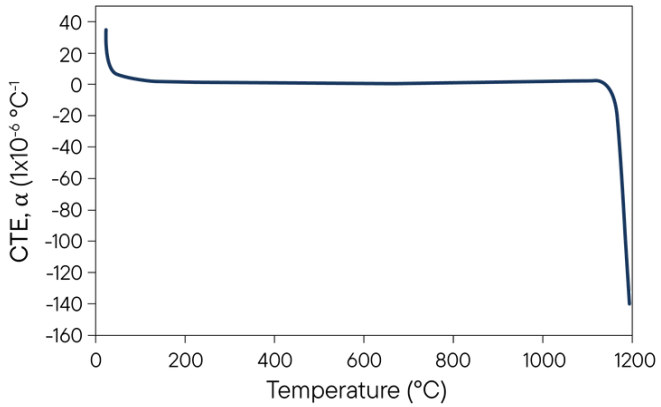
Thermal Characterization of Li_2O-Al_2O_3-SiO_2 Glass-Ceramics

DIL L75 Analysis of CTE for Thermal Shock Resistant Glass-Ceramics

The coefficient of thermal expansion (CTE) is a key parameter for evaluating the dimensional stability and thermal shock resistance of glass-ceramics. In this application example, lithium aluminosilicate (LAS) glass-ceramics were characterized using the LINSEIS DIL L75 Horizontal. The measurements demonstrate the exceptionally low thermal expansion behavior of β-spodumene glass-ceramics for demanding thermal applications.

Measurement Setup

- Instrument: LINSEIS DIL L75 Horizontal
- Material: Li_2O-Al_2O_3-SiO_2 (LAS) Glass-Ceramic
- Temperature Range: 30 °C to 1200 °C
- Measurement: Coefficient of Thermal Expansion (CTE)
- Application: Thermal shock resistant glass-ceramics and optical components



The dilatometric measurement reveals an exceptionally low coefficient of thermal expansion across a broad temperature range. Key observations include:

- CTE (30–500 °C): 1.13 × 10^{-6} K^{-1}
- Stable dimensional behavior up to approximately 1100 °C
- Extremely low thermal expansion compared to conventional glass materials
- High β-spodumene crystallinity contributes to reduced thermal strain
- Excellent suitability for thermal shock resistant applications

The results demonstrate the suitability of dilatometry for evaluating thermal expansion behavior and optimizing advanced glass-ceramic materials for high-temperature applications.

Interpretation

The observed behavior can be attributed to:

- Dominant β-spodumene crystal phase
- High crystallinity of the glass-ceramic
- Optimized sintering treatment

This results in:

- Reduced thermal stress
- Improved thermal shock resistance
- Excellent dimensional stability

Industrial Relevance

Dilatometry measurements support:

- Cooktop and cooking surface materials
- LTCC substrates and electronic packaging
- Optical and precision glass components
- Thermal shock resistant engineering materials

Conclusion

The measurements performed with the LINSEIS DIL L75 Horizontal demonstrate the outstanding low-expansion behavior of lithium aluminosilicate glass-ceramics. The extremely low CTE highlights the material's suitability for applications requiring high dimensional stability and resistance to rapid temperature changes. Dilatometric characterization provides valuable insight for optimizing glass-ceramic materials used in advanced thermal management and high-performance engineering applications.

Source:
Lutpi, H. A., Mohamad, H., Abdullah, T. K., Ismail, H.
Effect of Sintering Treatment Time on the Sintering Behaviour and Thermal Shock Resistance of Li_2O-Al_2O_3-SiO_2 Glass-Ceramics.
Adapted from dilatometric measurements performed using a LINSEIS DIL L75 Horizontal (formerly designated as DIL L75 PT Horizontal).