathode
- NTN + LNF Cathode
- NTN + $Pr_{1.2}Sr_{0.2}NiO_4$ Cathode

The samples will be appropriately sized to work with the existing test apparatus that has a fuel-side aperture of 1.5 cm x 1.5 cm. On the air side, the samples will be in an all-air environment inside the furnace, sealed along the edge with ceramic paste.

The dual atmosphere furnace setup will use Ni- and Pt- mesh as current collectors on the fuel and air sides, respectively. An EIS will be taken approximately every 50 hours under operating conditions to monitor the ASR.

After benchmarking tests on the 3 types of samples (approximately 500 hours each), multiple thermal cycle and fuel shut-off tests will be carried out in order to assess resilience and robustness of the samples. Both pre- and post- testing SEM-Raman and XRD analysis will also be conducted.

For the second part of the test, the best candidate will be selected for long term testing (>2000 hours). After completion of the testing, postmortem analysis will be conducted using SEM-Raman and XRD.