PbTe – A Thermoelectric Material Heat Capacity and Thermal Conductivity

Dr. Ekkehard Post

Introduction

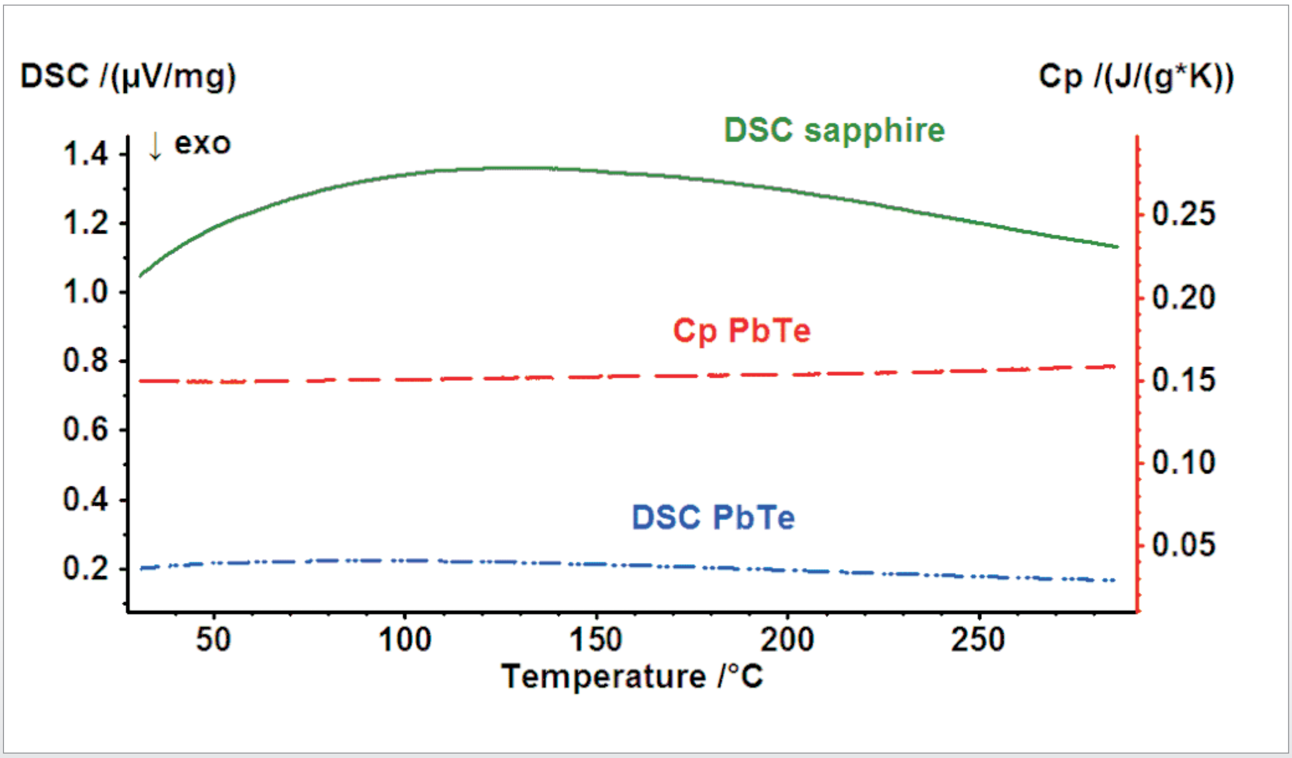
Thermoelectric substances are promising materials for waste heat harvesting. Examples of this would be the generation of electric energy by converting the heat of automobile exhaust, or from cooling devices used in power plants. Important physical properties to consider are the so-called Seebeck coefficient (S) and thermal conductivity δ). The well-known figure of merit (Z) describes the efficiency of such materials:

$$ZT = (S^2 \sigma \lambda^{-1})$$

with σ= denisty
T = temperature

From the formula, it can be concluded that for a high Z value, the material should have a high Seebeck effect and a low thermal conductivity value.

PbTe is a potential candidate for such applications as it has a moderate Seebeck coefficient and a relatively low thermal conductivity



1 Figure 1. Heat capacity (c_p) values for PbTe

NETZSCH-Gerätebau GmbH
Wittelsbacherstraße 42 · 95100 Selb · Germany
Tel.: +49 9287/881-0 · Fax: +49 9287/881505
at@netzsch.com · www.netzsch.com

Results and Dicussion

The specific heat of PbTe samples were measured with the NETZSCH DSC 204 F1 Phoenix® in the temperature range from RT to 300°C using the ratio method.

Figure 1 depicts the c_p curve of the PbTe sample. The specific heat values are in the range of 0.15 J/(g*K) to 0.16 J/(g*K) which is typical for this material.

The thermal diffusivity of PbTe was measured with the NETZSCH LFA 457 MicroFlash®. The thermal conductivity can be calculated by applying the following formula:

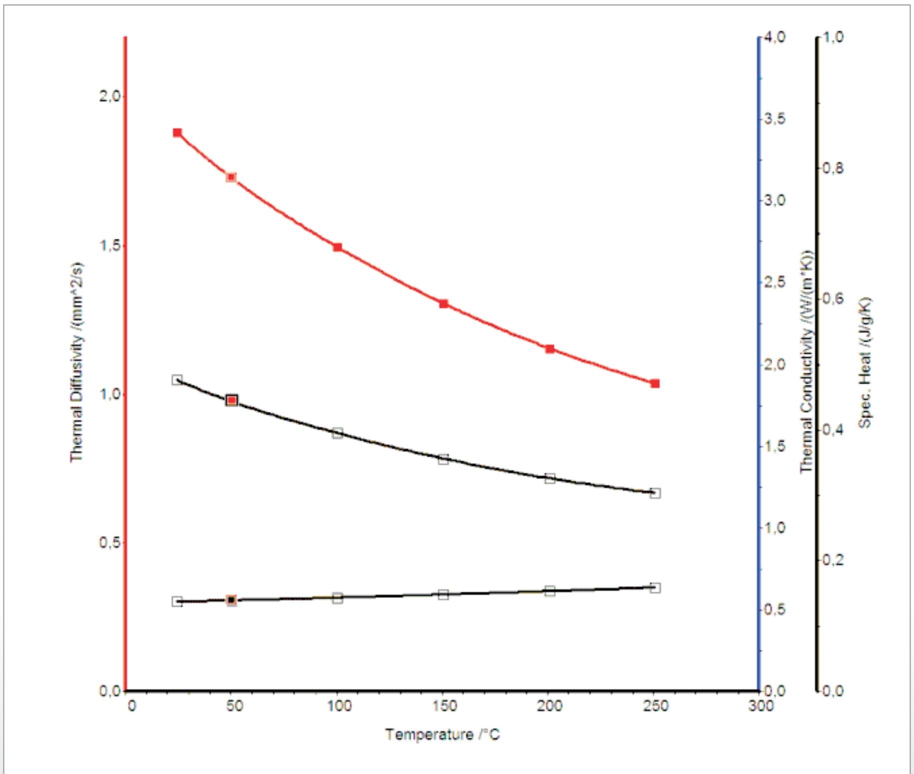
$$\lambda(T) = a(T) \cdot c_p(T) \cdot \rho(T)$$

with c_p = specific heat
ρ = density
λ = thermal diffusivity

Figure 2 shows the thermal diffusivity, specific heat and thermal conductivity curves.

Summary

The thermal diffusivity and specific heat of PbTe were measured with LFA and DSC instrumentation, respectively. The thermal conductivity, which is a very important physical property for the evaluation of efficiency of thermoelectric materials, was calculated utilizing this data along with the density of the material. The PbTe showed the expected decrease in thermal con-ductivity with increasing temperature as is normally observed for other semi-conducting materials.



2 Thermal conductivity, thermal diffusivity and specific heat curves of PbTe

NETZSCH-Gerätebau GmbH
Wittelsbacherstraße 42 · 95100 Selb · Germany
Tel.: +49 9287/881-0 · Fax: +49 9287/881505
at@netzsch.com · www.netzsch.com