TechBriefs

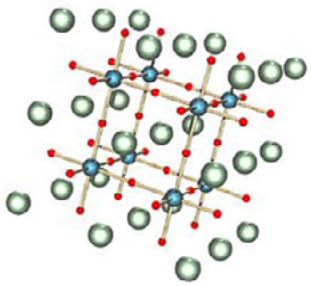
Savannah River National Laboratory

U.S. DEPARTMENT OF ENERGY • SAVANNAH RIVER SITE • AIKEN • SC srnl.doe.gov

At a glance

- Improved electronic conduction
- Suitable for hydrogen separation
- Separates contaminant gases
- Patent pending

New Nanocrystalline Separation Membrane for Improved Hydrogen Flux

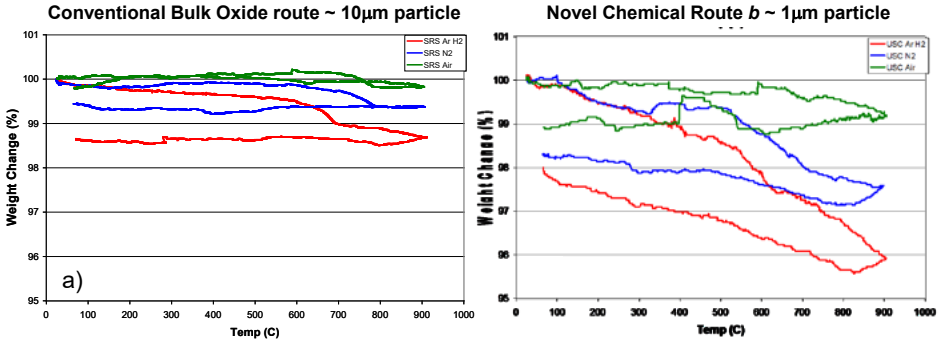


Scientists at the Savannah River National Laboratory have developed ionic transport membranes with improved ionic and electronic conductivity. Using a new processing technique, perovskite materials were modified to improve conductivity by altering the microstructure without changing the ratio of the chemical constituents. The result is a nanocrystalline material that exhibits an increase in weight loss over similar materials made under standard bulk oxide synthesis. The enhanced oxygen loss translates into an increase in the number of electron charge carriers and elevated electronic conducting which impacts applications in catalysis, sensors, separation, and energy conversion device operation.

Background

Membrane separations are a key enabling technology for energy conversion devices. Ionic transport membranes must have both proton and electronic conductivity to function as hydrogen separation membranes without an external power supply. In addition, membrane materials

Weight Loss of Particles at Elevated Temperature in Air, N_2 and Ar/H_2



1.4% weight loss in H_2 4% weight loss in H_2

Weight loss due to oxygen loss leading to oxygen non-stoichiometry: $SrCe_{0.95}Yb_{0.05}O_{3-d}$

$$O_o = 1/2O_2(g) + Vo^{\cdot\cdot} + 2e'$$

Contact Information

Partnering Opportunities

Savannah River National Laboratory
Bldg. 773-41A
Aiken, SC 29808

Phone: 803.725.8482
E-mail: partnerships@srnl.doe.gov

Technology transfer

The Savannah River National Laboratory (SRNL) is the U.S. Department of Energy's (DOE) applied research and development laboratory at the Savannah River Site (SRS).

With its wide spectrum and expertise in areas such as homeland security, hydrogen technology, materials, sensors, and environmental science, SRNL's cutting edge technology delivers high dividends to its customers.

The management and operating contractor for SRS and SRNL is Savannah River Nuclear Solutions, LLC. SRNS is responsible for transferring its technologies to the private sector so that these technologies may have the collateral benefit of enhancing U.S. economic competitiveness.

electronic conductivity or material crystal stability should not be greatly affected by the presence of contaminant gases such as CO_2, CO, CH_4, and H_2O that are associated with steam reforming/ water gas shift reactions.

Perovskite materials (ABO_3) of the general formula $SrCeO_3$ and $BaCeO_3$ form the basis of most ceramic compositions with proton conductivities in the range of 2×10^{-2} S/cm at 600°C, showing good stability under the extremely low oxygen partial pressure where many perovskites decompose to their primary oxides. However they suffer from low electronic conductivity which limits use as hydrogen separation membrane. Using a new perovskite processing technique consisting of novel chemical synthesis followed by a rapid sintering technique, SRNL scientists have been able to alter the microstructure resulting in an order of magnitude increase in electronic conductivity and enhanced separation membrane performance.

Partnering opportunities

SRNS invites interested companies with proven capabilities in this area of expertise to develop commercial applications for this process or product under a cooperative research and development agreement or licensing agreement. Interested companies will be requested to submit a business plan setting forth company qualifications, strategies, activities, and milestones for commercializing this invention. Qualifications should include past experience at bringing similar products to market, reasonable schedule for product launch, sufficient manufacturing capacity, established distribution networks, and evidence of sufficient financial resources for product development and launch.

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