Manufacturer of high-precision miniature capacitance dilatometers
Table of Contents

02 High Performance since 2002
04 Manufacturing
05 Key features and advantages
06 Applications
08 Selected Measurements
10 Normal-Dilatometer
12 Stress-Dilatometer
14 Mini-Dilatometer
High Performance since 2002

TRADITION

More than 15 years of experience as Scientist in the Max-Planck-Institute for Chemical Physics of Solids, Germany

2002
One of the world’s leading experts in the field of thermal expansion and magnetostriction measurements

2007
Start to develop different types of dilatometers

2012
The new scientific instruments are fabricated using a patent pending technology

INNOVATION

Own company to manufacture high-precision miniature dilatometers

2007

2014
Continued optimization of design and manufacturing method using latest production technology

2015
Development of the uniaxial stress dilatometer

2014

2017
Release of the world’s smallest high-precision dilatometer

2017

2007

2007

2007

2007
Key features and advantages

- Very Small dimensions
- Extremely high-resolution ($\Delta L = 0.01 \, \text{Å}, \Delta L/L = 10^{-7}$)
- Very small weight and excellent thermalisation
- Compact and stable
- Simple sample mounting
- Suitable for a large temperature range ($10 \, \text{mK} < T < 320 \, \text{K}$) and for very high magnetic field (currently max. tested field: 37.5 T)

Innovative patent-pending production method allows for an unprecedented resolution in a dilatometer of this compact size.

The great advantage of the new type of measuring cells is based on a unique combination of powerful design, production technology and high level of manufacturing quality.
Applications

The dilatometers can be used in a wide temperature range (from room temperature down to less than 10 mK) and in magnetic fields up to at least 40 T and with several cryogenic systems.

Working environment

Our dilatometers can be used in a wide range of temperature. They were tested and operated down to extremely low temperature (10 mK). The maximal operation temperature is determined by the thermal capability of the insulating pieces of vespel and the used coaxial cables. So far, dilatometers were only tested at temperatures just above room temperature. To achieve the best possible results the dilatometers have to be operated in a steady flowing inert gas atmosphere, where the dielectric constant of the medium does not change with temperature (e.g. helium, nitrogen, clean and dry air, vacuum). The operation in flow cryostats or directly in cryogenic liquids (helium) is not recommended. Our dilatometers have been successfully operated in most commonly measurement systems, e.g. in the Quantum Design PPMS under helium atmosphere or in an Oxford Instruments Kelvinox dilution refrigerator under vacuum. For all these systems, we offer the matching accessories for suitable mounting.

Selected Applications

1. PPMS® (Physical Property Measurement System by Quantum Design)
2. Kelvinox™ Dilution Refrigerator by Oxford Instruments
3. Resistive Bitter Magnets (High Field Magnet Laboratory)
4. Exchange Gas cryostat

PPMS-dilatometry probe includes all necessary cables and software
Selected Measurements

Thermal expansion: Smoking gun experiment to determine Quantum Critical Points (QCPs):
For materials near a QCP, the volume thermal expansion coefficient $\beta$ diverges much more strongly than the specific heat $C$ as $T \to 0$.
$$\Rightarrow \Gamma = \frac{\beta}{C} \text{ has to diverge at any pressure tuned QCP.}$$
The exponent $x$ of $\Gamma$ even allows to determine the nature of the QCP. Moreover, the sign of $\Gamma$ must to change by entering the ordered phase close to a QCP. Dilatometry enables to obtain directional dependent information.

Phase diagram of bismuth in the quantum limit studied with high-resolution magnetostriction:
Tiny changes in length for various orientations of the magnetic field could be resolved with our extremely sensitive dilatometer. From the sample's change in length one can deduce the changes in the electronic distribution in the respective direction of the magnetic field. Physicists refer to this as determining the energy distribution or energy structure of the electrons as a function of the magnetic field. With our dilatometer, this relief map for bismuth, which shows how the electronic structure changes as a function of the magnetic field, was measured more precisely than has been possible to date using other methods.

- Article | Science 339, 933 (2013) Ferromagnetic Quantum Critical Point in the Heavy-Fermion Metal YbNi$_4$(P$_{1-x}$As$_x$)$_2$
Standard-Dilatometer
Compact and miniaturized high resolution capacitance dilatometer

Size and Dimensions
footprint; height 20 mm × 26 mm; 34 mm
weight 45g

Absolute resolution
@ low Temperature (Kelvinox-Systems (0.01 K up to 6 K))
ΔL = 0.02 Å
@ PPMS ΔL = 0.1 Å

Range of operation
Temperature range 10 mK < T < 320 K
Magnetic field range At least up to 30 T (max. tested field)

Measurable sample size
footprint (max.) (3.5 mm × 10 mm) or Ø = 5 mm
height Less than 1 mm up to 5 mm

Materials
Dilatometer-parts copper beryllium
Insulating pieces; washers vespel; sapphire

Options
Variety of Cryostats Dilatometer + attachments
PPMS Dilatometer complete with PPMS-probe and cables + software

A compact and miniaturized high resolution capacitance dilatometer for measuring thermal expansion and magnetostriction
Stress-Dilatometer

Uniaxial stress capacitance dilatometer for high-resolution thermal expansion and magnetostriction

Size and Dimensions
footprint; height 20 mm × 26 mm; 41 mm
weight 5.2 g

Absolute resolution
@ low Temperature (Kelvinox/Systems (0.01 K up to 6 K))
ΔL = 0.02 Å
@ PPMS
ΔL = 0.1 Å

Range of operation
Temperature range 10 mK < T < 320 K
Magnetic field range At least up to 30 T (max. tested field)

Range of operation
Applied force from 40 up to 75 N
max. uniaxial stress 3 kbar for cuboid sample of (0.5 mm)² cross section

Measurable sample size
footprint (max.) (3.5 mm × 10 mm) or Ø = 5 mm
height Less than 1 mm up to 5 mm

Materials
Dilatometer-pants copper beryllium
Insulating pieces; washers vespel; sapphire

Options
Variety of Cryostats Stress-dilatometer + attachments
PPMS Dilatometer complete with PPMS-probe and cables + software

A uniaxial stress capacitive dilatometer for high-resolution thermal expansion and magnetostriction under multiextreme conditions.
**Mini-Dilatometer**

Super compact high-resolution capacitance dilatometer

### Size and Dimensions

<table>
<thead>
<tr>
<th>footprint; height</th>
<th>14 mm × 15 mm; 16 mm</th>
<th>weight</th>
<th>13g</th>
</tr>
</thead>
</table>

### Absolute resolution

- **@ low Temperature (Kelvinox-Systems (0.01 K up to 6 K))**
  \[ \Delta L = 0.01 \, \text{Å} \]
- **@ PPMS**
  \[ \Delta L = 0.1 \, \text{Å} \]

### Range of operation

- **Temperature range**
  \[ 10 \, \text{mK} < T < 320 \, \text{K} \]

- **Magnetic field range**
  \[ \text{At least up to 38 T (max. tested field)} \]

### Measurable sample size

<table>
<thead>
<tr>
<th>footprint (max.)</th>
<th>(2.3 mm × 6 mm) or Ø = 3.3 mm</th>
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<tr>
<td>height</td>
<td>Less than 1 mm up to 2.75 mm</td>
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</table>

### Materials

- Dilatometer parts: copper beryllium
- Insulating pieces: vespel, sapphire
- Washers

### Options

- Any Cryostat + attachments
- PPMS Dilatometer (can be rotated) complete with PPMS-probe and cables + software


The world’s smallest capacitive dilatometer; for high-resolution thermal expansion and magnetostriction in high magnetic fields
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