APPLICATION**NOTE**

Polymers – TCT

Determination of the Thermal Conductivity by Means of TCT– Straighforward through Direct Measurement

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Introduction

Thermal conductivity can be determined using various methods. One established and recognized method is LFA (Laser Flash Analysis). This primarily determines the thermal diffusivity, α; then, along with the data for density, ρ, and specific heat capacity, c_p, it is possible to calculate the thermal conductivity, λ, using Formula 1.

$$\lambda = \alpha \cdot c_p \cdot \rho \qquad \text{(Formula 1)}$$

A total of three measurements of different properties are therefore required to determine the thermal conductivity using LFA. With the TCT 716 *Lambda*, though, which works according to the GHFM (Guarded Heat Flow Meter) method, the thermal conductivity can be measured directly. This reduces the measurement effort and makes it easy for the user to generate the required measured value.

PEEK (Polyether Ether Ketone)

PEEK (polyether ether ketone) is a high-melting polymer and a high-performance thermoplastic. Due to its excellent resistance, PEEK is often used where it has to withstand high loads under unfavorable thermal and/or chemical conditions. Examples of applications can be found in the aerospace, medical technology and chemical industries.

Measurement Conditions

The following measurements were carried out on PEEK. All samples were prepared from a larger rod.

- Determination of the thermal conductivity by means of the TCT 716 *Lambda* on two samples with a diameter of 51 mm and a thickness of 3 mm.
- Determination of the thermal diffusivity by means of the LFA 467 *HyperFlash*® on two samples with a diameter of 12.7 mm and a thickness of 2 mm.
- Determination of the density at room temperature by means of the buoyancy method on LFA samples.
- Determination of the specific heat capacity by means of the DSC 204 ***F1*** *Phoenix*® on two samples with a diameter of 4 mm and a thickness of 1 mm.

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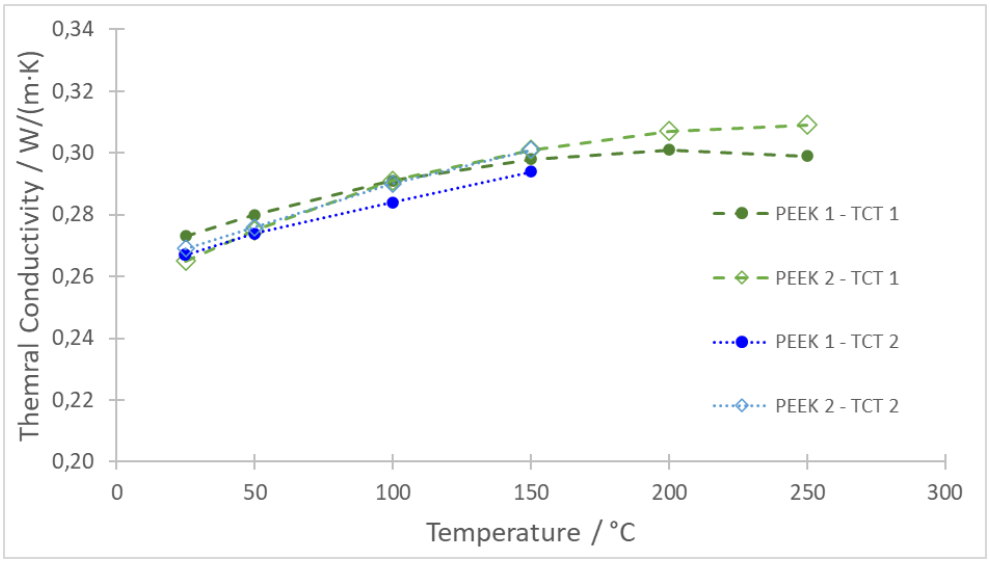
Measurement Results

Figure 1 shows the results for the thermal conductivity of PEEK measured by TCT as a function of temperature. The blue and green dots or diamonds show the results for two PEEK samples on two different TCT instruments from 25°C to a maximum of 250°C. The thermal conductivity tends to increase with increasing temperature. The TCT measurements show a good reproducibility of max. ± 2%. The TCT instruments were calibrated with fused silica for the measurements.

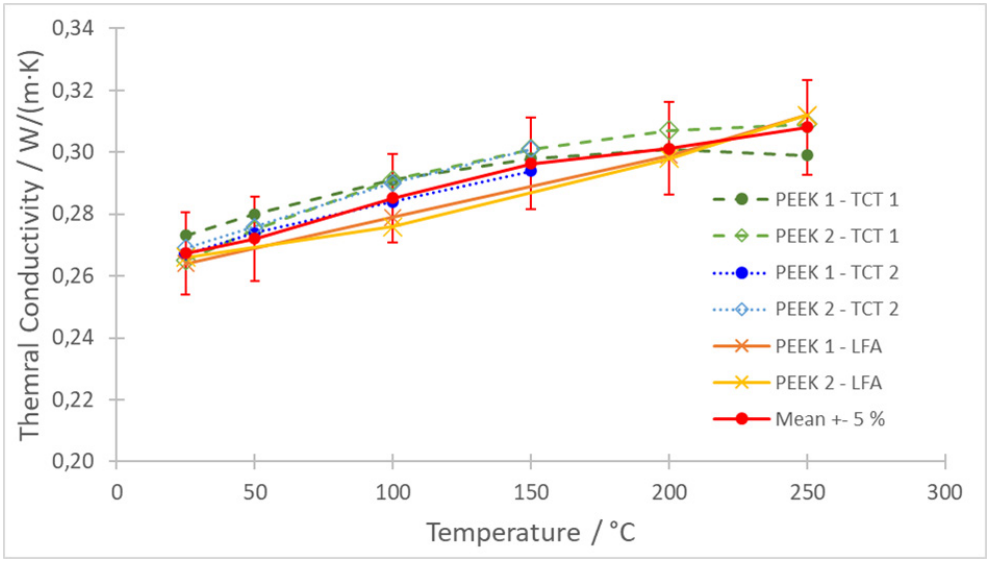
Figure 2 summarizes the results of the TCT and LFA measurements. The orange and yellow crosses represent the results obtained using LFA. For this purpose, the specific heat capacity was determined via DSC, and the density was determined at room temperature. The red dots with error bars represent the mean value of all measurements. The results for all tests are within ± 5%.

Summary

With the TCT 716 *Lambda*, determination of the thermal conductivity is easy and the measured value can be determined directly. A comparison with other established methods such as LFA shows both good agreement and reproducibility of the measurement results.



1 Thermal conductivity of two PEEK samples measured with two different TCT 716 *Lambda* instruments as a function of temperature.



2 Comparison of the thermal conductivity results for PEEK obtained with the LFA 467 *HyperFlash*® and TCT 716 *Lambda* measuring instruments.

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