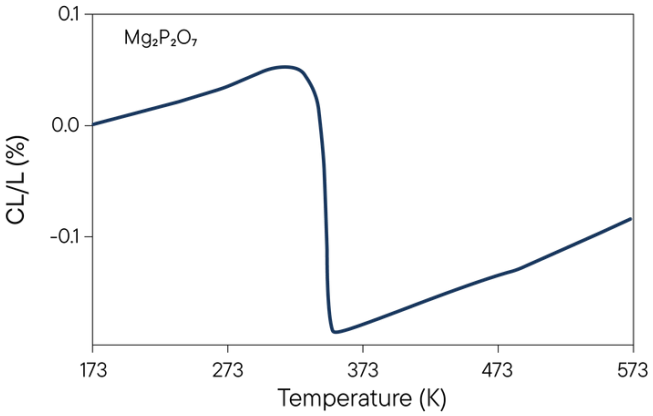
Giant Negative Thermal Expansion of $Mg_2P_2O_7$

DIL L76 Analysis of Phase-Transition-Induced Thermal Contraction

Negative thermal expansion is an important material property for applications requiring precise dimensional stability. In this study, the LINSEIS DIL L76 was used to investigate the thermal expansion behavior of $Mg_2P_2O_7$ and reveal the pronounced contraction associated with its structural phase transition.

Measurement Setup

- Instrument: LINSEIS DIL L76
- Material: $Mg_2P_2O_7$
- Temperature Range: 173–573 K
- Heating Rate: 5 K/min
- Measurement: Linear Thermal Expansion
- Application: Negative Thermal Expansion Materials



The dilatometric measurement reveals a pronounced change in the thermal expansion behavior of $Mg_2P_2O_7$.

Key observations include:

- Positive thermal expansion below 313 K
- Abrupt contraction between 337 and 351 K
- Linear CTE of -1.73×10^{-4} K^{-1} during the transition
- Return to positive thermal expansion above 351 K

The strong contraction corresponds to the first-order structural transition from α-$Mg_2P_2O_7$ to β-$Mg_2P_2O_7$.

Interpretation

The observed behavior can be attributed to:

- Temperature-induced α→β phase transition
- Structural rearrangement of the $Mg_2P_2O_7$ lattice
- Contraction of the crystallographic axes

This results in:

- Giant negative thermal expansion
- Distinct dimensional change
- Clear identification of the phase transition

Industrial Relevance

Dilatometric characterization supports:

- Dimensionally stable materials
- Thermal expansion compensation
- Precision components
- Functional ceramics
- Phase-transition materials
- Materials development

Conclusion

The LINSEIS DIL L76 enables precise characterization of phase-transition-induced thermal expansion in $Mg_2P_2O_7$. The measurement clearly reveals the pronounced negative thermal expansion between 337 and 351 K associated with the structural transition from the α- to the β-phase. These results demonstrate the suitability of dilatometry for evaluating phase transitions and dimensional changes in functional materials and provide valuable information for the development of materials with controlled thermal expansion and high dimensional stability.

Source:
Du, Y., Gao, Q., Sanson, A. et al.
Optimized negative thermal expansion property in low-cost $Mg_2P_2O_7$-based bulk material.
Results in Physics, 2022.
Adapted from dilatometric measurements performed using a LINSEIS DIL L76.