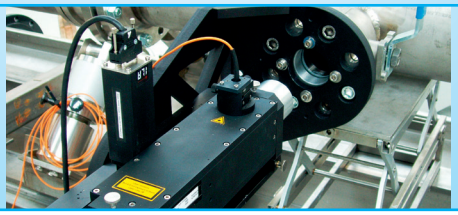
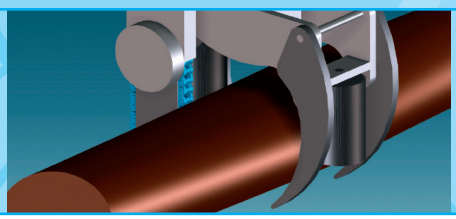
PTB news 2/2011
The Science Newsletter of the Physikalisch-Technische Bundesanstalt


Sensor test in operation *Page 2*


Cleaner thanks to ultrasound *Page 3*


Log measuring in harvesters *Page 8*

Scientific news

Technology transfer

Miscellaneous

PTB obtains first value for Boltzmann-constant

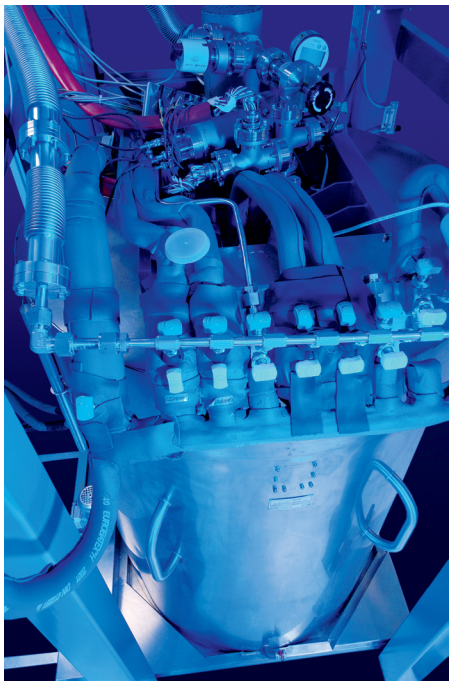
One essential step towards the redefinition of the unit “kelvin” has been taken

Initial measurements performed with PTB's dielectric-constant gas thermometer have yielded, a value of $1.380655 \cdot 10^{-23}$ J/K with an uncertainty of approx. 8 ppm for the Boltzmann constant. The ultimate step towards an uncertainty of 2 ppm is expected within the next two years, which will pave the way for the redefinition of the unit “kelvin” via the definition of *k*.

Within the scope of the redefinition of the base units of the International System of Units (SI) via fundamental constants, research groups from all over the world have been dealing with determining the value of the Boltzmann constant with uncertainties of a few ppm. If they are successful, the unit “kelvin” could be redefined. Many groups apply acoustic gas thermometry, a method which has provided the most accurate value to date (approx. 2 ppm). PTB has chosen a different – and completely independent – path to rule out systematic sources of errors and, thus, to put the redefinition on solid ground.

PTB employs dielectric-constant gas thermometry (DCGT) which is based on the in-situ determination of the density of the measuring gas helium. This approach consists in measuring how much the gas changes the capacitance of a capacitor. From measurements at a constant temperature (at the triple point of water) and at different pressures in the measuring capacitor, *k* can be determined by means of fundamental relations. This method makes high demands on the measuring technique used and was realised by several departments of PTB in cooperation

Especially interesting for
- *primary thermometry*
- *the fundamentals of metrology*
- *the International System of Units (SI)*


Thermostat probe of the dielectric-constant gas thermometer with gas handling system ensuring gas delivery to the various measuring capacitors.

with external partners. The measurement of the pressure at 7 MPa with piston gauges aimed at uncertainties of 1 ppm was just as demanding as all other subprojects. In order to measure changes in the capacitance of around 1 billionth, a new capacitance bridge was designed. The required temperature stability of the measuring system is provided by a large bath thermostat which was manufactured and optimised in cooperation with the national metrology institute of Italy (INRiM). This took place within the scope of an EU project coordinated by PTB, which has just been successfully completed.

The experimental set-up developed now allows DCGT measurements to be carried out at the triple point of water and furnishes a value for k of $1.380655 \cdot 10^{-23}$ J/K. This value lies approx. 3 ppm above the CODATA value and is, with a relative uncertainty of approx. 8 ppm, the first proof that DCGT is able to determine k with greatest accuracy.

However, until the uncertainty of 2 ppm aimed at is reached, some difficulties will have to be overcome. Thus, besides improving pressure measurement within the next 2 years, especially the design and the materials used for the capacitors will have to be optimised in order to reduce the – currently – dominating uncertainty component which is due to the deformation of the capacitors' electrodes under the effects of the gas pressure. This would pave the way for a reliable redefinition of the unit “kelvin”.

Contact
Christof Gaiser
Department 7.4 Temperature
Tel. +49 (0)30 3481-7349
E-mail: christof.gaiser@ptb.de

Scientific publication
Fellmuth, B.; Fischer, J.; Gaiser, C.; Jusko, O.; Priruenrom, T.; Sabuga, W.; Zandt, T.: Determination of the Boltzmann constant by dielectric-constant gas thermometry. Metrologia 48 (2011) 382-390

Sensor test in operation

A new procedure enables the in-situ testing of heat meters without service interruption

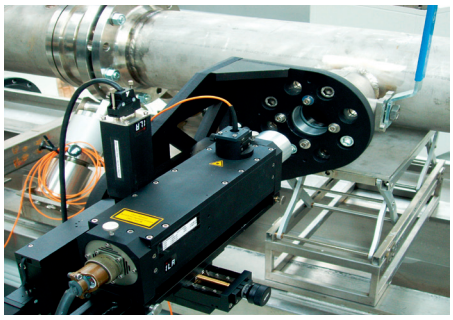
In practical applications, the operating conditions for heat meters in large facilities or networks often deviate from the idealised calibration conditions which are predominant at PTB's test facility. This leads to – partly considerable – measurement deviations. A newly developed procedure now allows heat meters to be investigated under installation conditions and without service interruption.

Especially interesting for
- *district heating and cooling*
- *network operators*

The greatest uncertainty contribution during the operation of a heat meter is caused by the flow sensor. It has, to date, always been calibrated on a test facility for its specific use. Due to the idealised conditions prevailing there, unknown measurement deviations of the flow sensor occur at the later place of use. Over the years, these can change due to ageing, depositions or abrasive wear, since the devices can have a long service life.

To date, the flow sensors could not be calibrated in-situ. At best, the sensors were recalibrated on a test facility; for that, they had to be dismounted. The service interruption which became necessary for this purpose led to high costs. The optical procedure developed by PTB – in cooperation with the TÜV Rheinland and the companies ILA GmbH and Optolution GmbH – allows the flow sensors to be examined in-situ without service interruption, i.e. without having to dismount the flow sensor and without having to empty the pipe circuit. This procedure has already been patented.

With the aid of a known drilling procedure (hot tapping), an inspection window is mounted into the pipe. Hereby, first of all, a ball valve is welded onto the pipe through which the pipe is perforated. By means of a special mounting bushing, a window can now be mounted which fits the contours of the pipe. After that, a Laser Doppler velocimeter (LDV) is installed, and the flow velocity is determined over a measurement path by means of the Doppler shift of the back-scattered Laser light. After completion of the measurements, the laser can be removed, and the optical access can be closed with a blank flange. By integrating the measured flow velocity over the pipe cross section, the volume flow is determined. This result of the LDV measurement provides the reference for the measurement result of the flow sensor.



For the new optical procedure for in-situ measurements of flowrates on large facilities in accordance with the Laser Doppler velocimetry principle, a laser is coupled to the respective pipe system via an optical window.

Investigations carried out on the heat meter test section of PTB confirm that – under ideal conditions – a measurement uncertainty of less than 1 % can be achieved. Presently, investigations are being carried out to find out which measurement uncertainty can be achieved in the event of disturbed incident flows and how the pipe cross-section – which is important for the integration – can be determined more precisely.

Contact
Oliver Büker
Department 7.5 Heat and Vacuum
Tel. +49 (0)30 3481-7527
E-mail: oliver.bueker@ptb.de

Scientific publication
Guntermann, P.; Rose, J.; Lederer, T.; Dues, M.; Müller, U.; Duckwe, A.: Vorort-Untersuchungen von Wärmemengenzählern im Betrieb. EuroHeat & Power 39 (2010) 44–47

Quantum-based impedance bridges

Broadband calibration of impedance ratios is now possible

A novel impedance bridge using programmable Josephson arrays enables the broadband characterisation of resistance and capacitance ratios with great accuracy within a very short measurement time.

Especially interesting for
- *metrology institutes*
- *calibration laboratories*
- *manufacturers of high-precision resistors*

Traditional impedance bridges make use of inductive dividers and achieve, in their frequency range from 500 Hz to 10 kHz, excellent relative measurement uncertainties of only a few parts in 10^{-9}. The bridges must, however, be adjusted for each frequency of operation and this involves a complex manual procedure.

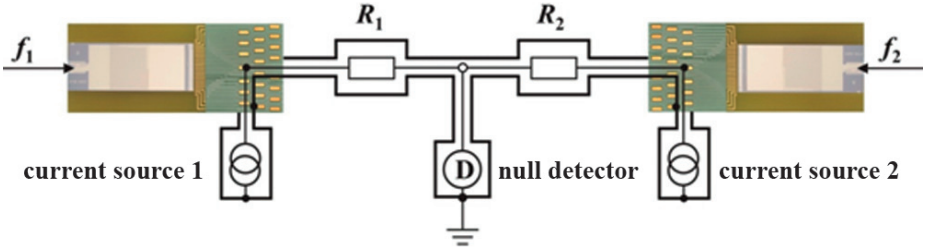
PTB's newly developed Josephson impedance bridge can be adjusted very easily. The AC voltage amplitudes from two Josephson arrays are adjusted over their microwave frequency, and the phase angle between the synthesised voltages is adjusted via delay electronics with a resolution of 10 ps. Both processes are fully automatic. The utilisation of quantum standards to generate a voltage on both sides of the bridge renders new adjustments at all other frequencies unnecessary. It is therefore possible to perform precise measurements at 20 different frequencies within just 30 minutes.

The efficiency of the new procedure has been demonstrated by measuring the 1:1 ratio between two 10 kΩ resistors and two 100 pF capacitors. The resistance ratio over the frequency range from 25 Hz to 10 kHz was determined with a measurement uncertainty of approx. $2 \cdot 10^{-8}$. For capacitance ratios, the uncertainty lies in the kHz range below $1 \cdot 10^{-8}$. With decreasing frequency, the uncertainty increases as a function of the impedance $1/\omega C$. With $2 \cdot 10^{-7}$ at 25 Hz, the uncertainty is, however, still 20 times smaller than when measuring with traditional bridges.

In further development steps, the new Josephson bridge is to be used also for ratio measurements where a resistor is compared to a capacitor. By integrating the frequency-independent quantum Hall resistor, the frequency response of capacitors could then be calibrated up to the range of technical frequencies (in Germany: 50 Hz) with high precision.

Contact
Luis Palafox
Department 2.6 Quantum Electrical Metrology
Tel. +49 (0)531 592-2140
E-mail: luis.palafox@ptb.de

Scientific publication
Lee, J.; Schurr, J.; Nissilä, J.; Palafox, L.; Behr, R.: The Josephson two-terminal-pair impedance bridge. Metrologia 47 (2010) 453–459



Schematic set-up of the quantum bridge. The quantum voltages are adjusted by varying the microwave frequencies f_1 and f_2, and the bridge is balanced. By synchronising the current sources 1 and 2 with the delay electronics, the phase between the AC voltages can be adjusted.

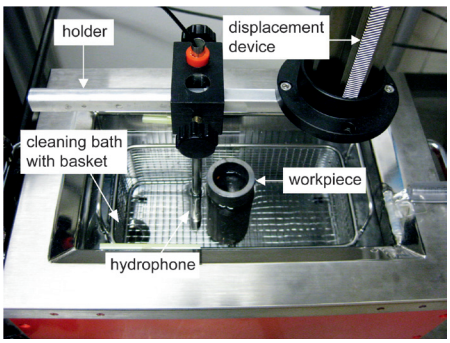
Cleaner thanks to ultrasound

Test procedures for optimising ultrasonic baths

How good is my ultrasonic bath? How much power is necessary? When will the parts to be cleaned start to be damaged? To date, manufacturers and users could not rely on any objective parameters for the quality assurance of such ultrasonic cleaning baths, because the fundamental physical mechanisms are difficult to determine. At PTB, test procedures have now been developed that are easy to use in everyday practice. Cleaning and reaction effects can be estimated quantitatively, and the operating parameters can be optimised.

Especially interesting for
- *manufacturers of ultrasonic devices*
- *process engineering*
- *laboratory equipment and medical engineering*

Ultrasonic cleaning baths are found in nearly all commercial and industrial sectors since they can be used for various purposes. They clean things that are as different as engine parts, microchips, optical glasses or surgical equipment, but can also be used for the pre-treatment of sewage sludge or as reaction accelerators, for example, in the production of biodiesel. Even workpieces having a complex shape are thoroughly cleaned without brushes. The efficiency of the cleaning is based on cavitation, the short-term generation of the smallest oscillating gas bubbles which can locally create very high pressures and



Measurement of sonic field indicators on a workpiece

temperatures when collapsing. The forces and micro currents generated hereby cause dirt particles to come off, enabling an intensive and yet gentle cleaning.

Cavitation processes are, however, complex and difficult to predict. At PTB, uniform and objective measurement procedures have now been determined that are suited to characterise ultrasonic baths. The investigations took place within the scope of a project carried out by the AiF Research Association DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e. V. (Society for Chemical Engineering and Biotechnology) and were funded via the AiF within the scope of the "Programme for the promotion of industrial joint research and development (IGF)" of the Federal Ministry of Economics and Technology.

The new measuring arrangement offers the possibility of controlling all essential ambient parameters such as, e.g., the water temperature and the gas content. By means of suitable indicators, manufacturers and users can determine the properties of an ultrasonic bath objectively. Among these cavitation indicators are: the chemical effect, the erosion of aluminium foil, and sonoluminescence, i.e., the occurrence of ultrashort light flashes in the imploding bubbles. For each indicator, there is a corresponding measurement procedure that has been developed by PTB. A self-developed computation method searches for correlations in the measurement results by means of statistical methods and identifies the measurands which can be used as an "adjusting screw" in order to optimise an ultrasonic bath for a specific use.

These procedures for the characterisation of ultrasonic cleaning baths are available to industry.

Contact
Christian Koch
Department 1.6 Sound
Tel. +49 (0)531 592-1600
E-mail: christian.koch@ptb.de

Scientific publications

Koch, C.; Jüschke, M.: Multivariate Datenanalyse zur objektiven Beschreibung von Kavitationsanwendungen. DAGA 2011, Düsseldorf

Jüschke, M.; Koch, C.: Messung und Vergleich verschiedener Effekte von Kavitation für eine quantitative Beurteilung von Anwendungsprozessen. DAGA 2011, Düsseldorf

Simulations show possible new mechanism for heart failure

Damaged cells could turn out to be more important than previously thought

Investigations of a new discrete heart model, which also takes modified cells or a disturbed cell-to-cell coupling into account, describe a possible new mechanism for severe cardiac arrhythmia and the resulting heart failure. In simulations, corresponding cardiac dynamics are caused by percolating pathologically modified cells within a sufficiently large area of tissue.

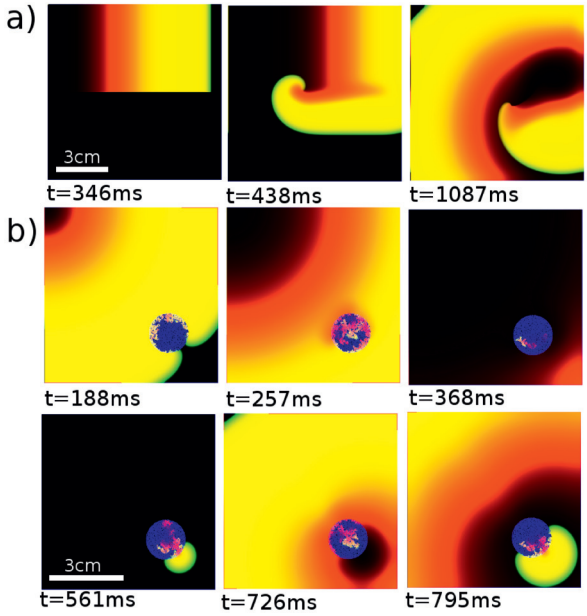
Especially interesting for
- *physicians*
- *medical research*

The propagation of electrical signals in the heart of a mammal is usually modelled with reaction-diffusion equations. This opens up the possibility of realistically simulating biosignals such as the electrocardiogram (ECG) or the magnetocardiogram (MCG). On the other hand it is known that cardiac tissue is composed of relatively large muscle cells (length: approx. 0.1 mm) which are coupled to each other by so-called "gap junctions". Electrical signals in the heart thus propagate in a coarse-grain discrete medium. A heterogeneous, discrete medium occurs if cells die or if their properties are modified with a pathological pattern. Simulations have provided PTB scientists with new findings concerning the influence of such heterogeneities on the occurrence of life-threatening cardiac arrhythmia.

Quantitatively speaking, continuum models describe the dynamics of nonlinear waves correctly as long as the density of the heterogeneities is not too large. This density corresponds to the heart tissue, for example, to the part of the heart muscle cells showing pathologically modified activity or to the number of disturbed connections between adjacent cells. Numerical simulations have shown that the heterogeneities in the model have to be taken into account explicitly (multiscale modelling) as soon as their density exceeds a critical value. This value lies roughly below the percolation threshold of the cell compound, which amounts to, e.g., 50 % of pathological cells for a square lattice and 66 % for a hexagonal one.

This finding is important to understand cardiac arrhythmia. Around the percolation threshold, the wave propagation is strongly disturbed, and due to the heterogeneities, a re-activation of the cells (also called "re-entry") is triggered. It can lead to high-frequency activity of the heart tissue (tachycardia) or to irregular, chaotic activity (fibrillation). The re-entry phenomenon caused by heterogeneities (Figure b) looks very different to the well-known and thoroughly investigated phenomenon of the spiral re-entry dynamics in homogeneous media (Figure a). The irregular activity pattern of the cells leads to a loss of the synchronisation of the heart muscle cells – which is vital for the pumping function of the

heart. If this condition is not suppressed early enough by massive intervention (defibrillation), sudden cardiac death becomes inevitable.



Comparison of re-entry phenomena in numerical simulations of the electrical activity (transmembrane potential, resting state black, excited state red to yellow) in a two-dimensional heart model. Computations in (a) a homogeneous medium and (b) a medium with a circular heterogeneity (bottom right).

Contact
Sergio Alonso
Department 8.4 Mathematical Modelling and Data Analysis
Tel. +49 (0)30 8481-7948
E-mail: sergio.alonso@ptb.de

Scientific publications

Alonso, S.; Kapral, R.; Bär, M.: Effective medium theory for reaction rates and diffusion coefficients of heterogeneous systems. Phys. Rev. Lett. 102 (2009) 238302

Alonso, S.; Bär, M.; Panfilov, A.V.: Effects of reduced discrete coupling on filament tension in excitable media. Chaos (2011) 013118

Precise measurement of radioactive thoron

First primary standard worldwide for the calibration of thoron measuring instruments

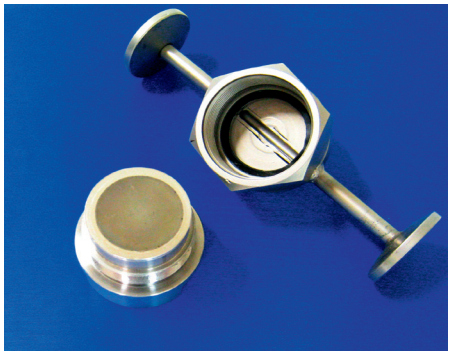
A primary standard for the measurement of the short-lived radioactive thoron developed at PTB is used for the calibration of thoron measuring instruments from the whole world. It provides the basis for accurate measurements of the radioactive gas which occurs naturally in the ground, can collect in living areas and whose progenies are considered carcinogenic.

Especially interesting for
- *geologists*
- *epidemiologists*
- *radiation protection*

Just like its sister isotope radon (Rn-222), the radioactive gas thoron (Rn-220) can also cause lung cancer through its progenies if these are breathed in over long periods of time and in high concentrations. The degree of the radiation exposure of living areas varies greatly and is dependent on the construction of the house and the way it is ventilated. Whereas radon has been measurable with high precision for a long time already, this has not yet been the case with thoron. The exact measurement of thoron is, however, important for the estimation of risks, as at the same activity concentration, a 14-fold higher radiation level results from the thoron progenies than from the progenies of radon.

The development of a primary standard like the one that already exists for radon was considered impossible for a long time, because thoron has a relatively short half-life of only 55 seconds. PTB finally succeeded, though. The core of the primary standard is a test container which is filled with a defined amount of thoron. Since a closed container, like the one used in the case of radon, was out of the question due to the short half-life of thoron, a circuit system was developed that constantly introduces newly produced thoron with a high flow air stream and keeps the activity in the container constant.

The production and the accurate measurement of the activity which was fed in, was a technical challenge. In the case of the novel measurement set-up – the thoron emanation measuring arrangement (TEM) – the activity comes from a thorium (Th-228) source which produces thoron continually. A constant, strong air stream transports the thoron into the test container. The quantity of the thoron removed and of that remaining in the source can be measured to the nearest per mil. Parallel to operating the TEM, the measuring instrument to be calibrated can be connected to the test container.



The emanation container developed at PTB contains an electro-deposited thorium-228 source for the thoron (radon-220) needed.

As more and more geological and epidemiological studies in Asia, Europe and Latin America are focussed on thoron (to which little attention has been paid to date), the newly set-up measuring arrangement at PTB is constantly fully booked by international customers.

Contact
Annette Röttger
Department 6.1 Radioactivity
Tel. +49 (0)531 592-6130
E-mail: annette.roettger@ptb.de

Scientific publication

Röttger, A.; Honig, A.: Recent developments in radon metrology: New aspects in the calibration of radon, thoron and progeny devices. Radiation Protection Dosimetry 145 (2011) 260–266

Spatially resolved metabolite determination in the brain

Imaging and a new magnetic resonance spectroscopy method combined

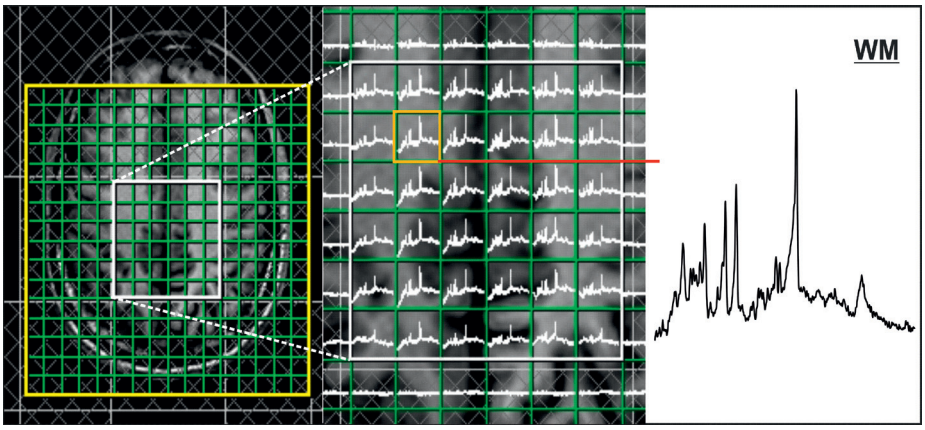
Autologous substances in the brain – so-called "metabolites" – can serve as biomarkers, for example, in neurological diseases. The concentration of metabolites and their location within the brain can now be determined more precisely by combining the so-called "SPECIAL" Magnetic Resonance Spectroscopy (MRS) method with spectroscopic imaging at 3 tesla. In studies with volunteers using the 3T MR scanner of the PTB, it was possible to determine the concentration as well as the distribution of up to 14 different metabolites. This was the first time that the SPECIAL method was used in spectroscopic imaging on a clinical scanner.

Especially interesting for
- *physicians*
- *neuroscientists*
- *manufacturers of MRI devices*

Magnetic resonance imaging (MRI) relies on the nuclear spin of water protons – which are very numerous in the organism – in order to obtain highly resolved images of tissues. By selecting the parameters of the so-called "MR measurement sequences", it is, however, also possible to differentiate and quantify biochemical substances in a spatially resolved way, based on different chemical environment of the protons within these metabolites. MRS (Magnetic Resonance Spectroscopy) is used to obtain quantitative information on metabolites in the human brain, i.e. neurotransmitters and amino acids. It benefits from high and ultrahigh magnetic field strengths (≥ 3 tesla), which are becoming increasingly common. Due to the low concentrations of metabolites, the signal strengths in MRS are, however, up to 10 000 times lower than in MRI. Thus, the requirements for spectral resolution and for the data quality of the measurement procedures for the quantification of metabolites are exceptionally high.

A new method, which meets these criteria, is the so-called "spin echo full intensity acquired localized (SPECIAL) technique" with which MRS signals can be measured relatively sensitively. It has already been demonstrated in studies with MR scanners at field strengths of 3 T and 7 T that this method can provide precise data concerning metabolites in single volume elements (voxels) of the brain. Many applications, however, require data from several voxels, for example, in order to obtain the distribution of metabolites in larger areas of the brain.

With the 3-tesla scanner of the PTB, the short echo times of the SPECIAL method have now been combined with the spatial selection of the magnetic resonance spectroscopic imaging (MRSI). This combination has made it possible to detect different metabolites in several voxels of a freely selectable brain region. In healthy volunteers, artefact-free spectra with high signal/noise ratio were recorded with an echo time of 6.6 milliseconds. Based on this, it was possible to determine the concentrations of 8 metabolites reliably; for certain voxels, 14 metabolites were even reliably quantified. The obstacle to a broad application in the medical field is the still rather long measuring duration (34 minutes for one MRSI dataset). Currently, efforts are being undertaken to reduce this long scan time.



Voxel arrangement for MRSI (left) and corresponding spectra (centre) from the parietal lobe of the brain of a volunteer; acquired with the SPECIAL MRSI sequence. Right: example of a spectrum of a voxel consisting mainly of white matter (WM). The spectral lines represent metabolites, their amplitudes represent their concentrations. The narrow linewidths and the defined spectral lines are proof of the high quality of the data.

Contact
Ralf Mekle
Department 8.1 Medical Metrology
Tel. +49 (0)30 3481-7767
E-mail: ralf.mekle@ptb.de

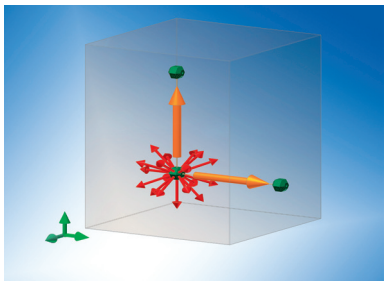
Scientific publication
Mekle, R.; Mlynarik, V.; Walaszek, B.; Gruetter, R.; Ittermann, B.; Schubert, F.: ^{1}H SPECIAL-MRSI at Ultra-Short TE: Improved Metabolite Detection for Multiple Voxels in Human Brain at 3T. Proc. 19 ISMRM, Montreal, Canada, 7.–13.5.2011, Abstract 3422

Direction-dependent thermal conductivity

Licence partner wanted

Especially interesting for
- *process engineering*
- *construction*
- *plastics manufacturers*

A PTB foil sensor accurately and reliably measures both thermal conductivity and thermal diffusivity in just a few minutes and in one single step. It even determines the directional dependence of these two material parameters – simultaneously and in all three spatial directions. In order to perform a measurement, the sensor is simply laid between two halves of the sample. The sensor consists of three individual measuring probes which are integrated into the foil sensor and arranged at a right angle. The measuring probe in the centre induces a heat flow of known rate into the sample. Similar to the other two – purely passive – measuring probes, it detects the temperature increase during the time of measurement. The three directional components of thermal conductivity and thermal diffusivity can be easily determined from the three temperature variations. Thanks to the new sensor, time-consuming multiple measurements are a thing of the past. Developing new materials, e.g., more efficient insulation materials in the construction industry, is thus becoming less costly.



Schematic diagram of the sensor

Contact
Ulf Hammerschmidt
Department 1 Mechanics and Acoustics
Tel. +49 (0)531 592-3211
E-mail: ulf.hammerschmidt@ptb.de

Interferometry and differently reflecting surfaces

Licence partner wanted

Assessing the optical quality of surfaces by means of a Fizeau interferometer is considerably more complex if the surfaces under test show different reflectivities. Up to now, several reference surfaces have been necessary. PTB has developed a Fizeau interferometer which makes this redundant. Now, maximum contrast can be attained regardless of the reflectivity of the sample. This is achieved by introducing a commercially available, so-called “on-axis beam splitter” which splits the light irradiated along the axis of symmetry. Sample characterization is simplified by the reduction to a two-beam interference. Finally, the increased measurement dynamics enable topography measurements also in environments affected by vibrations.

Especially interesting for
- *optics*
- *the semiconductor industry*

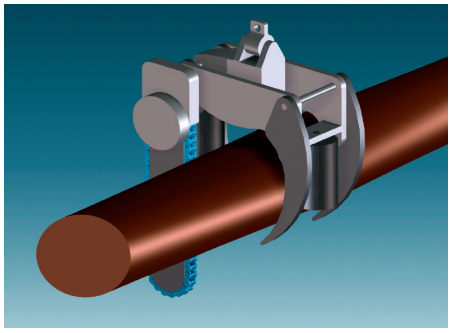
Contact
Bernhard Smandek
Department Q.3 Legal Metrology and Technology Transfer
Tel. + 49 (0)531 592-8303
E-mail: bernhard.smandek@ptb.de

Log measuring in harvesters

Licence partner wanted

Especially interesting for
- *the timber industry*
- *manufacturers of harvesters*

Measuring the diameter of logs is presently not precise enough to determine the volume of timber for verification purposes during the felling and limbing process inside harvesters. A new combination of sensors and test pieces, developed at PTB, now enables clear progress in determining the diameter of logs. This is achieved by integrating the diameter-measuring sensors into the lateral surface of the cylinder barrel surface of the feed rolls. Together with the software analysis, the accuracy is increased. In addition, this saves work steps during the calibration of the harvester's measuring probes.



Test piece for the calibration of the diameter-measuring sensors in harvesters

Contact
Ingo Lohse
Department 5.4 Interferometry on Material Measures
Tel. +49 (0)531 592-5450
E-mail: ingo.lohse@ptb.de

Contact person for questions about technology transfer
Bernhard Smandek, Phone: +49 (0) 531 592-8303, E-mail: bernhard.smandek@ptb.de, Internet: www.technologietransfer.ptb.de

Awards

Peter Ambrosi
The Head of Department 6.3 "Radiation Protection Dosimetry" has been awarded the DKE Pin by VDE/DKE for his personal commitment and dedication to standardisation in electrical engineering. He obtained it on the occasion of the DKE meeting in May 2011.

Dates

17 November 2011 Correction Procedures for Dimensional Measurements on Microsystem Components Made of Transparent or Resilient Materials
263rd PTB Seminar. Location: PTB-Braunschweig. Contact: Uwe Brand. Phone: +49 (0)531 592-5111

17–18 November 2011 23rd WELMEC WG 10 Meeting
Measuring systems for liquids other than water. Location: PTB Braunschweig, Vieweg Building. Contact: Michael Rinker. TPhone: +49 (0)531 592-1380

21–25 November 2011 Photometry Seminar
Location: PTB Braunschweig, Einstein Building. Contact: Klaus Stock. Phone: +49(0)531 592-4100

22–23 November 2011 DKE/GUK 967.2 Standards Session
Location: PTB Braunschweig, Elster Geitel Building. Contact: Annette Röttger. Phone: +49 (0)531 592-6130

29 November–1 December 2011 International Conference on Advanced Metrology for Cancer Therapy
Location: PTB Braunschweig. Contacts: Ulrike Ankerhold; Katharina Winkelhöfer. Phone: +49 (0)531 592-6200, +49 (0)531 592-6201

30 November–1 December 2011 Protection of Measurement Data in Legal Metrology and Related Challenges
Location: PTB Berlin, Hermann von Helmholtz Building, Lecture Hall. Contacts: Heike Kautz, Florian Thiel. Phone: +49 (0)531 592-7494, +49 (0)531 592-7529

125 years precisely

Since its founding in 1887, the keyword which has stayed with PTB (at that time: Physikalisch-Technische Reichsanstalt, PTR) is: accuracy. More precisely: measurement accuracy. After a 125-year success story, PTB will be celebrating its anniversary on 28 March 2012 (on the very same day it was granted its first imperial budget 125 years ago) with a political ceremonial event in the Braunschweiger Stadthalle (Braunschweig Civic Centre) and a scientific symposium scheduled on the day before with the significant title “Metrology, the Universe and Everything”.

Events on the occasion of PTB's anniversary

27 March 2012: Metrology, the Universe and Everything
Helmholtz Symposium on the occasion of the completion of PTB's first “3 · 42 – 1 years”. Location: Braunschweig, Stadthalle (Braunschweig Civic Centre), 9.00 am to 5.00 pm

27 March 2012: Awarding of the Helmholtz Prize 2012
The Helmholtz Fonds (Helmholtz Foundation) and also the Stifterverband (Donors’ Association) award the Helmholtz Prize for outstanding work in metrology. Location: Braunschweig, Stadthalle (Braunschweig Civic Centre), 5.30 pm

28 March 2012: Ceremonial Event on the occasion of PTB's 125th anniversary
Official reception with the Federal President and other guests of honour. Location: Braunschweig, Stadthalle, 10.00 am to 12.30 noon

For further information: http://www.ptb.de/cms/en/presseaktuelles/125-years-precisely.html

Imprint

PTBnews 2/2011, English edition, November 2011, ISSN 1611-163X
The PTBnews are the science newsletter of the Physikalisch-Technische Bundesanstalt (PTB). They are aimed at PTB‘s cooperation partners in the economy and science as well as anyone else who is interested. The PTBnews are published three times each year in a German as well as in an English edition and can be subscribed to free of charge.
Subscription form: www.ptb.de > English Version > Publications > PTB-news > scroll down to contact form
html and pdf versions: www.ptb.de > English Version > Publications > PTB-news
Publisher: Physikalisch-Technische Bundesanstalt (PTB), Braunschweig und Berlin
Editors: Franz Josef Ahlers, Harald Bosse, Christian Lisdat, Mathias Richter, Erika Schow, Jens Simon (verantwortlich), Florian Schubert, Peter Ulbig
Translation: Cécile Charvieux (PTB-Sprachendienst/Translation Office)
Layout: Volker Großmann, Alberto Parra del Riego (concept)
Editorial Office: Press and Information Office, PTB, Bundesallee 100, D-38116 Braunschweig, phone +49 (0)531 592-3005, fax +49 (0)531 592-3008, e-mail: ptbnews@ptb.de