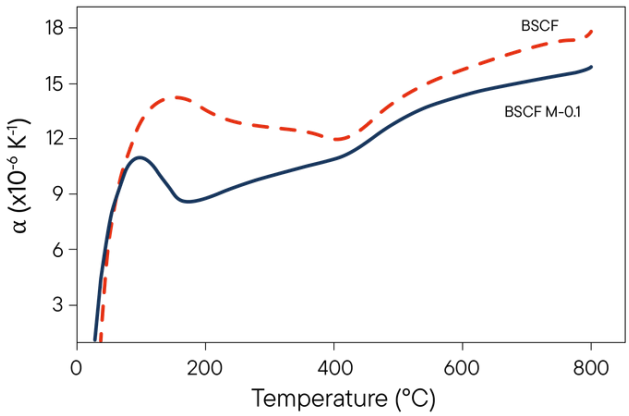
Low Thermal Expansion of BSCFM-0.1 Cathode Material for Solid Oxide Fuel Cells

Dilatometric Analysis of Thermal Expansion Behavior

Dilatometry enables the precise measurement of dimensional changes under controlled temperature conditions. In this application example, the thermal expansion behavior of Mn-doped $Ba_{0.5}Sr_{0.5}Co_{0.7}Fe_{0.2}Mn_{0.1}O_3$-δ (BSCFM-0.1) was investigated using the Linseis DIL L76.
The measurement provides valuable information about thermal compatibility between cathode and electrolyte materials used in intermediate-temperature solid oxide fuel cells (SOFCs).

Measurement Setup

- Instrument: Linseis DIL L76
- Sample: BSCFM-0.1 Cathode Material
- Reference Material: Quartz
- Heating Rate: 5 K/min
- Temperature Range: Ambient to 800 °C
- Measurement: Thermal Expansion Coefficient (TEC) determination



The dilatometric measurement reveals the thermal expansion coefficient behavior of the investigated cathode material.
Key observations include:

- Lower TEC values compared to conventional BSCF cathodes
- Gradual increase in thermal expansion with temperature
- Improved thermal compatibility with ceria-based electrolytes
- Stable expansion behavior up to 800 °C

The reduced thermal expansion supports improved compatibility between cathode and electrolyte materials.

Interpretation

The observed thermal expansion behavior can be attributed to:

- Partial substitution of Co by Mn
- Reduced lattice expansion during heating
- Controlled oxygen vacancy formation

This results in:

- Lower thermal stress during operation
- Improved material compatibility
- Enhanced cell durability

Industrial Relevance

Dilatometric measurements are widely used for:

- SOFC material development
- Cathode characterization
- Thermal compatibility studies
- High-temperature ceramic materials
- Fuel cell lifetime optimization

Conclusion

The measurement performed with the Linseis DIL L76 demonstrates the suitability of dilatometry for evaluating thermal expansion behavior in SOFC cathode materials.
The reduced thermal expansion coefficient of BSCFM-0.1 compared to conventional BSCF indicates improved thermal matching with ceria-based electrolytes, supporting enhanced durability and long-term performance of fuel cell systems.

Source:
Li, D., Zhang, Y., Zhu, G., Wang, X.
"Low Thermal Expansion of $Ba_{0.5}Sr_{0.5}Co_{0.7}Fe_{0.2}Mn_{0.1}O_3$-δ Cathode Material"
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Adapted and extended with measurements performed on a Linseis DIL L76.