

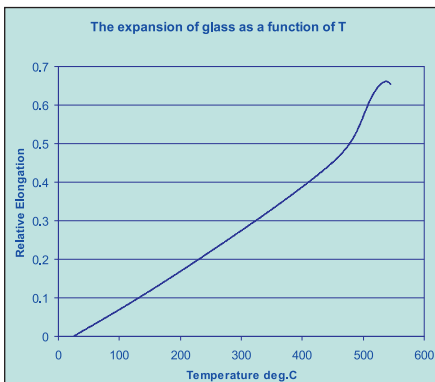
IN FOCUS
glass analysis

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Determination of the transformation temperature and the expansion coefficient of glass



Method description

Using a double Quartz dilatometer the elongation of a sample is measured as a function of the temperature. From the elongation, the sample length and the temperature, the expansion coefficient in a chosen temperature range is calculated according to:

$$a_{avg}(T_0, T) = \frac{\Delta\lambda}{\lambda \cdot \Delta T}$$

where T_0 is the reference temperature, e.g. 25°C, T is the chosen temperature, λ is the length of the sample and $\Delta\lambda$ is the elongation, ΔT is the temperature increase.

Below the transformation temperature the slope of the elongation-temperature relation is fairly constant. Above the transformation temperature the slope increases significantly. The transformation temperature is given by the intersect of the tangents of the two regions.

Measured Quantity

Elongation as a function of temperature.

Derived Quantity

Average expansion coefficient a_{avg} in a chosen temperature range and transformation temperature T_g .

Measuring Range

$a_{avg}(T_0, T)$: 0-20 * 10⁻⁶/°C
 T_g : up to 800°C

Precision

$a_{avg}(T_0, T)$: $\sigma = 2 \cdot 10^{-8}/°C$
(determined from 10 measurements on sapphire)

T_g : $\sigma = 2°C$

Accuracy

Standards (sapphire and Pt) deviate less than 3*10⁻⁸/°C. Calibration is done monthly.

Possible Errors

Samples should be homogeneous and free from stress. Sample ends should be flat and square. Glass above the transformation temperature behaves as a viscous fluid. Elongation in the transformation range is sensitive to fixture and clamping forces. Expansion values above T_g , measured with different dilatometers are susceptible for these effects and generally cannot be compared.

Sampling

Preferably a rod shaped sample, $\lambda = 50$ mm. ± 1 mm. and 5-6 mm \circ or \square , should be available. References for 50, 40, 25, 20 and 10 mm are available.

Measuring time

Two samples can be measured each day and results are generally available within one week.

Cost aspect

1 man hour.