

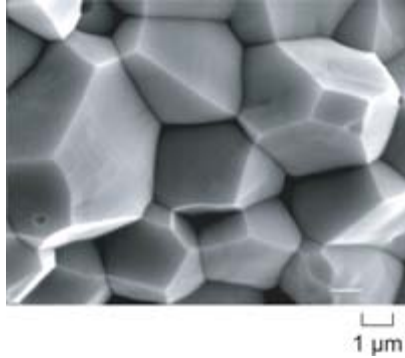
# Process Developed for Generating Ceramic Interconnects With Low Sintering Temperatures for Solid Oxide Fuel Cells

Solid oxide fuel cells (SOFCs) have been considered as premium future power-generation devices because they have demonstrated high energy-conversion efficiency, high power density, and extremely low pollution, and have the flexibility of using hydrocarbon fuel. The Solid-State Energy Conversion Alliance (SECA) initiative, supported by the U.S. Department of Energy and private industries, is leading the development and commercialization of SOFCs for low-cost stationary and automotive markets. The targeted power density for the initiative is rather low, so that the SECA SOFC can be operated at a relatively low temperature ( $\sim 700$  °C) and inexpensive metallic interconnects can be utilized in the SOFC stack.

As only NASA can, the agency is investigating SOFCs for aerospace applications. Considerable high power density is required for the applications. As a result, the NASA SOFC will be operated at a high temperature ( $\sim 900$  °C) and ceramic interconnects will be employed. Lanthanum chromite-based materials have emerged as a leading candidate for the ceramic interconnects. The interconnects are expected to co-sinter with zirconia electrolyte to mitigate the interface electric resistance and to simplify the processing procedure. Lanthanum chromites made by the traditional method are sintered at 1500 °C or above. They react with zirconia electrolytes (which typically sinter between 1300 and 1400 °C) at the sintering temperature of lanthanum chromites. It has been envisioned that lanthanum chromites with lower sintering temperatures can be co-fired with zirconia electrolyte. Nonstoichiometric lanthanum chromites can be sintered at lower temperatures, but they are unstable and react with zirconia electrolyte during co-sintering.

NASA Glenn Research Center's Ceramics Branch investigated a glycine nitrate process to generate fine powder of the lanthanum-chromite-based materials. By simultaneously doping calcium on the lanthanum site, and cobalt and aluminum on the chromium site, we could sinter the materials below 1400 °C. The doping concentrations were adjusted so that the thermal expansion coefficient matched that of the zirconia electrolyte. Also, the investigation was focused on stoichiometric compositions so that the materials would have better stability.

Co-sintering and chemical compatibility with zirconia electrolyte were examined by x-ray diffraction, scanning electron microscopy, and energy dispersive spectroscopy (line scanning and dot map). The results showed that the materials bond well, but do not react, with zirconia electrolyte. The electric conductivity of the materials measured at 900 °C in air was about 20 S/cm.



*Sintering results: fractured surface of the ceramic interconnect after sintering at 1400 °C for 2 hr.*

## **Bibliography**

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