Objectives and Activities of the Thermophysics Working Group within GEFTA

M. Rohde
Karlsruher Institut für Technologie (KIT)
Institut für Materialforschung I

H.-P. Ebert (ZAE Bayern), W. Hohenauer (AIT), S. Sarge (PTB)

Thermophysics Working Group

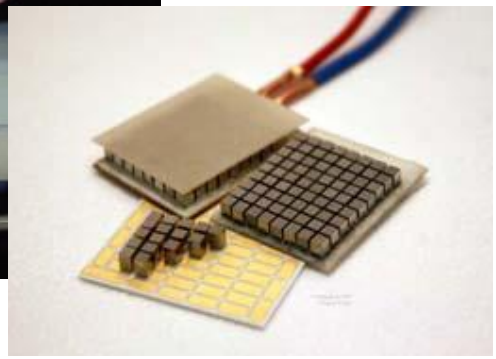
- Scientific organisation
- Working area: Determination of thermophysical properties

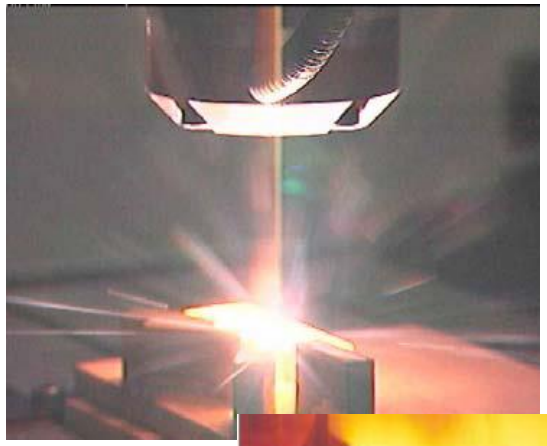
  thermal conductivity, thermal diffusivity
  specific heat
  thermal expansion
  infrared-optical properties

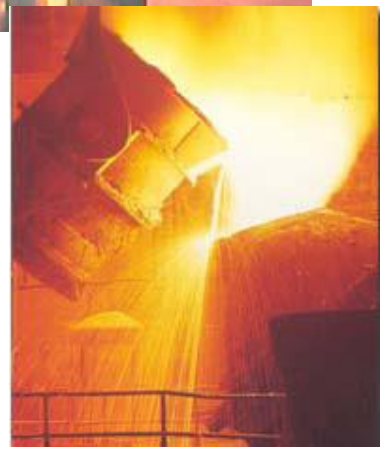
- Forum for discussion and exchange of experience

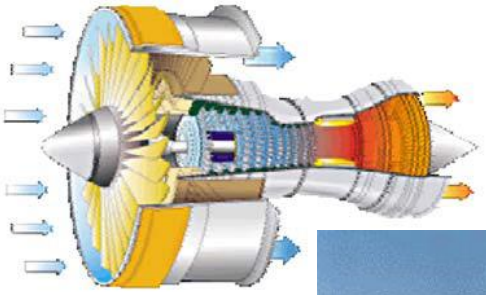
  Comparison of measuring methods
  Organisation and performance of intercomparisons
  Certification of reference materials
  Agreements on co-operation and joint projects

Expertise in Thermophysics

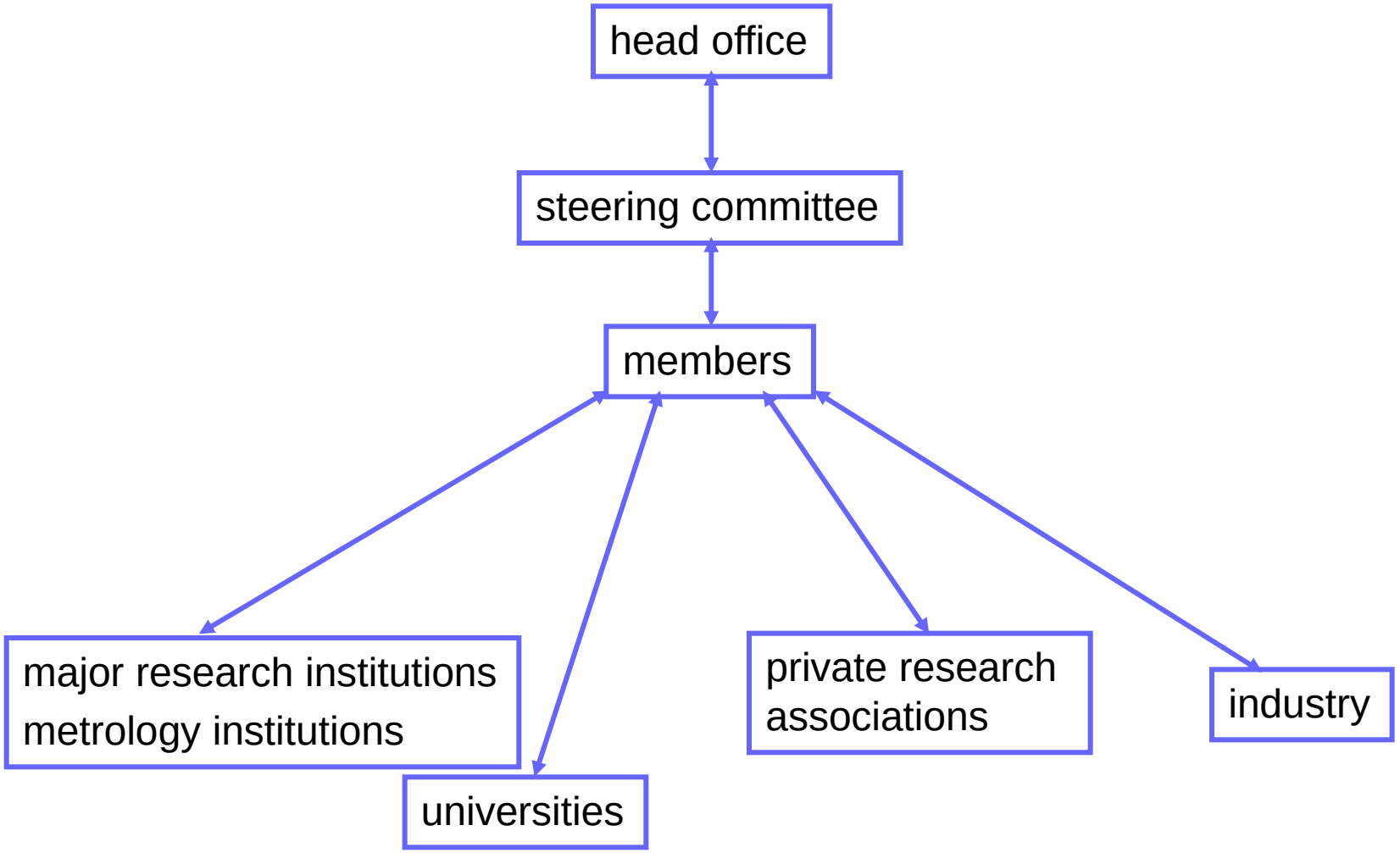




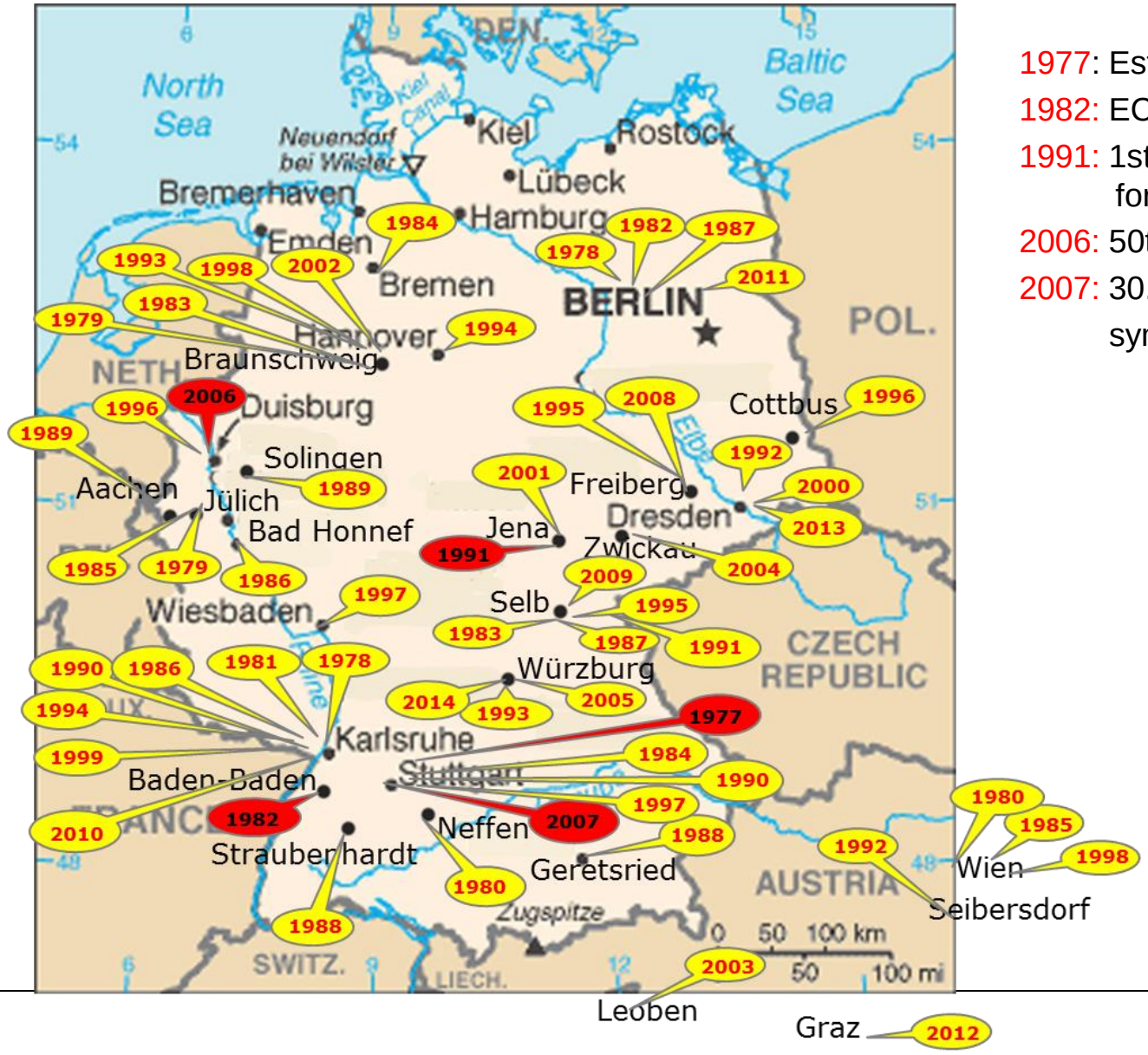




Organisation



Annual meetings of the thermophysics working group



1977: Establishment of the AKT

1982: ECTP in Baden-Baden

1991: 1st meeting in the newly formed German States

2006: 50th meeting of the AKT

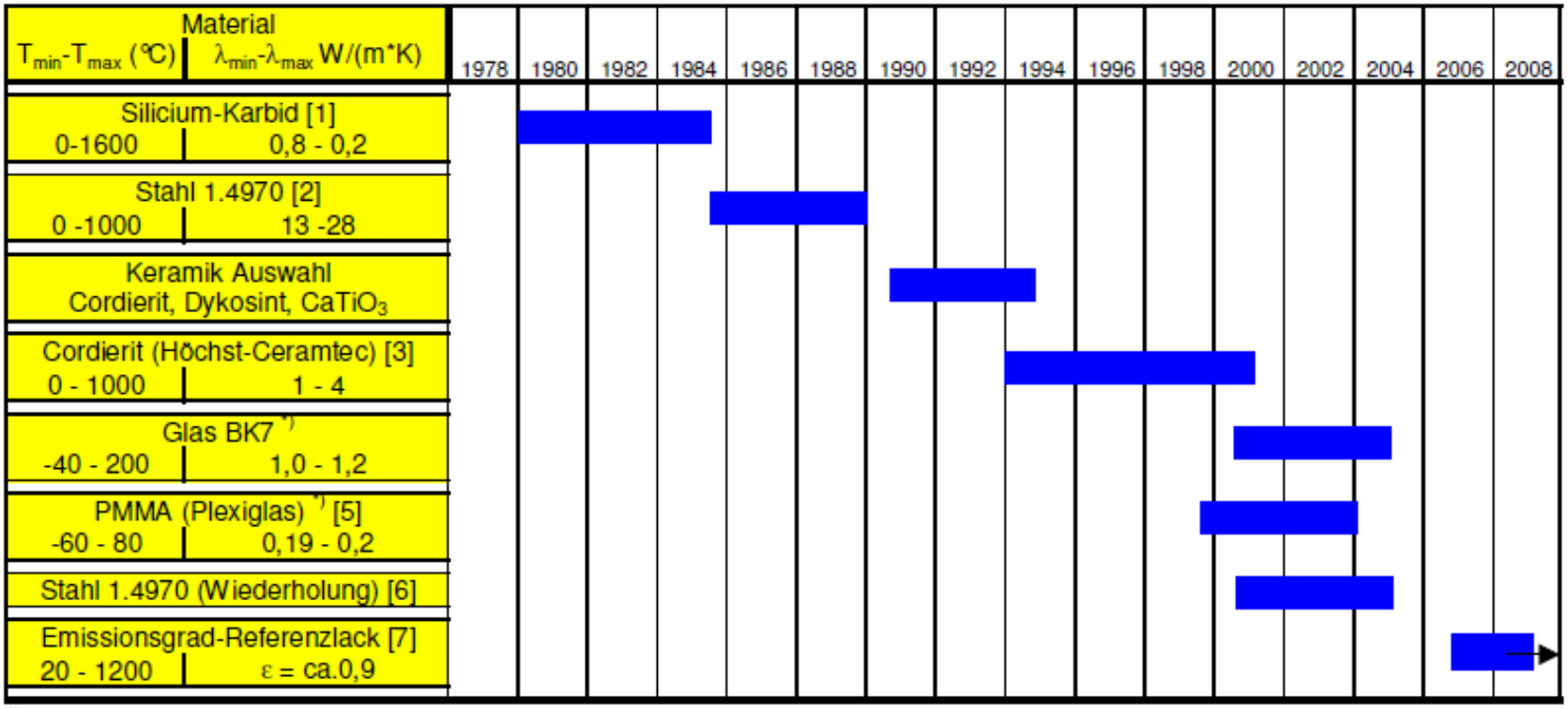
2007: 30. anniversary symposium in Stuttgart

Intercomparisons especially offer the following capabilities:

- Verification of the instrument calibration
- Verification of the uncertainty budget
- Identification of influences as for specific materials (unrecognised systematic deviations)
- Examination of geometry influences (i. e. thin layers)
- Examination of material-specific influences
- Evaluation of realistic values for:
  - *Efficiency of methods*
  - *Variations and deviations due to material*
- Qualification of reference materials

Comparability and repeatability for materials of practical relevance

Reference materials and intercomparisons



*) Externes Programm unter Teilnahme von Mitgliedern des Arbeitskreises [4]

Intercomparisons

Ongoing Intercomparisons

- Dilatometry (Si_3N_4, Al_2O_3, Ni-Alloy)
- Thermal conductivity Cu-Alloy
- Thermal conducitivity Calciumsilicate
- Emissivity of thermal paints

Completed Intercomparisons

- Austenitic nickel chromium steel (2000-2002)
- Crown borosilikatglass BK7 (2001)
- PMMA (2002)

PMMA, 2002 (Plexiglass Type GS; Degussa Plexiglas GmbH)

Determined thermophysical property: thermal conductivity, temperature: -70 °C to +80 °C

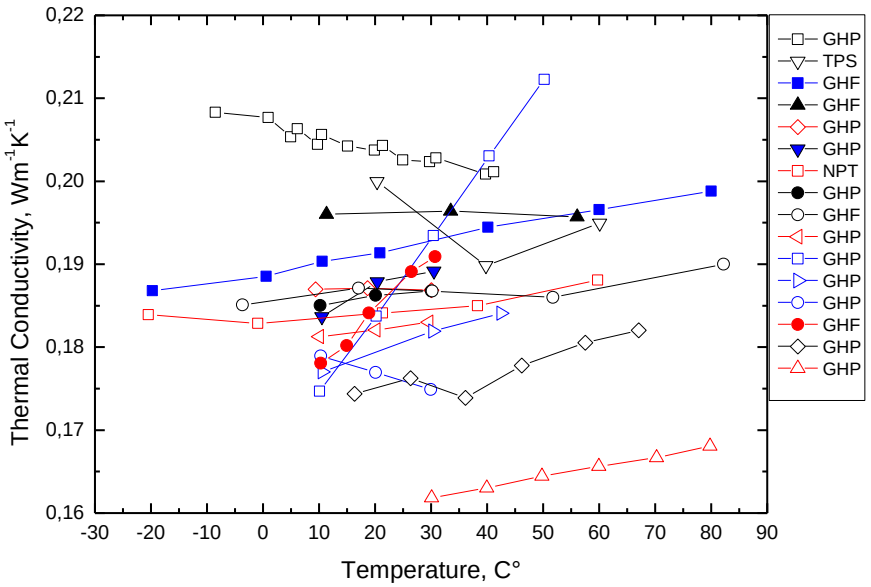
participating laboratories:

AIT Austrian Institute of Technology GmbH (Wien, Österreich)
BASF AG (Ludwigshafen, Deutschland)
Brandenburgische Technische Universität Cottbus (BTU, Deutschland)
Eidgenössisches Materialprüfungs- und Forschungsanstalt (Dübendorf, Schweiz)
Forschungsinstitut für Wärmeschutz e. V. (FIW, München, Deutschland)
Fraunhofer-Institut für Bauphysik (IBP, Stuttgart, Deutschland)
Institut für Begutachtung und Überwachung von Baustoffen GmbH (Herzogenrath, Deutschland)
Institut für Fenstertechnik e. V. (Rosenheim, Deutschland)
Laboratoire de Technologie Industrielles Henri Tudor (Luxemburg)
Materialforschungs- und Prüfanstalt (MPW, Weimar, Deutschland)
Materialprüfungsamt NRW (MPA NRW, Dortmund, Deutschland)
Materialforschungs- und Versuchsanstalt (Neuwied, Deutschland)
National Physical Laboratory (NPL, Teddington, Großbritannien)
Physikalisch-Technische Bundesanstalt (PTB, Deutschland)
Saint-Gobain Isover G + H AG (Ladenburg, Deutschland)
Taurus Instruments GmbH (Weimar, Deutschland)
Universität Erlangen-Nürnberg (Deutschland)

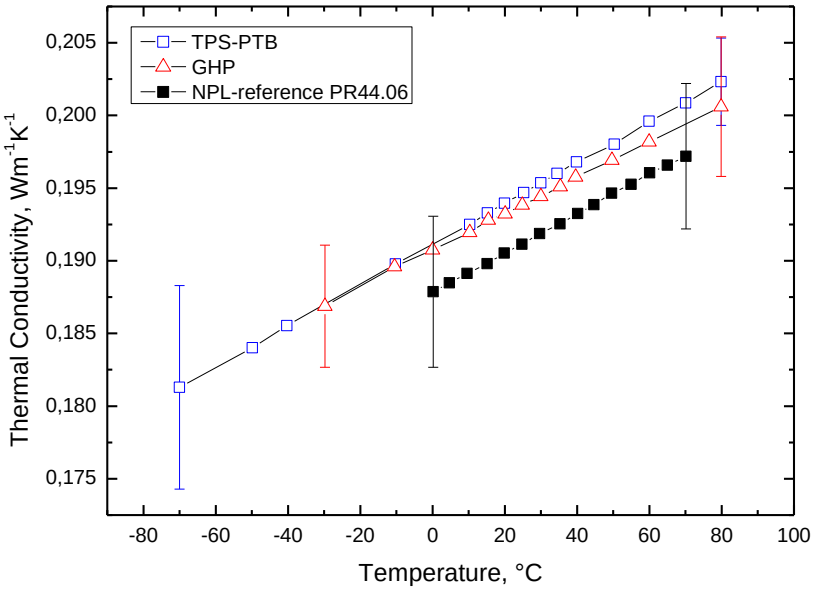
Publication: International Journal of Thermophysics, Vol. 25, No. 5, September 2004
Intercomparison of Measurements of the Thermophysical Properties of Polymethyl Methacrylate
S. Rudtsch, U. Hammerschmidt

PMMA-Intercomparison: results

S. Rudtsch, U. Hammerschmidt, Int. J. Thermophysics 2004



Different experimental methods



Comparison with reference data

Thermophysical measurands and methods

- Thermal conductivity and thermal diffusivity

$$\vec{q} = -\lambda \cdot \nabla T \qquad a = \frac{\lambda}{\rho \cdot c_p}$$

- Heat capacity and enthalpy changes

$$c_p = \frac{1}{m}\left(\frac{\partial Q}{\partial T}\right)_p \qquad \Delta H = \int_{T_1}^{T_2} \frac{dH}{dT}\, dT$$

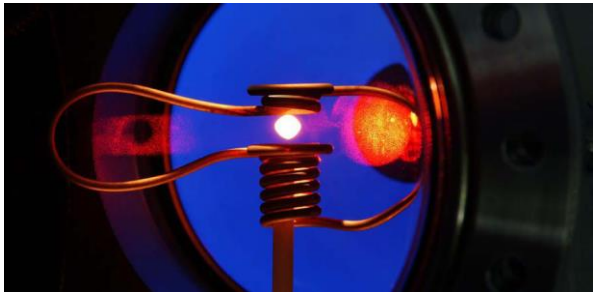
- Infrared-optical properties

$$\varepsilon(\lambda, T) = \frac{I_{\text{Oberfläche}}(\lambda, T)}{I_{\text{schwarzer Strahler}}(\lambda, T)}$$

- Thermal expansion $\alpha = \frac{1}{l_0}\left(\frac{dl}{dT}\right)_p$

Experts within the working group

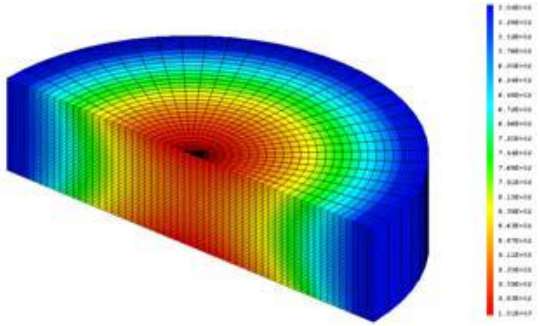
Summary



- there is lot of knowledge in the mind of scientists members of the thermophysics working group
- Annual meetings provide the possibility for discussion (attractive for early stage researches!)
- Intercomparisons organized by the thermophysics working group could improve the own expertise
- Next meeting will be Berlin at the PTB, 24.-25.03.2011

Further information:

www.ak-thermophysik.de



Contact - Steering Committee

Dr. Hans-Peter Ebert

Head of steering committee
Bayerisches Zentrum für Angewandte Energieforschung e.V. (ZAE Bayern)
Am Galgenberg 87, 97074 Würzburg
Tel.: 0931 70564-0
Fax: 0931 70564-600
E-Mail: ak-thermophysik@zae.uni-wuerzburg.de

Dr.-Ing. Wolfgang Hohenauer

Thermophysik & Thermokinetik
AIT Austrian Institute of Technology GmbH
Giefinggasse 2 , 1210 Wien, Österreich
Tel.: +43 664 825 1154
E-Mail: wolfgang.hohenauer@ait.ac.at

Dr. Magnus Rohde

Forschungszentrum Karlsruhe (KIT)
Institut für Angewandte Materialien (IAM)
Postfach 3640, 76021 Karlsruhe
Tel.: 0721 608-24328
Fax: 0721 608-24567
E-mail: magnus.rohde@kid.edu

Dr. Stefan Sarge

Physikalisch-Technische Bundesanstalt
Arbeitsgruppe 3.31 Kalorische Größen
Bundesallee 100, 38116 Braunschweig
Tel.: 0531 592-3310
Fax: 0531 592-3305
E-Mail: stefan.sarge@ptb.de