LINSEIS

THERMAL ANALYSIS

MEGA LAB

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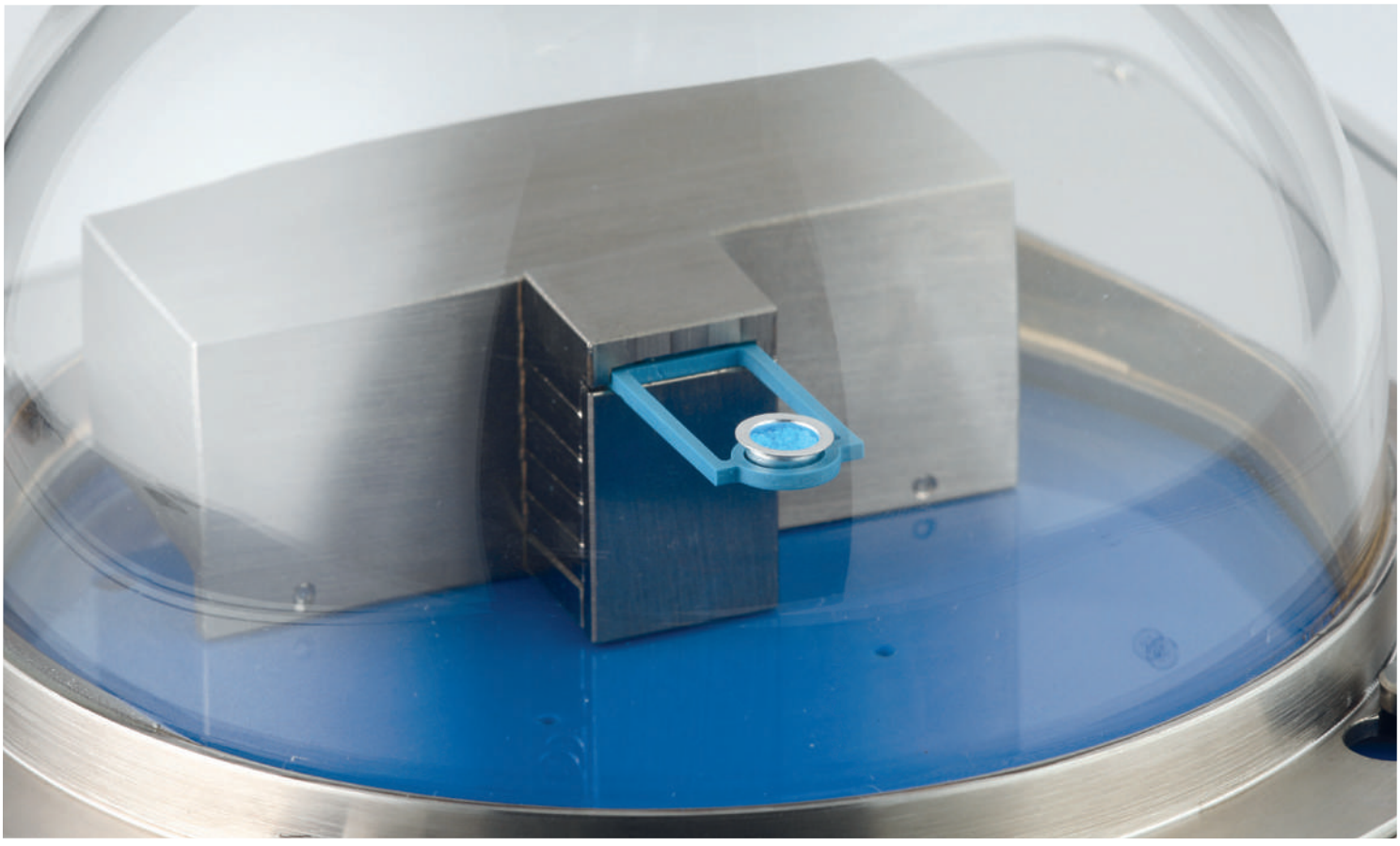
DIFFERENTIAL SCANNING CALORIMETER

Chip-DSC 100
Chip-DSC 10
Chip-DSC 1



Since 1957 LINSEIS Corporation has been delivering outstanding service, know how and leading innovative products in the field of thermal analysis and thermo physical properties.

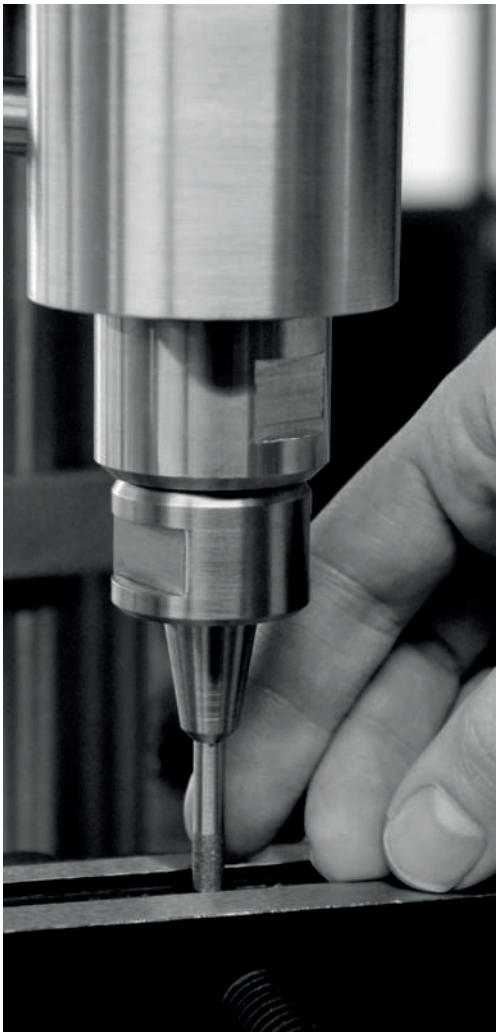
Customer satisfaction, innovation, flexibility and high quality are what LINSEIS represents. Thanks to these fundamentals, our company enjoys an exceptional reputation among the leading scientific and industrial organizations. LINSEIS has been offering highly innovative benchmark products for many years.

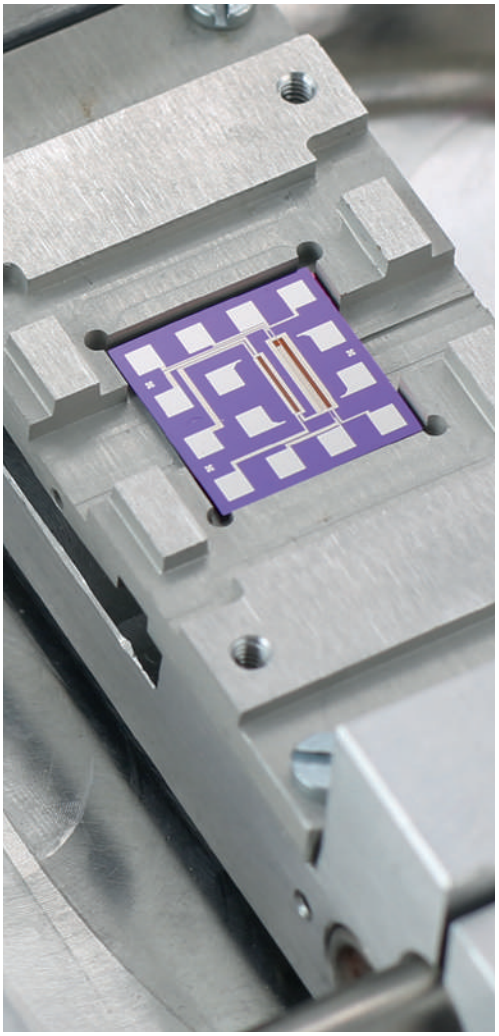
The LINSEIS business unit of thermal analysis is involved in the complete range of thermo analytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials and environmental analytics. In addition, thermo physical properties of solids, liquids and melts can be analyzed.

LINSEIS provides technological leadership. We develop and manufacture thermo analytic and thermo physical testing equipment to the highest standards and precision. Due to our innovative drive and precision, we are a leading manufacturer of thermal Analysis equipment.

The development of thermo analytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

Claus Linseis
Managing Director





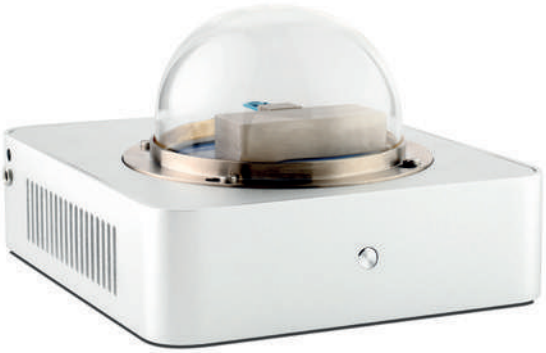
German engineering

The strive for the best due diligence and accountability is part of our DNA. Our history is affected by German engineering and strict quality control.

Innovation

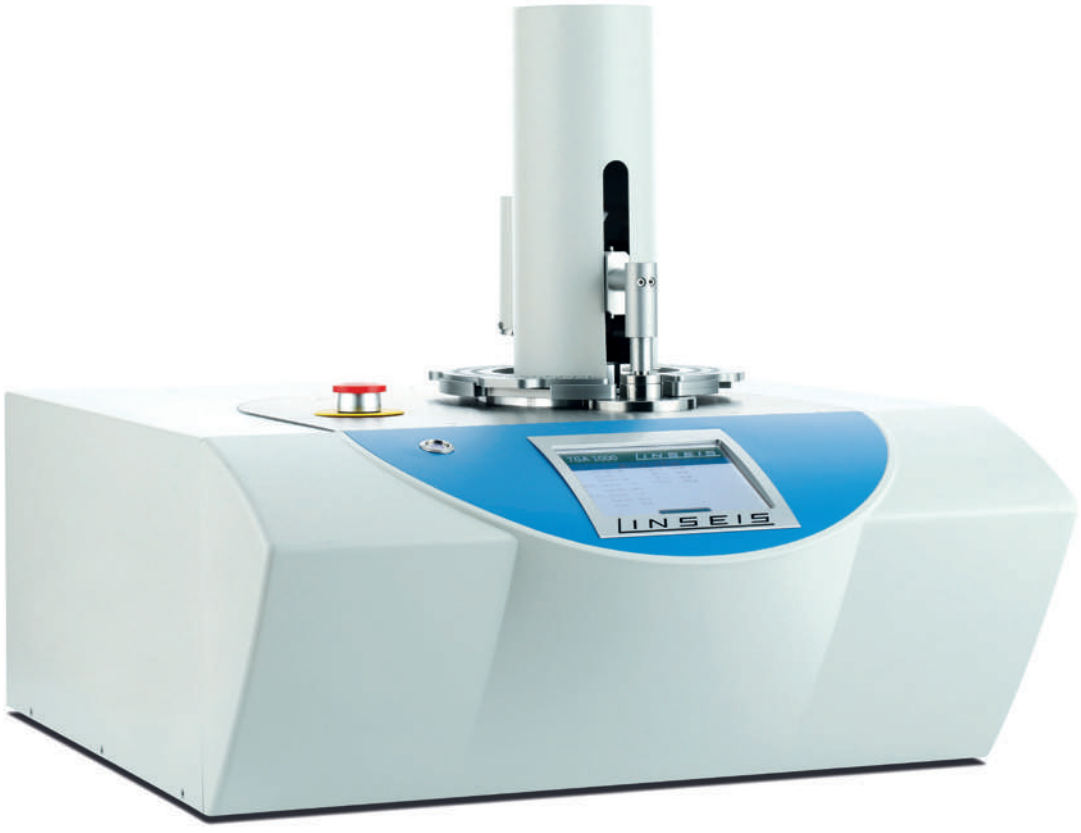
We want to deliver the latest and best technology for our customers. LINSEIS continues to innovate and enhance our existing thermal analyzers. Our goal is constant development of new technologies to enable continuous discovery in science.

DIFFERENTIAL SCANNING CALORIMETER



Chip-DSC 1

Chip-DSC 10



Chip-DSC 100

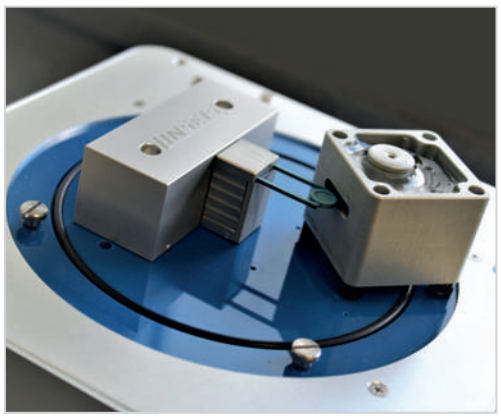
The DSC Principle

The Differential Scanning Calorimetry (DSC) is the most popular thermal analysis technique to measure endothermic and exothermic transitions as a function of temperature.

The instrument is used to characterize polymers, pharmaceuticals, foods/biologicals, organic and inorganic chemicals. Transitions measured include glass transition, melting, crystallization, curing, cure kinetics, oxidation induction time and heat capacity.

Unsurpassed performance

- **Revolutionary sensor design** – combined heat flux sensor and furnace in one chip.
- **Unsurpassed sensitivity** – for detection of melts and weak transitions
- **Benchmark resolution** – precise separation of close lying events
- **Reliable automation** – up to 96 position autosampler
- **Widest temperature range** – from -180 °C to 600°C in one measurement



The LINSEIS Differential Scanning Calorimeters (DSC) operate in agreement with national and international standards such as: ASTM C 351, D 3417, D 3418, D 3895, D 4565, E 793,
E 794, DIN 51004, 51007, 53765, 65467, DIN EN 728, ISO 10837, 11357, 11409.

INTEGRATED CHIP TECHNOLOGY

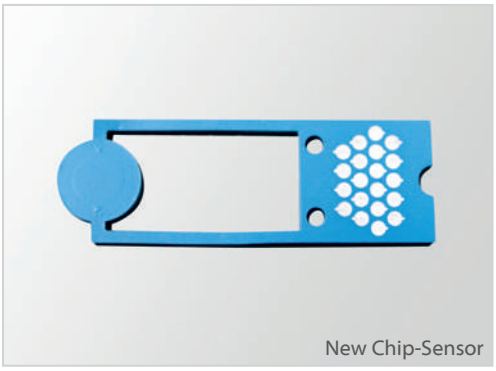
Reinventing Differential Scanning Calorimetry (DSC) – Integrated chip technology for your application needs

Revolutionary Sensor Concept

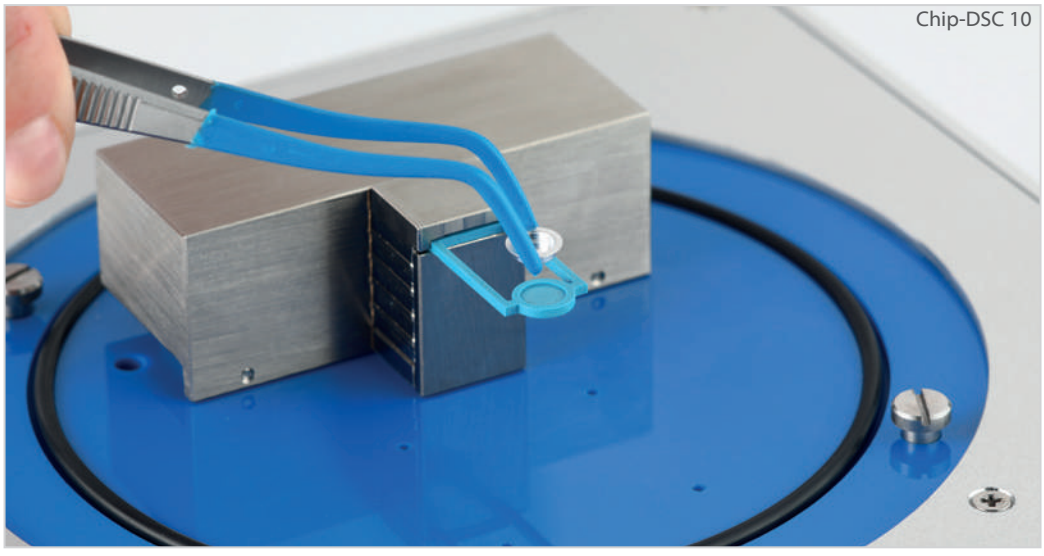
The novel Chip-DSC integrates all essential parts of DSC: furnace, sensor and electronics in a miniaturized arrangement. The chip-arrangement comprises the heater and temperature sensor in a chemically inert ceramic arrangement with metallic heater and temperature sensor.

This arrangement allows superior reproducibility and due to the low thermal mass outstanding temperature control and heating rates of up to 1000 K/min. The integrated sensor is easily user exchangeable and available at a low cost.

The integrated design of the chip-sensor delivers superior raw data, which enables a direct analysis without pre- or post-processing of heat flow data.



New Chip-Sensor



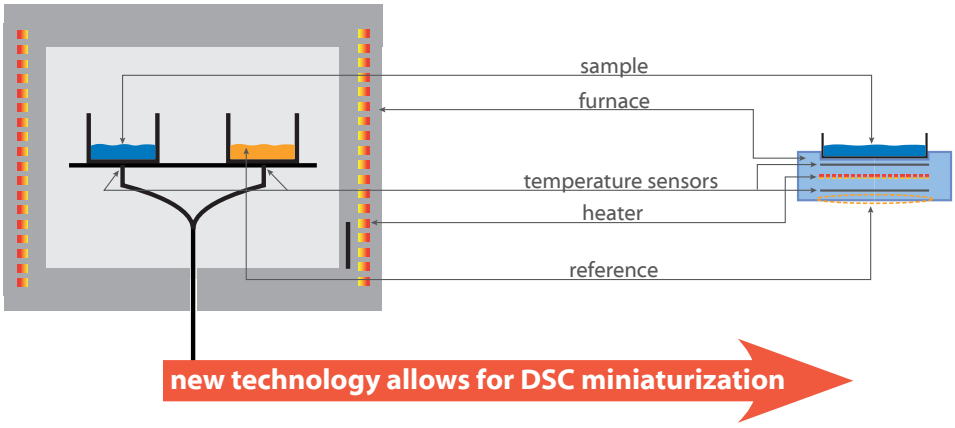
Chip-DSC 10

Small Footprint

The compact construction leads to a significant reduction in production cost which can be passed on to our customers. The low energy consumption and unrivaled dynamic response results in unsurpassed performance of this revolutionary DSC-concept.

Usual DSC

New chip technology



Chip reduction: similar to the memory cards

COOLING OPTIONS

Peltier-cooling system (0 – 600°C)

This is a Peltier cooled heat exchanger. The simple to install accessory reduces the starting temperature of the DSC-sensor by 20°C in regards to room temperature. Due to the low thermal mass of the sensor the DSC can now reach linear heating from 10°C onwards. With this starting temperature 90% of polymer applications can be covered.

Closed-loop intracooler (-100 – 600°C)

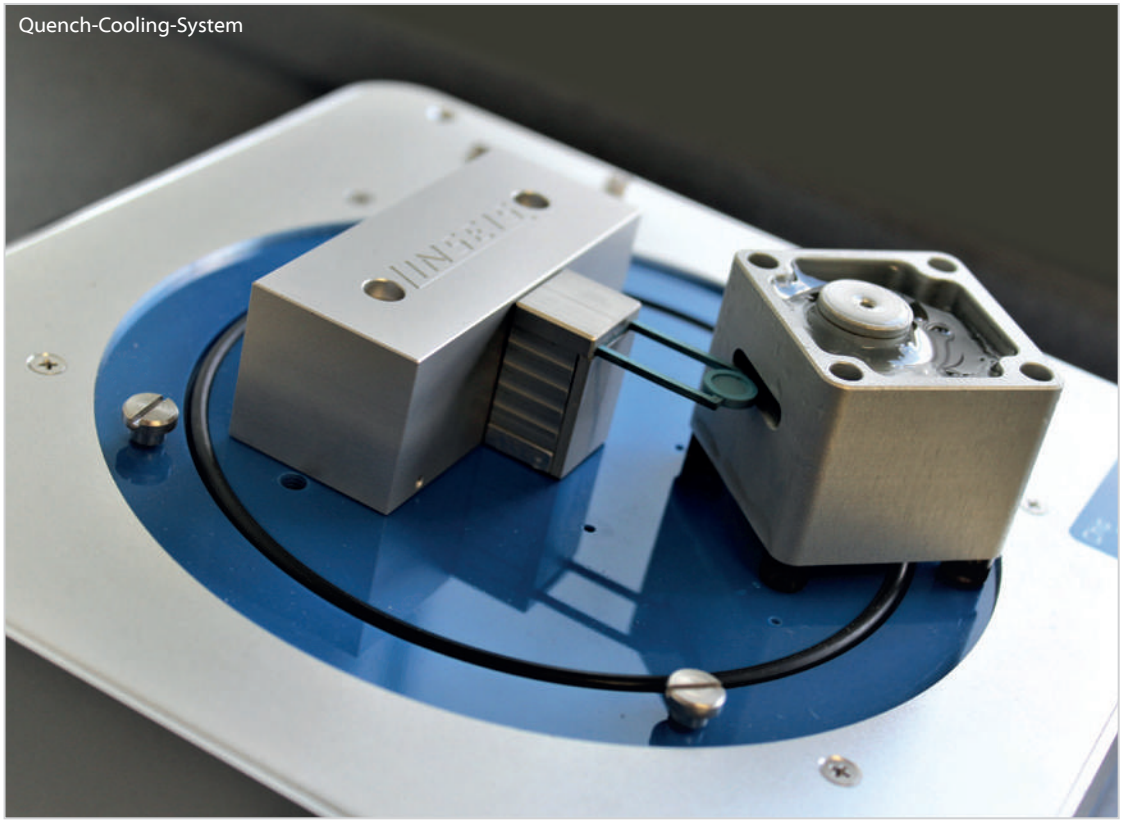
Closed cycle refrigerated cooling system. Can cool down to -100°C. This intracooler eliminates the need of refilling LN_2 for cooling purposes.

LN_2-cooling system (-150 – 600°C)

Controlled cooling system for ultra-low temperature application down to -150°C. This accessory provides the openest flexibility and cooling capacity of all available options.

Quench-cooling-system, (-180 – 600°C)

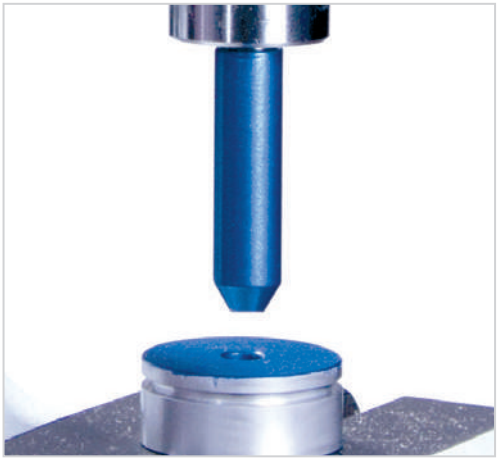
The quench-cooling accessory provides an open cooling container surrounding sensor and sample. Coolant dependent, e.g. dry ice or LN_2, sample temperature can go down to -180°C. This system does not allow defined gas atmospheres while measuring, as outgasing will surround the sample.


Quench-Cooling-System

ACCESSORIES

DSC-sample-press

For optimum sample preparation of aluminum crucibles a ergonomic sample press is available.

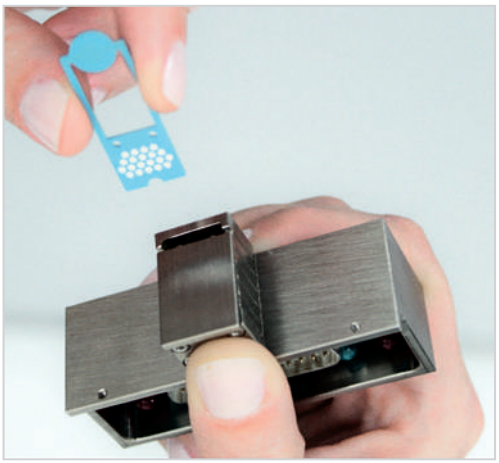


Crucibles

Various crucibles made of aluminum, alumina, copper, gold, platinum and sapphire are available for measurements with the Chip-DSC. Other crucibles are available on request.

User exchangeable Sensors

The new user exchangable sensor can be replaced within a few seconds. This innovative concept reduces the maintenance costs drastically.



3 Sensors designs to fit your needs:

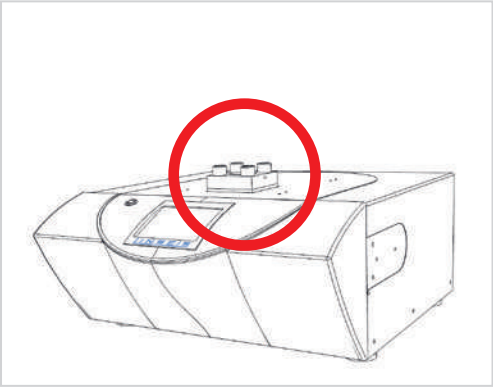
- High Resolution Sensor
- Universal Sensor
- High Speed Sensor

HARDWARE OPTIONS

HP DSC

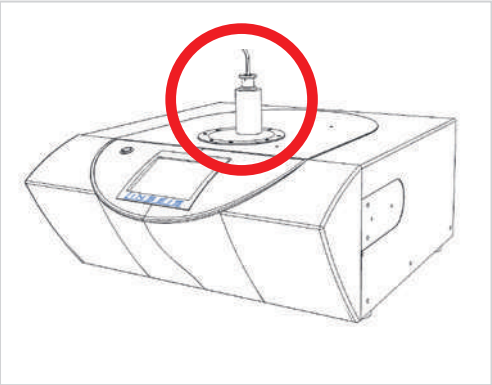
The 50/150 bar high pressure cell enables OIT stability tests to monitor aging of polymers, oils and fats.

Processes under high pressures can be simulated and optimized, e.g. sorption, chemical reactions etc.



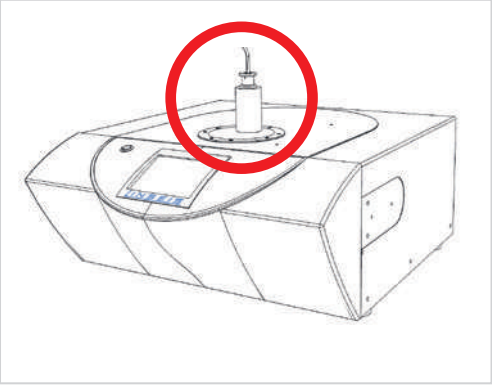
Optical DSC

The Chip-DSC 100 can be equipped with a CCD camera to observe the sample during the measurement. The visualization of the sample gives a much deeper insight to phase transitions and decomposition processes.



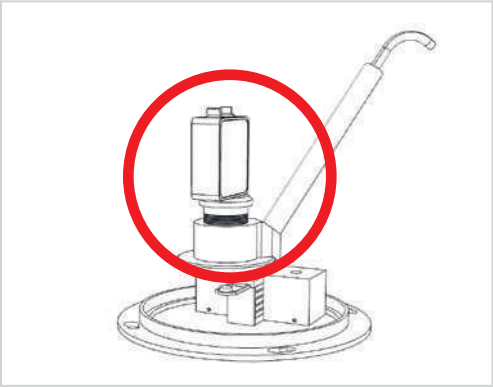
UV curing DSC

The Photo cell allows measurements under UV light to investigate UV curing systems. Due to the very short time constant of the chip sensor, also fast UV curing reactions in the smallest time scale can be measured.



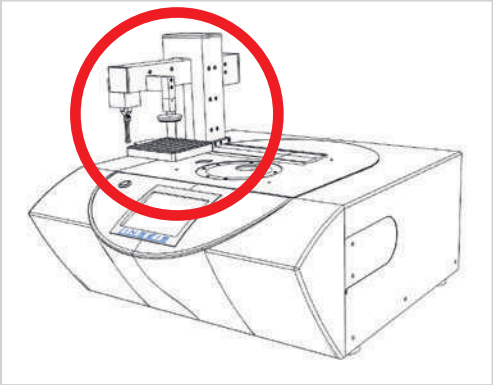
RAMAN DSC

The coupling of the Chip-DSC with a Raman spectrometer can be realized very cost effectively. In the Raman spectra the amorphous and crystalline phases can be detected very precisely and *In-Situ*.



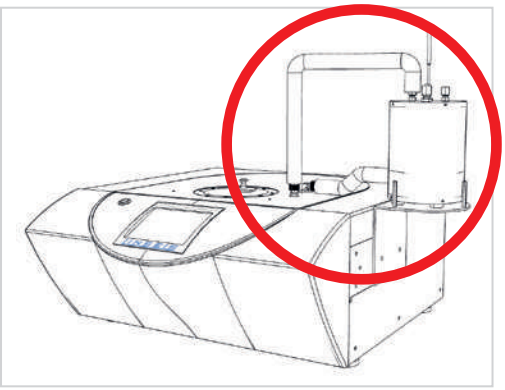
Sample Robot DSC

The sample robot for up to 96 samples increases the productivity significantly. The instrument can run automatically overnight or at the weekend. Together with the intuitive and intelligent software it reduces labour costs and saves time.



Low temperature DSC

The cooling can be realized with a variety of cooling options: intracooler, liquid nitrogen cooling or a Peltier cooling system. The available temperature range at subambient conditions can be extended down to -180°C.



SOFTWARE

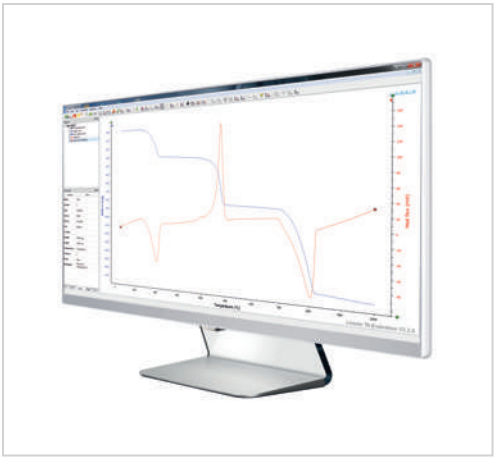
Smart Software Solutions from LINSEIS

The software greatly enhances your workflow as the intuitive data handling only requires minimum parameter input.

AutoEval offers a valuable guidance for the user when evaluating standard processes such as melting and crystallization points. The optional thermal library product identification tool, provides a database permitting an automatic identification tool for your tested polymer.

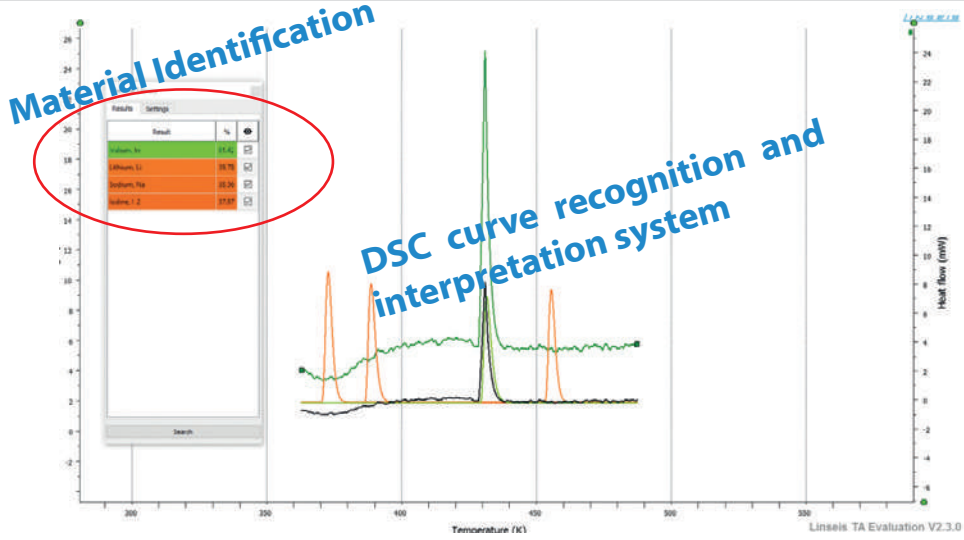
Instrument control and/or surveillance through mobile devices gives you control wherever you are.

- Software packages are compatible with latest Windows operating system
- Set up menu entries
- All specific measuring parameters (User, Lab, Sample, Company, etc.)
- Optional password and user levels
- Undo and redo function for all steps
- infinite heating, cooling or dwell time segments
- multiple language versions such as English, German, French, Spanish, Chinese, Japanese, Russian, etc. (user selectable)
- Evaluation software features a number of functions enabling a complete evaluation of all types of data
- Multiple smoothing models
- Complete evaluation history (all steps can be undone)
- Data acquisition and evaluation can be performed simultaneously
- Data can be corrected using zero correction
- Data evaluation includes: peak separation software signal correction and smoothing, first and second derivative, curve arithmetic, data peak evaluation, glass point evaluation, slope correction, zoom / individual segment display, multiple curve overlay, annotation and drawing tools, copy to clipboard function, multiple export features for graphic and data export, reference based correction.



Thermal Library

The LINSEIS Thermal Library software package comes as an option for the well-known, user friendly LINSEIS evaluation software that is integrated in almost all our instruments. The Thermal Library allows the comparison of the complete curves with a data base providing hundreds of references and standard materials within only seconds.



Measured and matching reference curves (green) and reference curves with poor fit (red).

Multi-Instrument

All LINSEIS instruments DSC, DIL, STA, HFM, LFA, etc. can be controlled from one software template.

Multi-Lingual

Our software is available in many different user exchangeable languages, such as: English, Spanish, French, German, Chinese, Korean, Japanese, etc.

Multi-User

The administrator can generate different user levels providing different rights to operate the instrument. An optional Log file is available, too.

Report Generator

Convenient template selection to generate customized measurement reports.

Data Base

State of the art data base design enables easy data handling.

Kinetic software

Kinetic analysis of DSC, DTA, TGA, EGA (TG-MS, TG-FTIR) data for the study of the thermal behavior of raw materials and products.

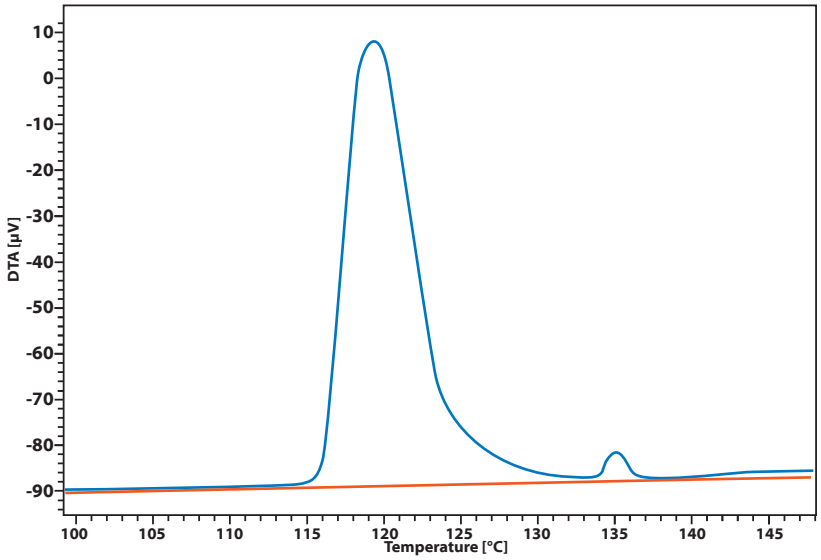
SPECIFICATIONS

	Chip-DSC 1	Chip-DSC 10	Chip-DSC 100
Temperature range	RT up to 450 °C (no cooling option available)	RT up to 600°C -180 up to 600°C (with optional LN_2 quench cooling)	-150 up to 600°C (Peltier cooling system, closed loop intracooler, LN_2 cooling system)
Heating and cooling rates	0.001 up to 100 K/min	0.001 up to 300 K/min	0.001 up to 1000 K/min
Temperature accuracy	+/- 0.2K	+/- 0.2K	+/- 0.2K
Temperature precision	+/- 0.02K	+/- 0.02K	+/- 0.02K
Cool down time 400°C to 50 °C	2.7 min	2.7 min	2.7 min
Digital resolution	16.8 million points	16.8 million points	16.8 million points
Resolution	0.03 µW	0.03 µW	0.03 µW
Atmospheres	inert, oxidizing (static, dynamic)	inert, oxidizing (static, dynamic)	inert, oxidizing (static, dynamic)
Measuring range	+/- 2.5 up to +/- 1000 mW	+/- 2.5 up to +/- 1000 mW	+/- 2.5 up to +/- 1000 mW
Calibration materials	included	included	included
Calibration	recommended 6-month interval	recommended 6-month interval	recommended 6-month interval

Up to 80% less power consumption than standard DSC-instruments!

APPLICATION TAWN TEST

TAWN Test – Resolution



LINSEIS Chip-DSC TAWN I Resolution Test 20K/min

Scope

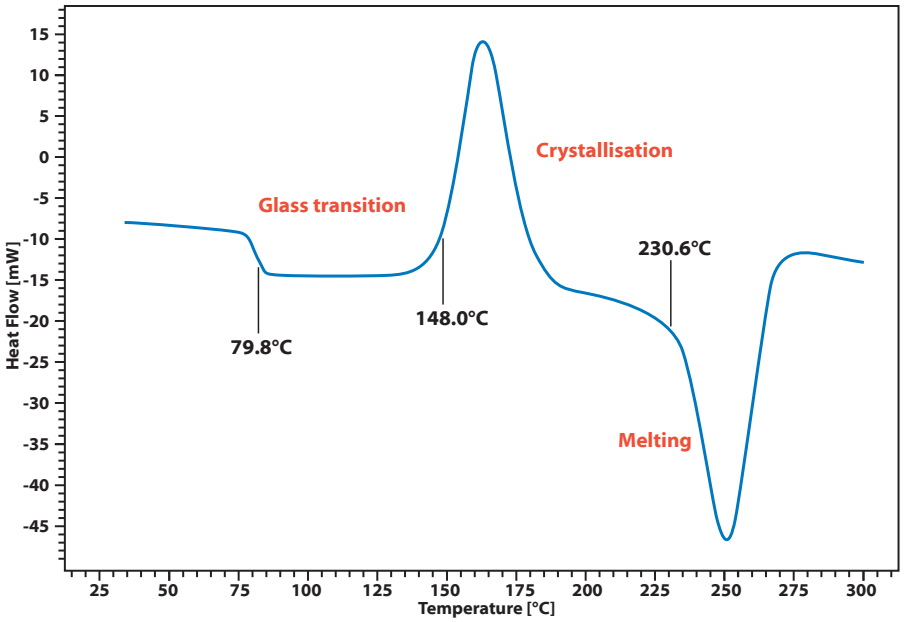
4,4´-Azoxyanisole reference material was used to perform the so called TAWN test. The substance forms a liquid crystalline phase at 120°C which transforms into a further liquid phase at 134°C with a small activation energy barrier in a second step.

This "double peak" is used in the TAWN test to investigate sensitivity and resolution of a DSC system and compare different DSC instruments with each other.

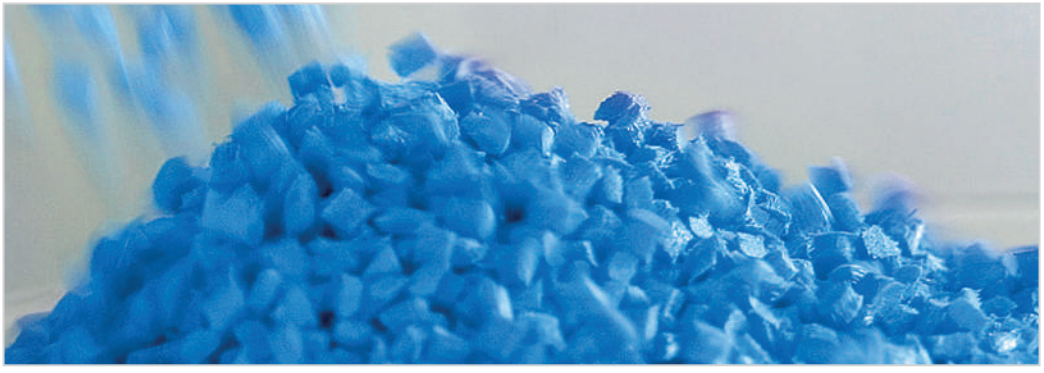
For the test an open aluminum crucible has to be used. The atmosphere must be air, argon or nitrogen, in this case we used air. The resolution is investigated with 5 mg of test substance and a heating rate of 20 K/min. The distance between the baseline to the minimum of the curve between the two peaks is measured. The ratio of this height to the height of the second peak is the resolution. The result of 0.13 is an excellent one.

APPLICATIONS

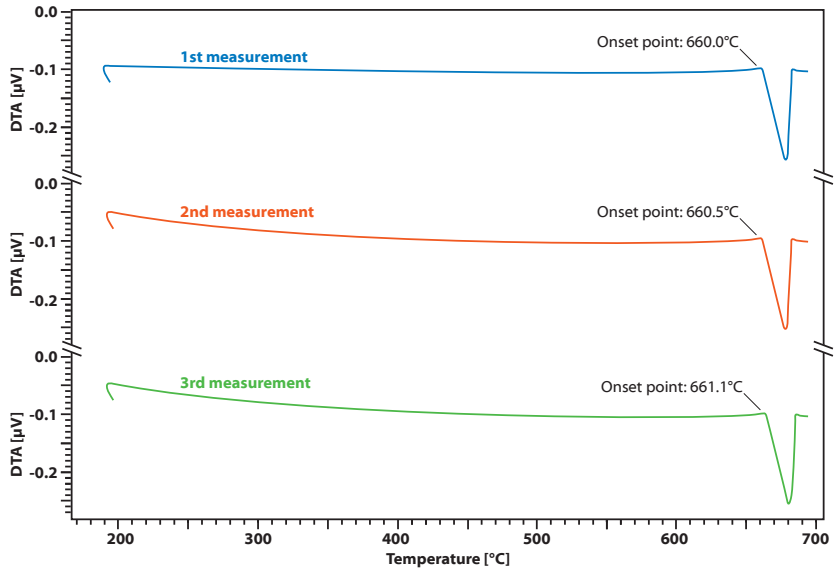
Measurement of PET granulate



The analysis of polymers is one of the main applications of DSC. Effects like glass transitions, melting and crystallization points are of interest and often very hard to detect. The new LINSEIS Chip-DSC provides high resolution and sensitivity, making it an ideal instrument for this kind of analysis. As an example, a PET granulate was heated, quench cooled to freeze the amorphous state and afterwards analyzed by Chip-DSC with a linear heating rate of 50 K/min. The curve shows a significant glass transition around 80°C, followed by a cold crystallization of the amorphous parts starting around 148°C and a melting peak at 230°C.

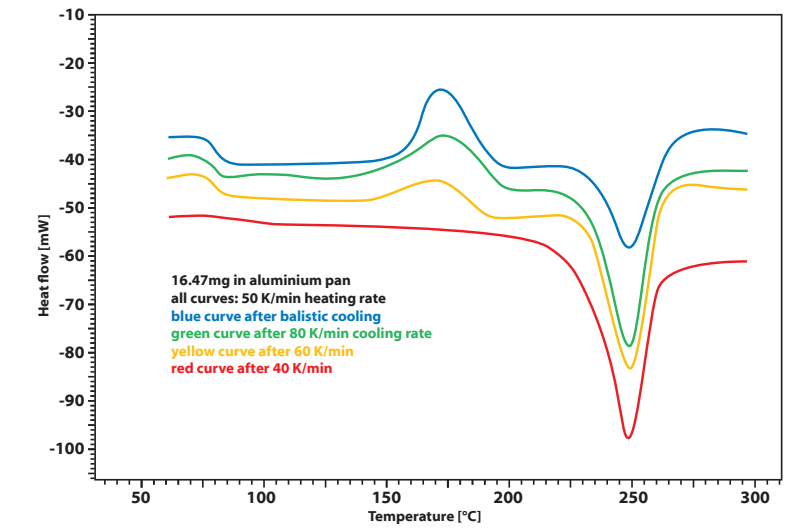


High(est) temperature reproducibility test for Chip-DSC



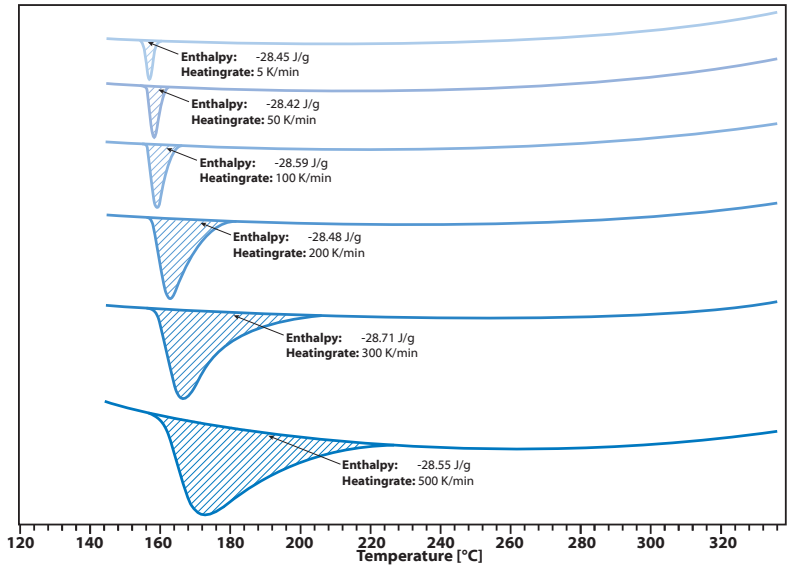
To find out the limits of the Chip-DSC 700/S system, some more temperature tests were performed on the sensor. An Aluminum reference material was used to prove the temperature stability of the sensor and its behavior at these high temperatures. The sensor was heated to 700 °C to show the melting peak of the Aluminum. During the durability test, this heating cycle was repeated 50 times and the sensor was still intact. The sensor can therefore also be pushed to its limits at 50 K/min, which is the advantage of the new, miniaturized sensor design. Due to the high temperature, convection and thermal radiation have a much higher influence on the measurement. This leads to a deviation of up to +- 1 K. This limit for the accuracy at the highest temperatures allows access to the higher temperature range up to 700 °C.

PET Cooling



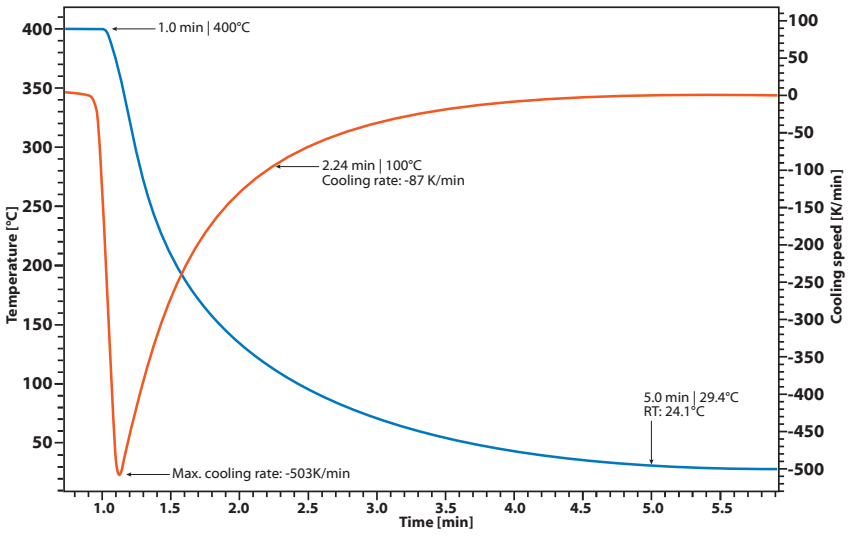
Depending on the cooling rate, the grade of crystallinity of the polymer changes significantly. During a following heating run, cold crystallization can only be observed if crystallization was not completed during a fast cooling run. If the previous cooling was slow, no glass transition or crystallization can be observed. Without the need of any active cooling such experiments with high cooling rates can be performed.

Indium sample: High heating rates



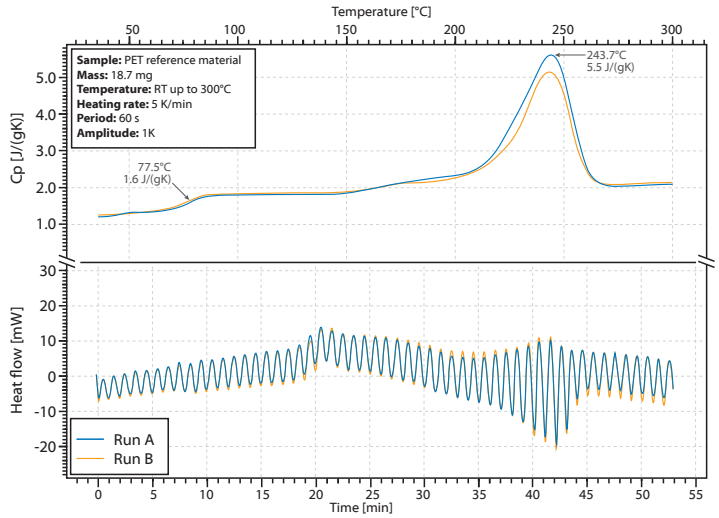
Extremely high heating rates up to 1000K/min can be achieved while the reproducibility of the melting enthalpy remains excellent.
The example shows the melting point of Indium measured with different heating rates (5 K/min; 50 K/min; 100K/min; 200K/min; 300 K/min and 500K/min).

High cooling rates without active cooling



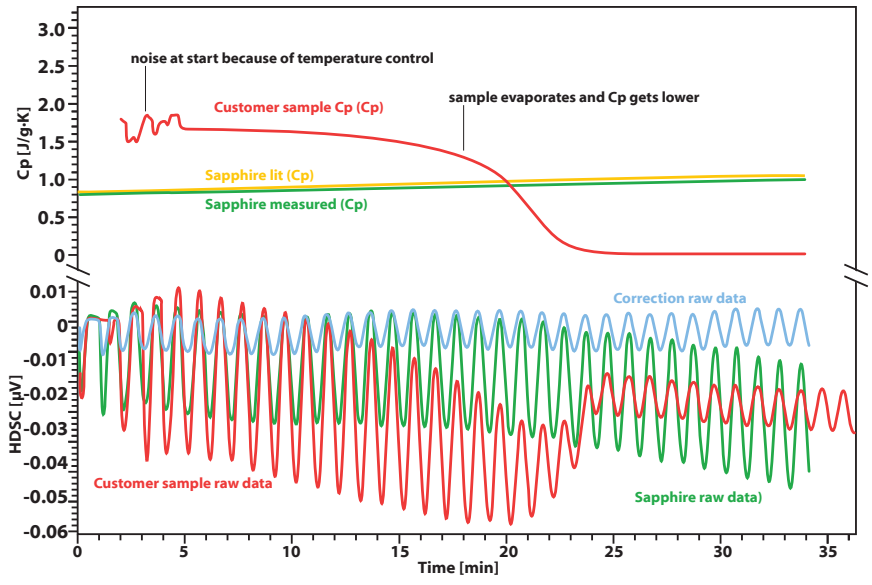
The LINSEIS Chip-DSC allows fastest possible ballistic cooling rates without any active cooler needed. Due to the low thermal mass and innovative sensor design, cooling rates up to 500 K/min from 400°C on can be reached. Even cooling to 100°C can be done with cooling rates of up to 90 K/min. A cooling from 400°C down to 30°C can be done in 4 minutes just by ballistic colling without need of any additional cooling devices.
Of course, the signal can still be evaluated during that cooling segment and does not lose sensitivity or accuracy.
This means that a complete analysis including heating and cooling can be done in only 10 minutes without any need for optional cooling devices.

Polymer sample – Specific heat capacity / modulated measurement



For the determination of specific heat, many methods are available but not always every method provides proper results. It depends very much on the sample type and shape, if a method can be used for cp determination or not. DSC in general is a common technique to measure temperature dependent cp, however sometimes it is not easy to perform. Especially if the sample is not solid or undergoes phase changes within the measured temperature range.

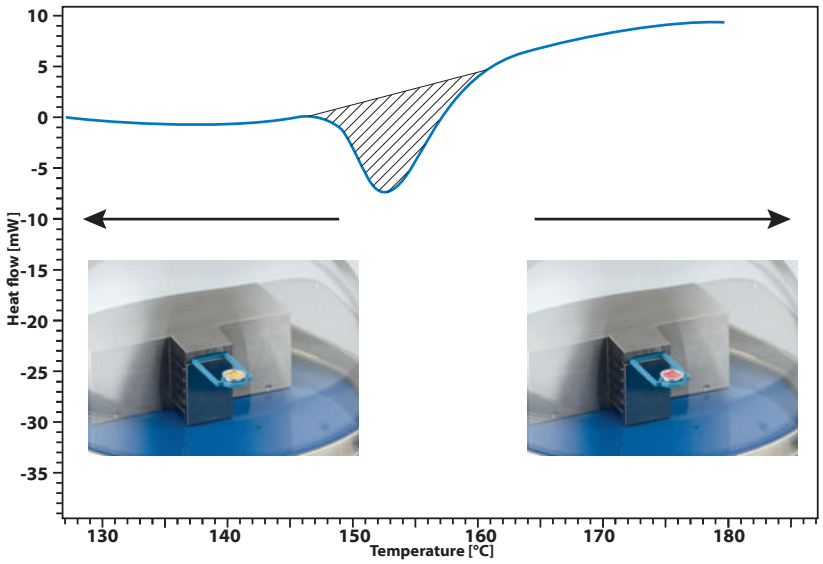
Cp of PET



Beside the caloric measurements of phase transitions and reactions, the Chip-DSC is also able to determine the specific heat capacity. The Chip-DSC can realize this with only one crucible by using a definite temperature- modulated heating rate. Therefore a calibration measurement with a reference material (like sapphire) is recorded, followed by the measurement of the unknown sample that can be evaluated using this calibration.

The measurement shows the modulated measurement of heat capacity of sapphire at a heating rate of 10 K/min with amplitude of 3 K. Cp was determined with an error of 2%, representing an outstanding performance.

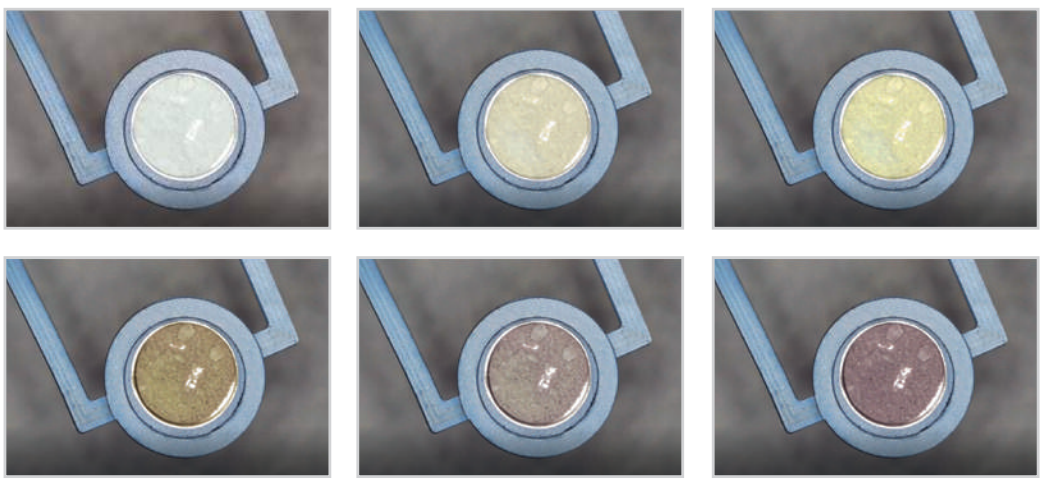
Thermochromism



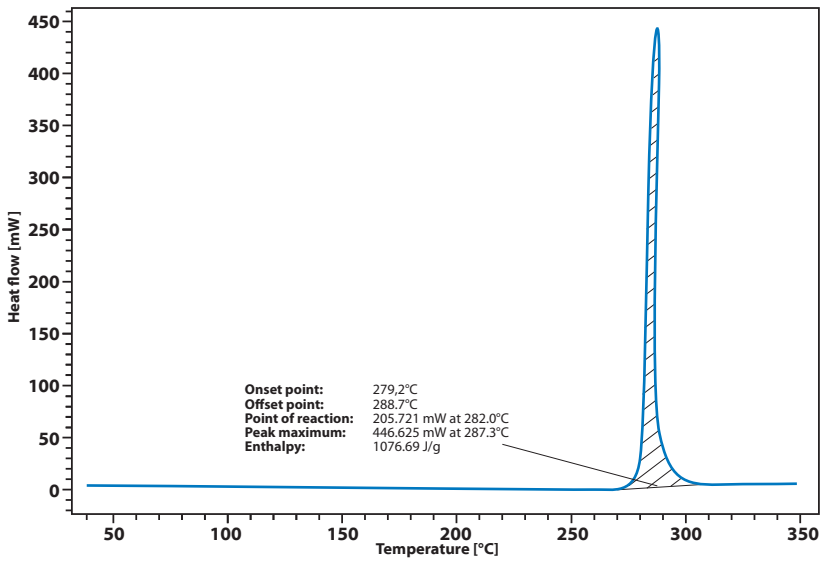
In classical DSC instruments the sample cannot be observed during the measurement. Observation can give further useful information (forming of bubbles, fumes, change of color, etc.).

The graphic above shows an example of a thermochromic material, showing an endothermic phase transition between 150°C and 160°C. The phases have different colors and the color change from red to yellow can be seen through the transparent cover. A camera option for recording images is available.

Gradient of a sample during a measurement



Highly energetic materials

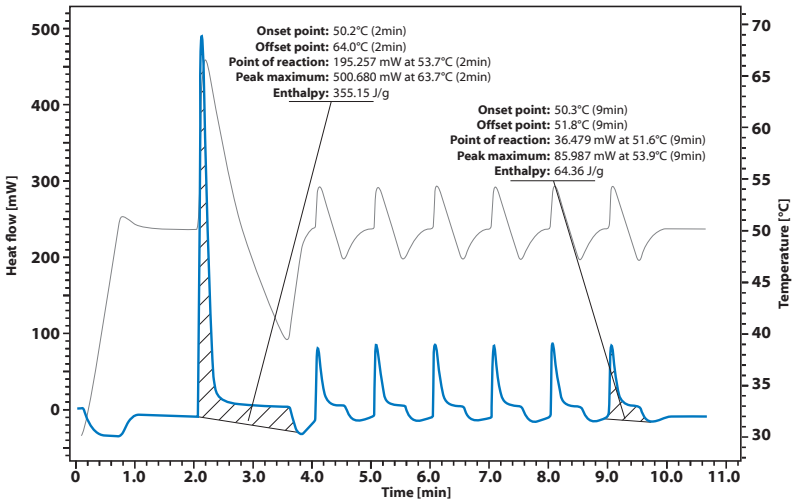


Highly energetic materials are used in airbags, as propellants, blasting materials etc.

For any type of DSC instrument, there is a risk of damaging the sensor and even the furnace. In the Chip-DSC, the chip (integrating sensor and furnace) can be easily replaced by the operator at low cost and in a short time. In case of a damage to the instrument, the downtime of the instrument is reduced drastically. Change of the sensor needs only some seconds and the calibartion can be done in approx. 15 minutes.

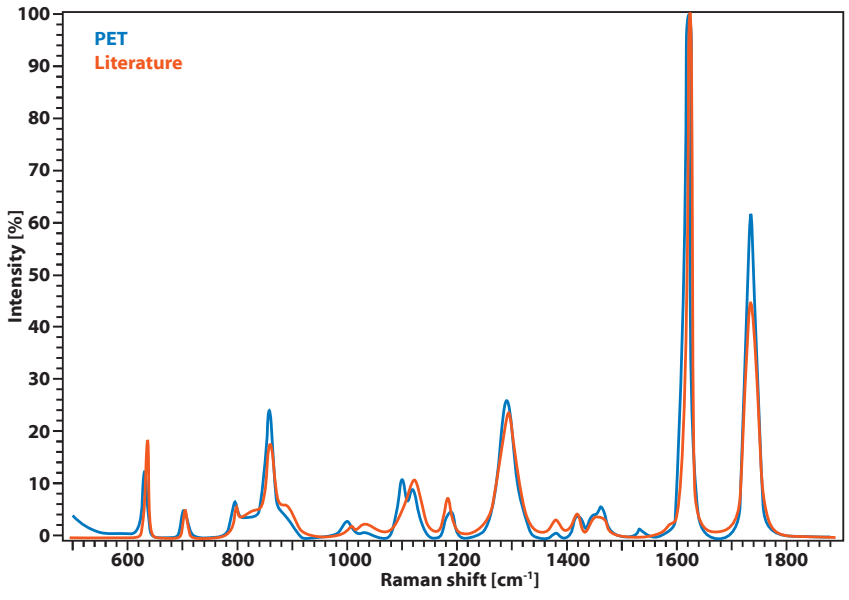
The example shows the DSC diagram of 2,8 mg of airbag igniter.

UV curing of polymers



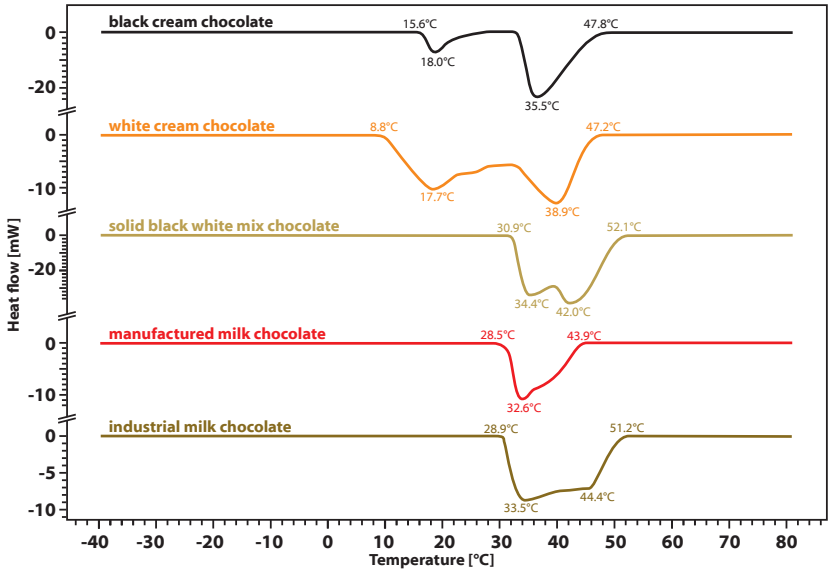
The Linseis Chip DSC in combination with an UV/LED source is a powerful tool for the characterization of fast photocurable resin systems [L. Gonzales, University of Bayreuth].
In this specific case, a mixture of a photocurable acrylate and thermally curable epoxy was used and around 10 mg of material was placed in an open crucible and irradiated with several UV light pulses until no change in peak area was detected.
The difference between the first irradiation peak and the last one, (when the area under the peak reaches a plateau, thus it is assumed that no reaction is taking place), is calculated to determine the heat of reaction for the UV-curing part, and to derive a conversion curve.

Raman measurement



Measurements using a DSC are a powerful tool to determine material properties or to perform material identification. However, due to the ever increasing combination of different materials of similar or very different nature, it is sometimes difficult to determine the clear origin of a reaction. Therefore, DSC measurement is often combined with other investigation methods such as Raman spectroscopy.

Thermal analysis of chocolate



A very interesting application for DSC is the analysis of chocolate. It helps to investigate the melting behavior, melting temperature and fat content of different mixtures and therefore it is crucial for the design of a tasty, creamy product. The figure shows DSC profiles of five different chocolate samples. Each sample was precooled with liquid nitrogen to -40°C and then measured using the same conditions and similar sample mass.

The result shows that nearly all tested chocolates show a double peak that is caused by low melting milk fats and higher melting vegetable plant fats.

The quality of emulsifiers and melting temperature can be compared and used for QC and product design. In this example, the handmade chocolate shows a much more homogeneous melting behavior than cheaper industrial chocolate.

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www.linseis.com

Products: DIL, TG, STA, DSC, HDSC, DTA, TMA, MS/FTIR, In-Situ EGA, Laser Flash, Seebeck Effect, Thin Film Analyzer, Hall-Effect
Services: Service Lab, Calibration Service

11/22

LINSEIS

pushing boundaries

DSC L63

Differential Scanning **Calorimeter**

WWW.LINSEIS.COM

Since 1957 LINSEIS Corporation has been delivering outstanding service, know-how and leading innovative products in the field of thermal analysis and thermo-physical properties.

Customer satisfaction, innovation, flexibility, and high quality are what LINSEIS represents. Thanks to these fundamentals, our company enjoys an exceptional reputation among the leading scientific and industrial organizations. LINSEIS has been offering highly innovative benchmark products for many years.

The LINSEIS business unit of thermal analysis is involved in the complete range of thermoanalytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials, and environmental analytics. In addition, thermophysical properties of solids, liquids, and melts can be analyzed.

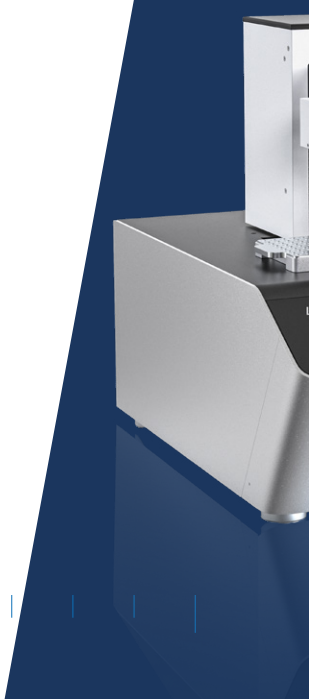
Rooted in a strong family tradition, LINSEIS is proudly steered into its third generation, maintaining its core values and commitment to excellence, which have been passed down through the family leadership. This generational continuity strengthens our dedication to innovation and quality, embodying the essence of a true family-run business.

LINSEIS provides technological leadership. We develop and manufacture thermoanalytic and thermophysical testing equipment to the highest standards and precision. Due to our innovative drive and precision, we are a leading manufacturer of thermal analysis equipment.

The development of thermoanalytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

C L A U S L I N S E I S

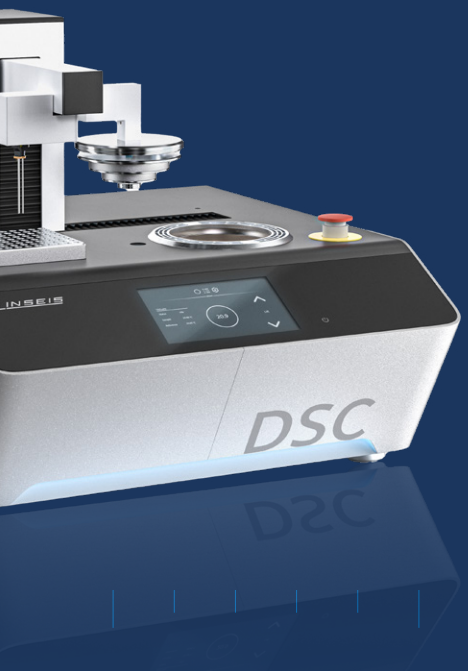
C E O D I P L . P H Y S .



Engineering & Innovation

To strive for the best due diligence and accountability is part of our DNA. Our history is affected by German engineering and strict quality control.

We want to deliver the latest and best technology for our customers. LINSEIS continues to innovate and enhance our existing thermal analyzers. Our goal is to constantly develop new technologies to enable continued discovery in Science.



Differential Scanning **Calorimetry**

Differential Scanning Calorimetry (DSC) is one of the central methods of thermal analysis: Indispensable when it comes to precisely investigating endothermic and exothermic transitions. It provides detailed insights into the thermal behavior of materials – as a function of temperature and time with high significance.

Typical applications range from the characterization of polymers, pharmaceuticals, foodstuffs to organic and inorganic substances. Measurable transitions include glass transitions, melting, crystallization, curing, reaction kinetics, oxidation stability (OIT) as well as heat capacities.

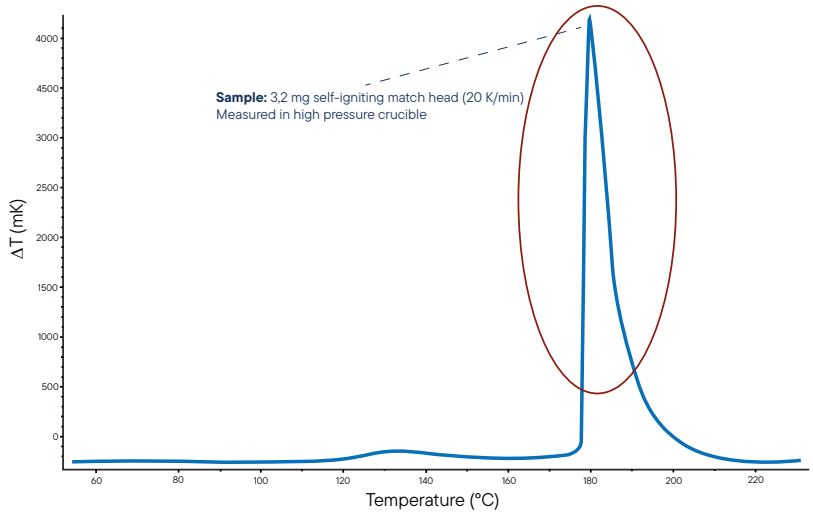
Thanks to its high sensitivity and reproducibility, the LINSEIS DSC L63 is an indispensable tool in research, development and quality assurance—whenever thermal properties determine material behavior, processability or durability.

Unsurpassed performance

- Unsurpassed Sensitivity
  Ideal for detecting melts and weak transitions
- Benchmark Resolution
  Precise separation of close lying events
- Reliable Automation
  Up to 90 position autosampler
- Widest Temperature Range
  From -170 °C up to 750 °C in one measurement

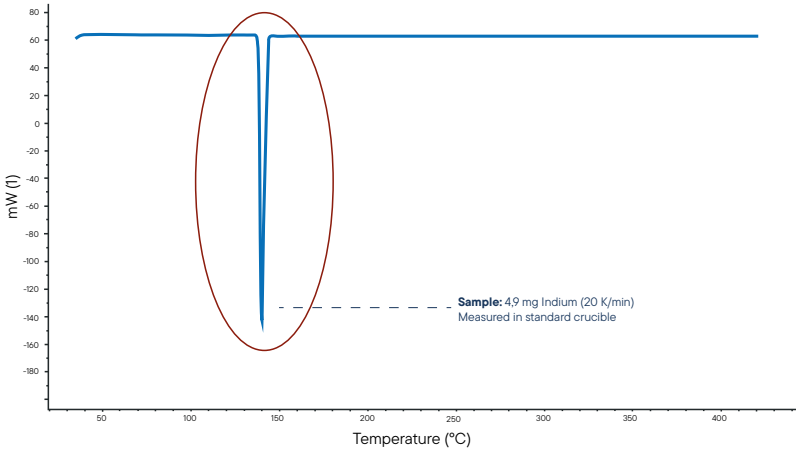
The LINSEIS DSC's operate in agreement with national and international standards

ASTM E967 · E968 · E793 · D3895 · D3417 · D3418
DIN 51004 · 51007 · 53765
ISO 11357



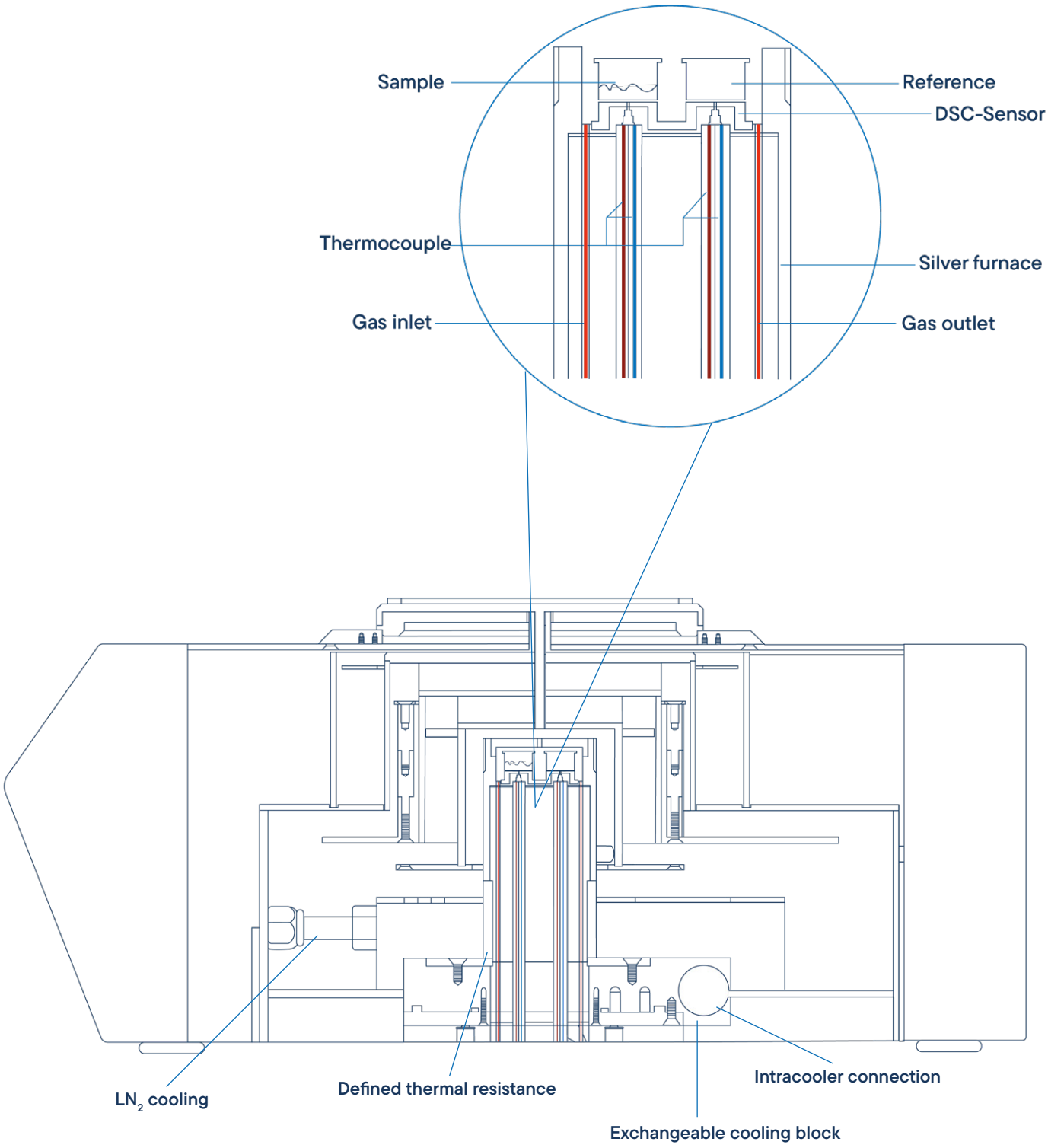
Exothermic Events

- Oxidation
- Cure Reactions
- Crystallization
- Polymorphic Transitions
- Decomposition



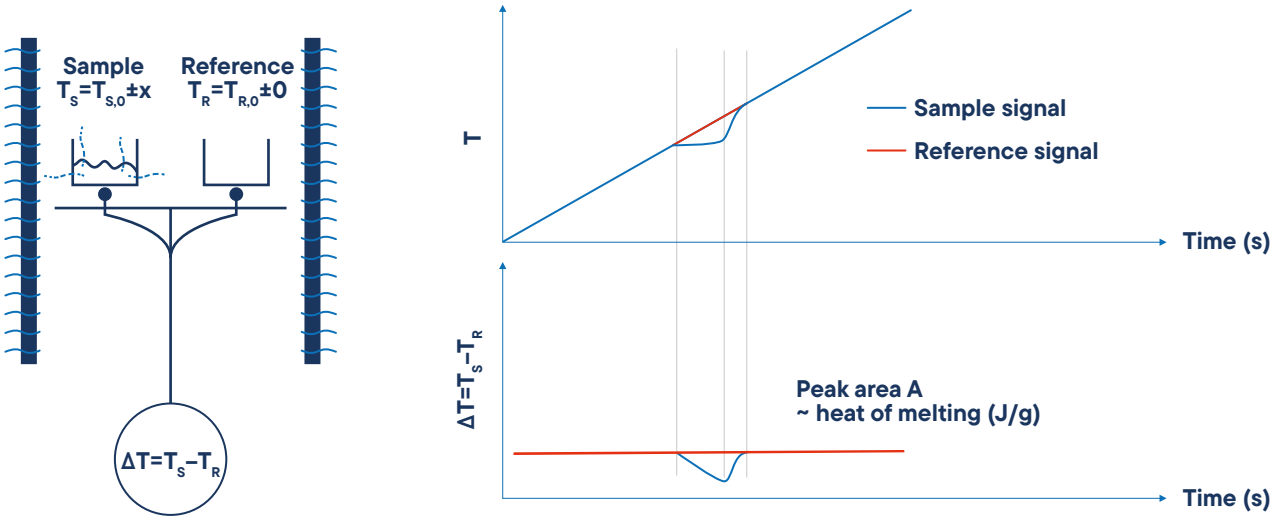
Endothermic Events

- Melting
- Glass transitions
- Enthalpic Recovery
- Polymorphic Transitions
- Evoration/Volatilization
- Decompositions


Sample
Reference
DSC-Sensor
Thermocouple
Silver furnace
Gas inlet
Gas outlet
LN2 cooling
Defined thermal resistance
Intracooler connection
Exchangeable cooling block

DSC-True Heat Flow measurement

Quantitative DSC-signal



Differential Scanning Calorimetry (DSC)

A technique in which the difference in energy input into a substance and a reference material is measured as a function of temperature, while the substance and reference material are subjected to a controlled temperature program.

Differential Signal

The differential signal is displayed as a baseline. Effects, for example the melting of a metal, can be observed as a peak. The area of the peak gives the amount of enthalpy and the direction of the peak indicates the way of heat flux – endothermic (down) or exothermic (up).

Temperature vs. Time

During an effect like a reaction, decomposition or phase transition, a temperature difference (heat flux difference) between the sample and the reference crucible can be measured by means of a thermocouple.

Measurable Properties

- Glass point
- Crystallinity
- Thermal stability
- Oxidation stability
- Purity
- Solidus relationship
- Liquidus relationship
- Product identification

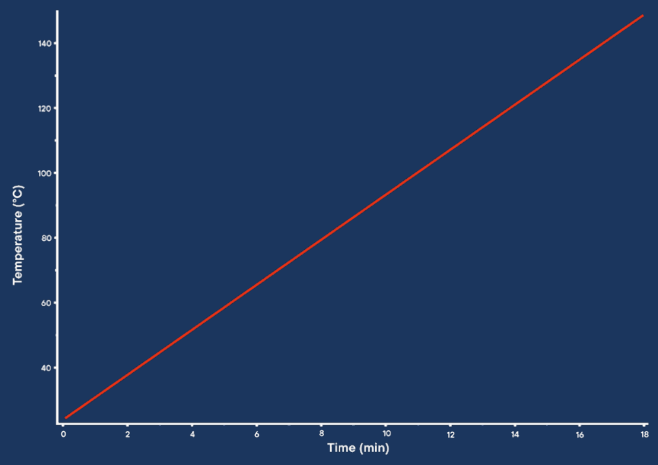
Modulated **DSC**

Differential Scanning Calorimetry (DSC) is an established method for analysing thermal transitions and reactions in materials. In classic DSC, measurements are taken at a constant heating rate, recording the entire heat flow generated by endothermic or exothermic processes. This provides reliable information about melting, glass transitions or crystallisation, for example.

Modulated DSC (MDSC) extends this principle: an additional sinusoidal temperature modulation allows the measured heat flow to be separated into reversible (e.g. glass transitions, melting) and non-reversible components (e.g. crystallisation, relaxation).
This makes it easier to differentiate between overlapping effects – a significant advantage for complex materials or weak transitions.
The precise determination of specific heat capacity (Cp) is particularly valuable in the study of polymers, composites and many others, as it reflects the material's ability to store thermal energy.

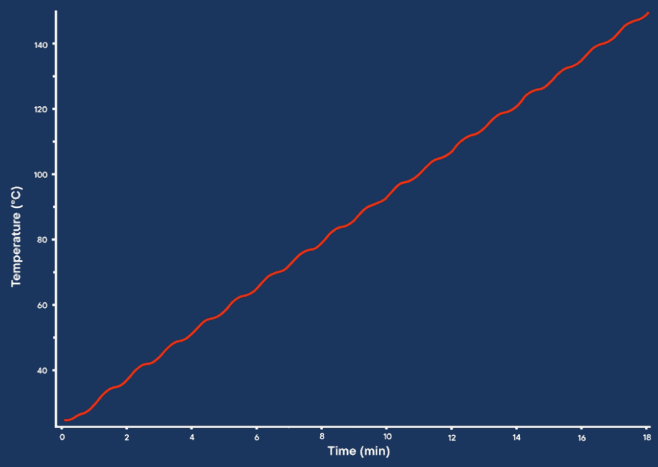
Conventional DSC measurements are based on a linearly increasing temperature profile and enable the analysis of thermal transitions such as melting or crystallization.

$T_s(t) = T_0 + b \cdot t$

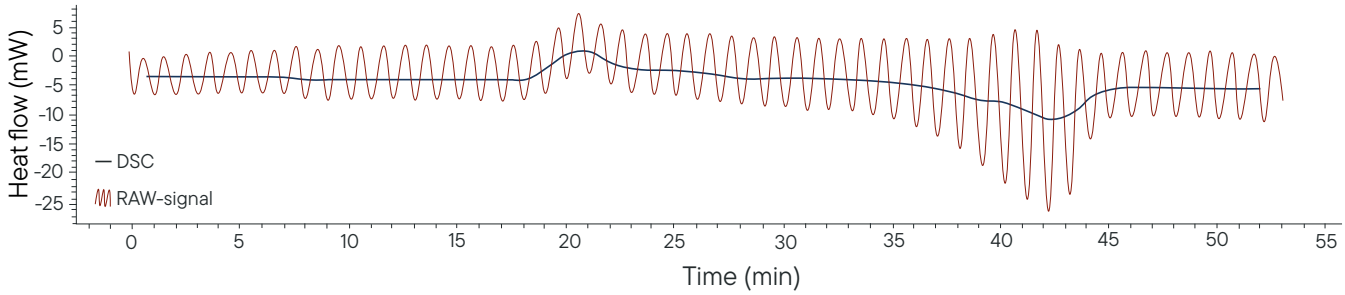


With modulated DSC, a sinusoidal modulation with a defined amplitude and period is superimposed on the linear temperature curve.

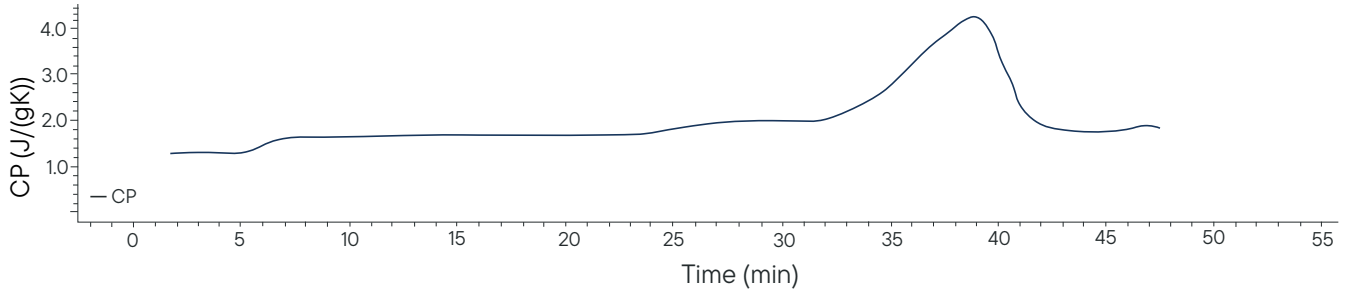
$T_s(t) = T_0 + b \cdot t + A_T \cdot sin(\omega \cdot t)$



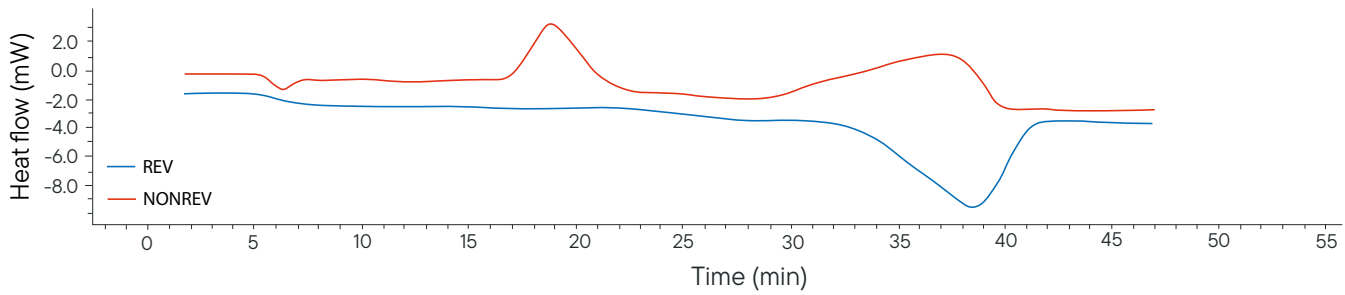
sample: **PET** reference material	heating rate: 5 K/min
weight: 18.7 mg	period: 60 s
temperatur: RT - 300 °C	amplitude: 1 K



The diagram above shows the difference between a conventional DSC measurement (dark blue) and the raw signal (red) of a modulated temperature applied to the same sample (PET).



The Cp signal, i.e. the specific heat capacity of the sample, can be derived from the measured raw signal. The diagram above shows thermal effects associated with structural changes in the sample, such as glass transitions or melting processes.



MDSC measurements allow the total signal to be separated into reversible and non-reversible components. The reversible component (shown in blue) includes effects such as glass transitions and melting, while the irreversible component (shown in red) represents phenomena such as hysteresis peaks or cold crystallisation. This differentiation is only possible with temperature-modulated measurements.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Software

The software greatly enhances your workflow as the intuitive data handling only requires minimum parameter input. LiEAP offers a valuable guidance for the user when evaluating standard processes such as melting and crystallization points.

The optional thermal library product identification tool, provides a database permitting an automatic identification tool for your tested materials such as polymers.

Data acquisition

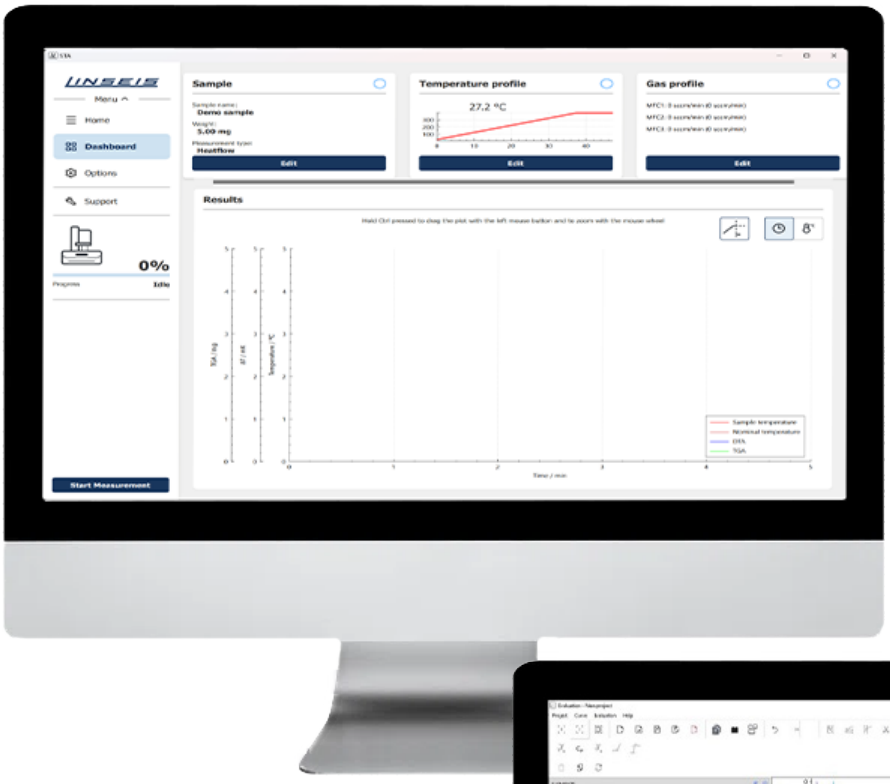
- **Shared database:**
  One software for many devices
- Compatible with the latest Windows® operating systems
- Online updates
- Automatic gas control for multiple gases and hardware types (Optional)
- Unlimited heating, cooling and dwell time segments
- Multi-language versions such as English, German, French, Chinese, Japanese, etc. (User selectable)
- Optional password protection and user access levels
- Simultaneous data acquisition and evaluation

Data evaluation

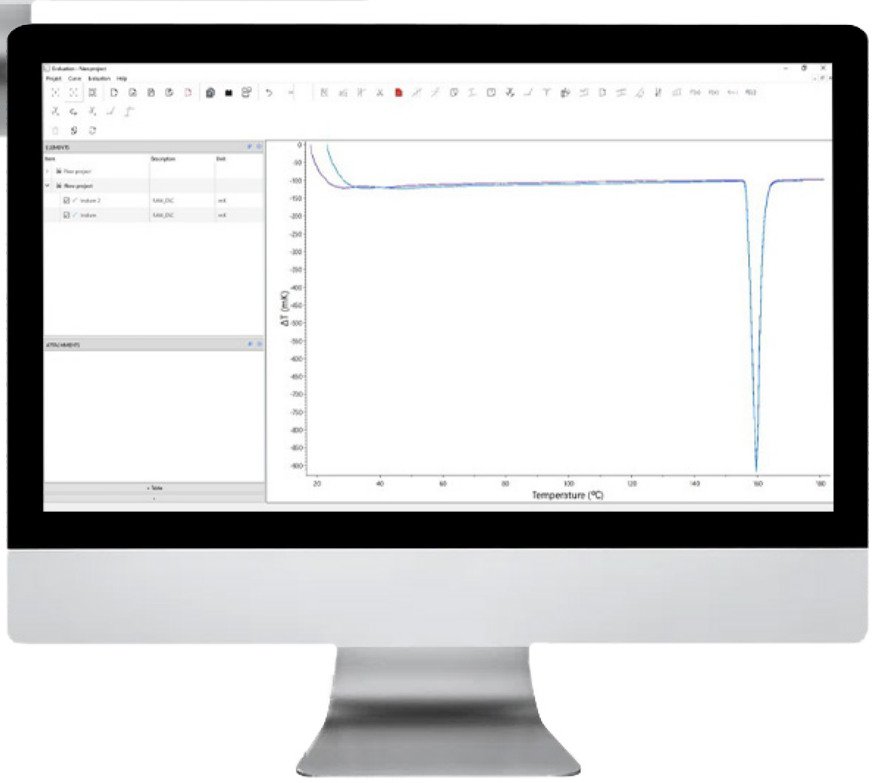
- **Includes:**
  Signal correction and smoothing, derivate/integral, arithmetic operations for curves, peak evaluation, glass point evaluation, onset-point determination, multiple curve overlay, annotation and drawing tools, copy to clipboard function, multiple export features for graphic and data export, reference based correction.
- Undo and redo function for all steps
- Complete evaluation history
- Export to various data formats
- Extendable via Python plugins

DSC L63 Software

1) View of the evaluation software with two measurements and customizable toolbars



LINSEIS Data acquisition



LINSEIS Data evaluation

2) Start view of the measurement software with an overview of all relevant measurement parameters such as temerature profile, sample information, gas profile and the result diagram

Technical **Specifications**

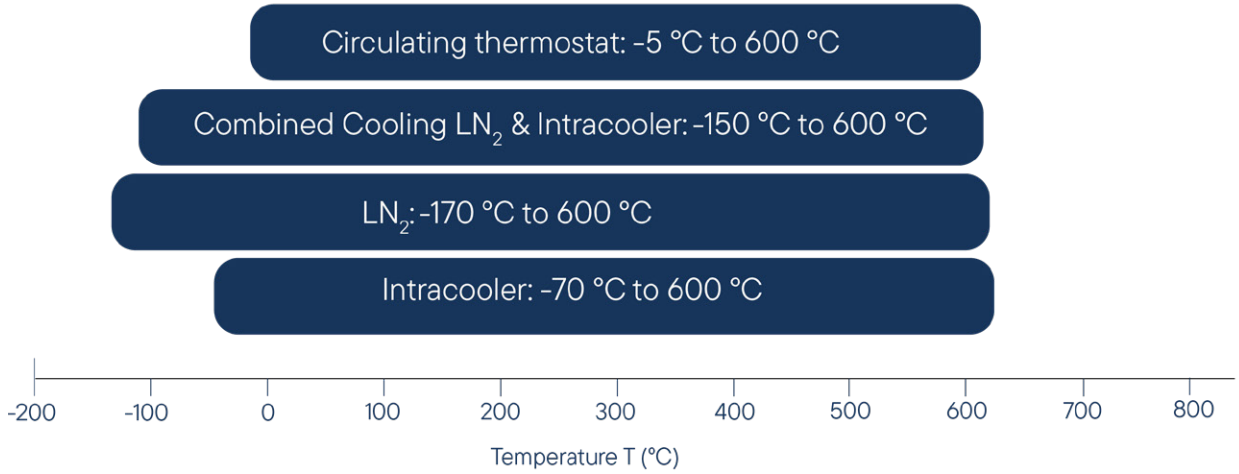
	Basic	Advanced
Heating rate	0.01 to 100 K/min	0.01 to 150 K/min
Cooling rate	Intracooler: 5 min (100 to 0 °C) LN_2: 10 min (100 to -100 °C)	Intracooler: 5 min (100 to 0 °C) LN_2: 10 min (100 to -100 °C)
Temperature range	-170 °C - 600 °C	-170 °C - 750 °C
User replaceable heatsink/cooling options	Yes	Yes
User replaceable furnace with sensors	Yes Furnace material: silver	Yes Furnace material: silver
Data capture	100 Hz	100 Hz
Temperature Accuracy	±0.1 K	±0.1 K
Enthalpy Precision	<1 % (Indium)	<1 % (Indium)
Measuring range	± 750 mW	± 750 mW
MFC (with 3 gases)*	Optional	Integrated
Unlimited warranty	Optional**	Optional**

* more gases on request
** In connection with a maintenance agreement

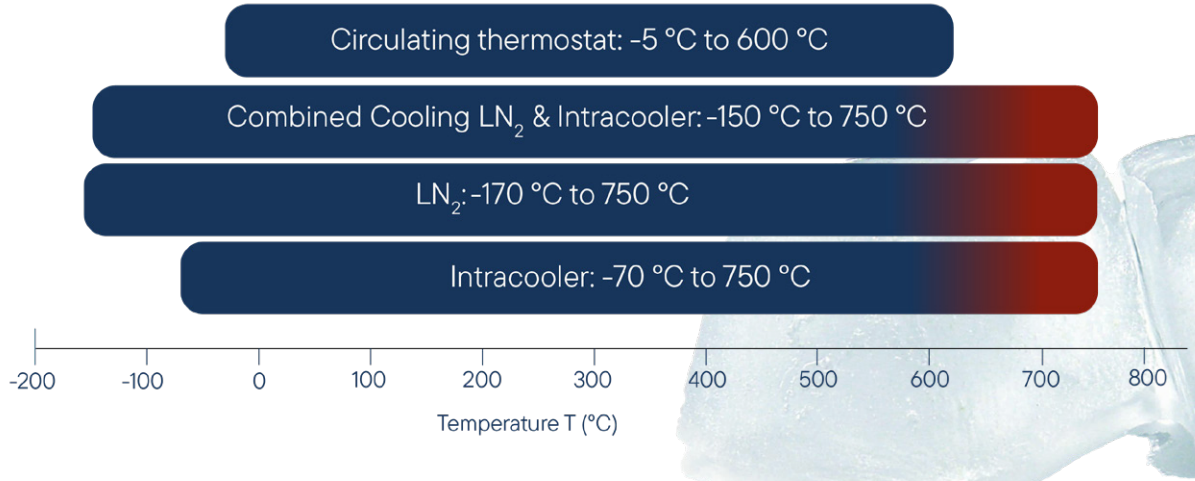
Cooling Options

Discover the variety of our interchangeable cooling systems – for maximum flexibility in **LINSEIS DSC** applications.

DSC L63 Basic



DSC L63 Advanced

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Sample
Temperature profile
Gas profile
Results
Dashboard
Start Measurement


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Applications

Research

- Specific heat capacity
- Reaction kinetics

Food

- Melting behavior of fats
- Denaturation

Pharmaceutical

- Melting point
- Stability analysis

Polymers

- Glass transition
- Crystallinity

Electronics

- Thermal stability
- Curing

Metals

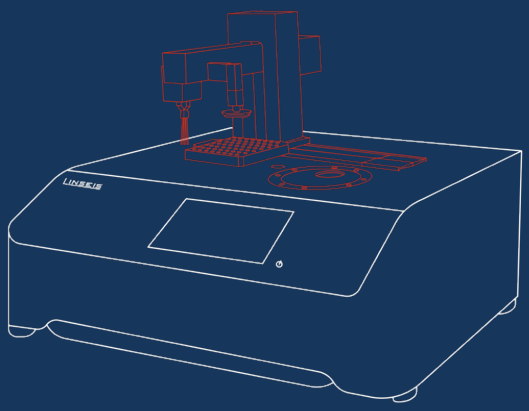
- Melting
- Solidification behavior

Accessories

Hardware options

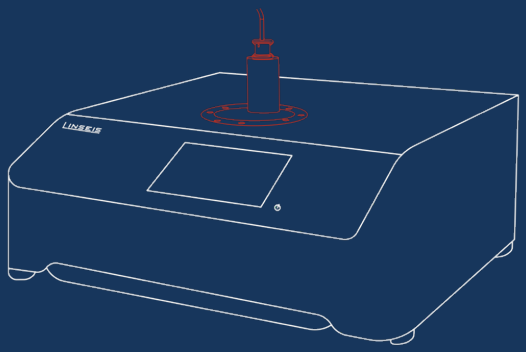
Sample Robot DSC

The sample robot for up to 90 samples increases the productivity significantly. The instrument can run automatically overnight or at the weekend. Together with the intuitive and intelligent software it reduces labour costs and saves time.



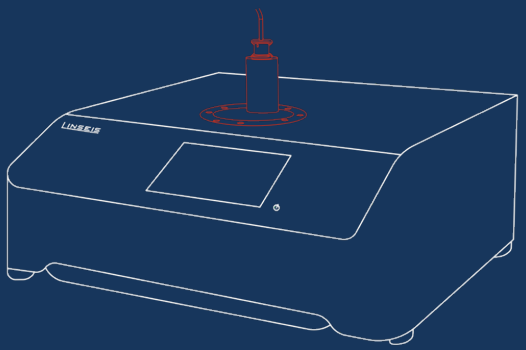
Optical DSC

The L63 DSC can be equipped with a CCD camera to observe the sample during the measurement. The visualization of the sample gives a much deeper insight to phase transitions and decomposition processes.



UV curing DSC

The Photo cell allows measurements under UV light to investigate UV curing systems. Due to the very short time constant, also fast UV curing reactions in the smallest time scale can be measured.



Service & Support

Crucibles

NAME	ORDER NUMBER	DESCRIPTION	PICTURES
Al Standard crucible 6x1,5mm 40µl	30293042	The most lightweight crucible and easy to use	
Al crimpable crucible 100µl	30293043	The biggest crucible for voluminous samples. Crimpable to measure with atmosphere	
Al crimpable crucible 40µl	30293045	The small crimpable crucible to measure with atmosphere	
Al lid without hole	30293044	Compatible with 30293043 and 30293045	
Al lid with hole	30293046	Compatible with 30293043 and 30293045	
Al crucible for foils with lid	30293050	Crimpable crucible to measure foils and powders. Special crimping tool is needed.	
Al crucible for small samples with lid	30293051 30293052	Crimpable crucible to measure small samples. Special crimping tool is needed.	
Cu crucible	30293049	The copper crucible to measure oxidation induction time and oxidation onset temperature	
High pressure crucible	20007024	Steel high pressure crucible enables the measuring under high pressure.	
Rhodium/Platin Scrucible with lid	PT087 PT082	The rhodium/platin crucible to measure the specific heat capacity.	
Al_2O_3 crucible 0,12 ml	200007018	Chemically inert universal crucible for higher temperature range	

Linseis Shop

Starter Kit advanced

A dedicated Starter Kit is available for the **DSC L63,** providing all essential components for immediate system operation. The kit includes tools for sample preparation, reference materials and accessories for safe handling and initial calibration.
This ensures that you can obtain reliable and meaningful measurement results right from the very first use.

LINSEIS Starter Kit includes:

Cutting tool

Stainless-steel tweezer

Standard pan with lid

Single-use cannulas

Single-use syringes - 2ml

PET granulat - 3,5 mm

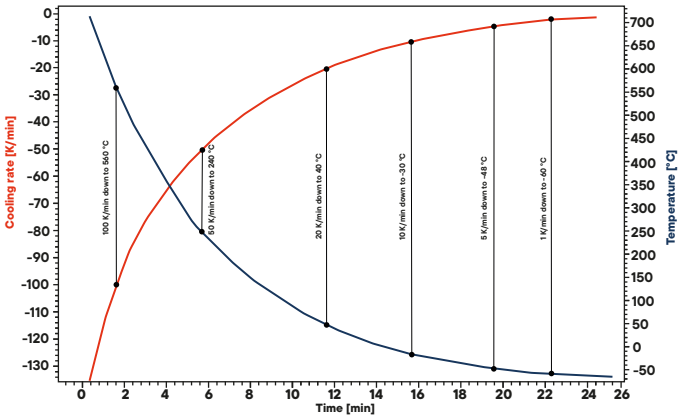
Glass sample vial - 10ml

Applications

The new DSC system offers an innovative design with a wide temperature range from -170 °C to 750 °C, without having to adjust the cooling options. This allows a more efficient workflow by eliminating time-consuming adjustments. The instrument enables seamless transitions between low and high temperatures, making it ideal for demanding applications such as material research, polymer analysis, and quality control. With its high flexibility and user-friendly operation, this DSC sets a new standard for advanced thermal analysis.

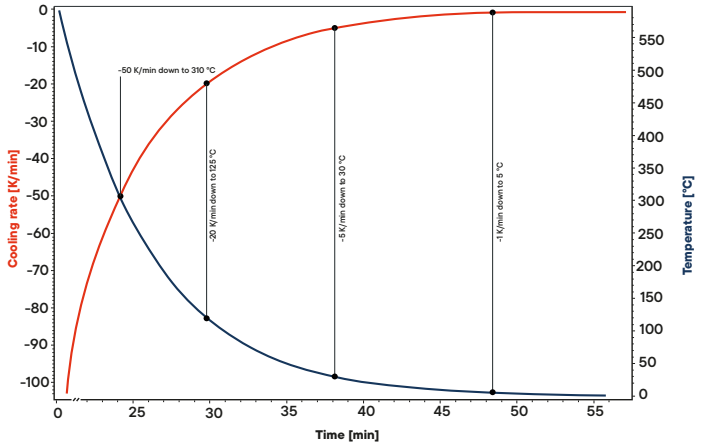
In the graphs you can see how the cooling options with and Intracooler and an circulating thermostat ensures efficient and rapid cooling.

Cooling rate with an Intracooler



Cooling rate	Down to
100 K/min	560 °C
50 K/min	240 °C
20 K/min	40 °C
10 K/min	-30 °C
5 K/min	-48 °C
1 K/min	-70 °C

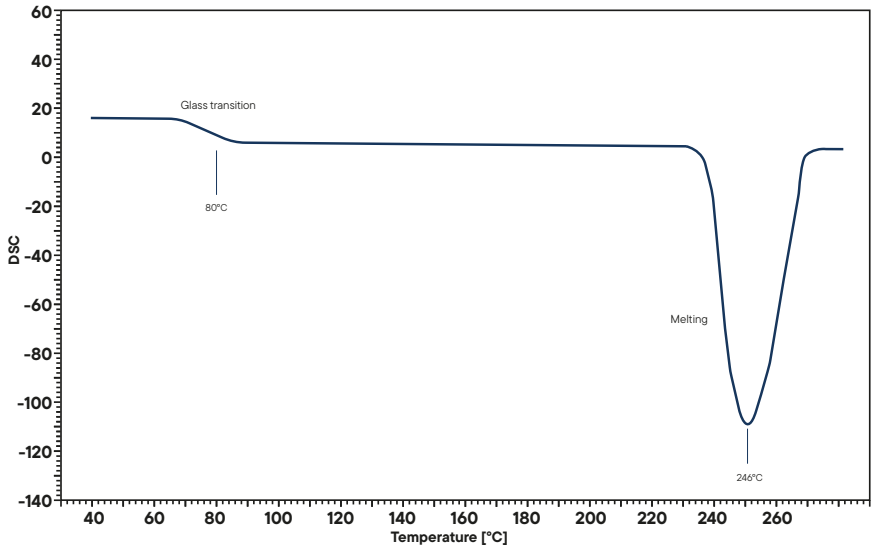
Cooling rate with an circulating thermostat



Cooling rate	Down to
50 K/min	310 °C
20 K/min	125 °C
5 K/min	30 °C
1 K/min	5 °C

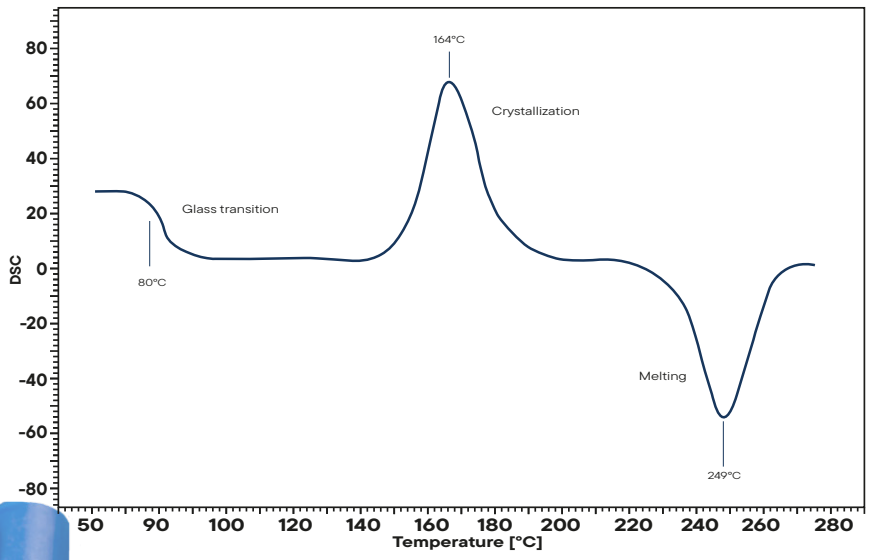
More applications

PET Granulate 1. Heating

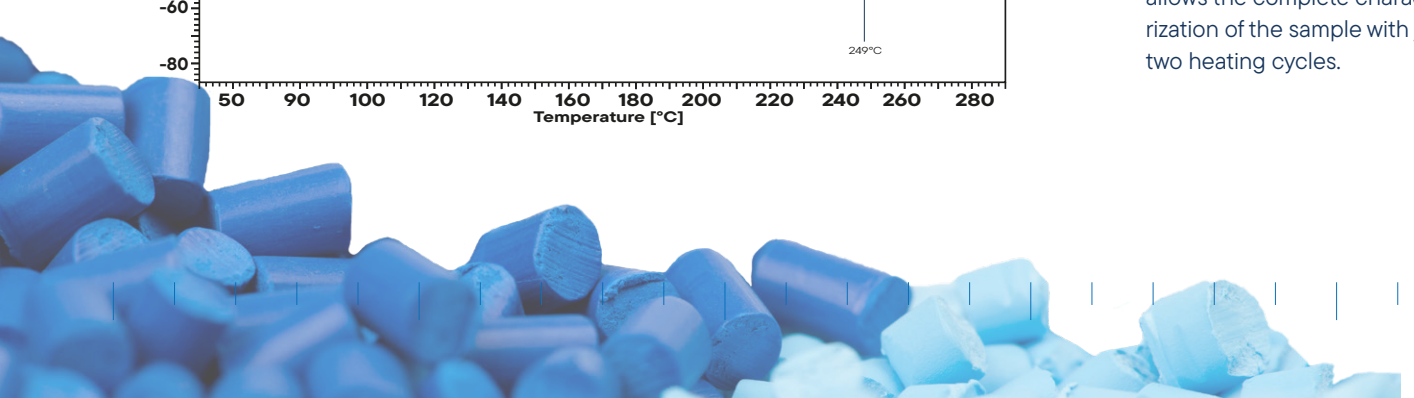


The analysis of polymers is one of the main applications of DSC. Effects such as glass transitions, melting and crystallization are of interest and sometimes hard to detect. The new LINSEIS L63 DSC offers high resolution and sensitivity, making it an ideal instrument for this type of analysis. With its innovative design, it is now possible to analyze important properties of the sample even during the initial heating of the PET granulate at a linear heating rate of 20 K/min. The curve shows a significant glass transition around 80 °C, followed by a melting peak at 246°C.

PET Granulate 2. Heating



Depending on the cooling rate, the degree of crystallinity of the polymer changes significantly. During a subsequent heating run, cold crystallization can be observed with a linear heating rate of 20 K/min. The curve reveals a distinct glass transition at around 80 °C, followed by cold crystallization of the amorphous regions starting at approximately 148 °C and a melting peak starting at 230 °C. This allows the complete characterization of the sample with just two heating cycles.



LINSEIS

pushing boundaries

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04/2026

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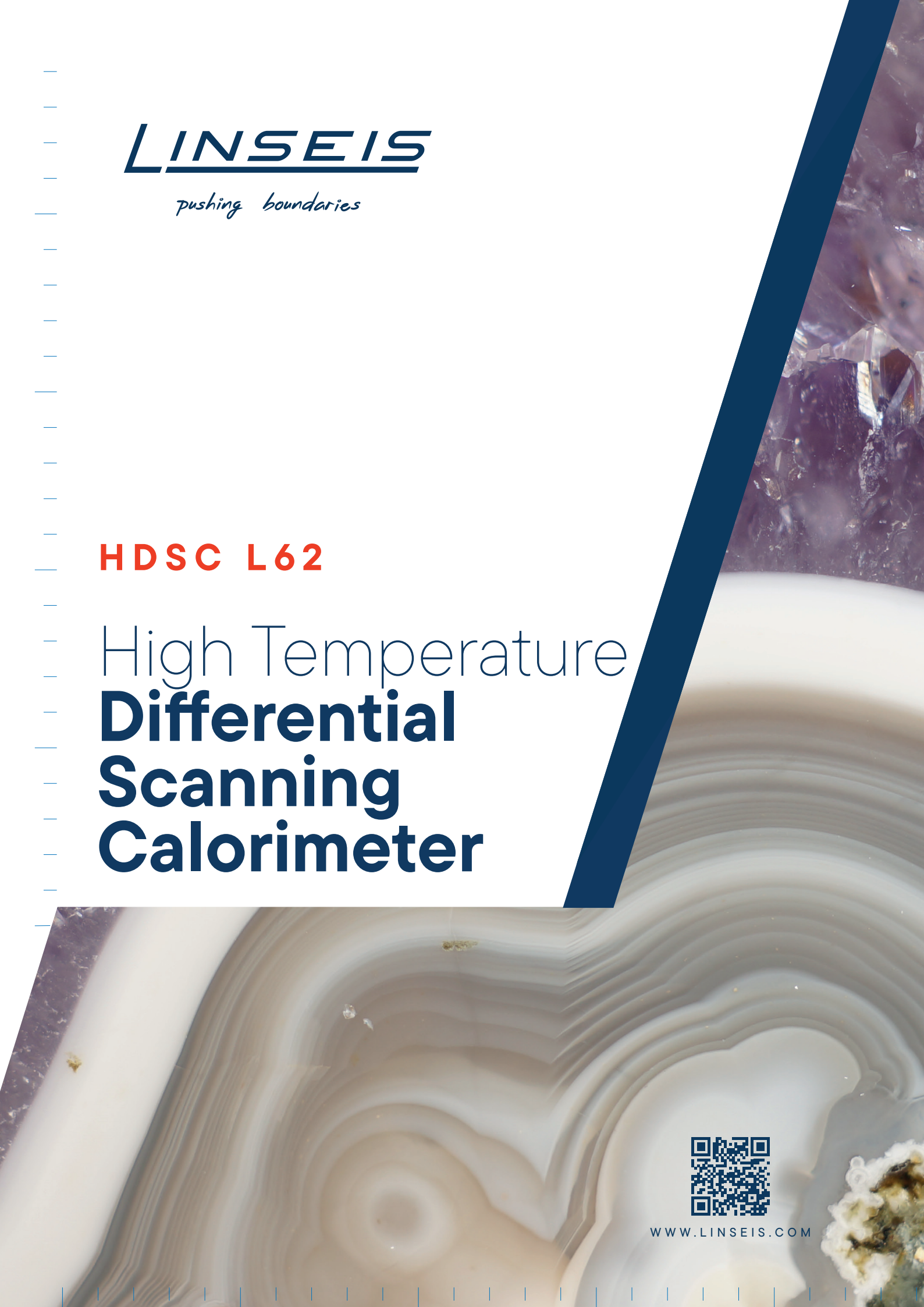
HDSC L62

High Temperature Differential Scanning Calorimeter



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Since 1957 LINSEIS Corporation has been delivering outstanding service, know-how and leading innovative products in the field of thermal analysis and thermo-physical properties.

Customer satisfaction, innovation, flexibility, and high quality are what LINSEIS represents. Thanks to these fundamentals, our company enjoys an exceptional reputation among the leading scientific and industrial organizations. LINSEIS has been offering highly innovative benchmark products for many years.

The LINSEIS business unit of thermal analysis is involved in the complete range of thermoanalytical equipment for R&D as well as quality control. We support applications in sectors such as polymers, chemical industry, inorganic building materials, and environmental analytics. In addition, thermophysical properties of solids, liquids, and melts can be analyzed.

Rooted in a strong family tradition, LINSEIS is proudly steered into its third generation, maintaining its core values and commitment to excellence, which have been passed down through the family leadership. This generational continuity strengthens our dedication to innovation and quality, embodying the essence of a true family-run business.

LINSEIS provides technological leadership. We develop and manufacture thermoanalytic and thermophysical testing equipment to the highest standards and precision. Due to our innovative drive and precision, we are a leading manufacturer of thermal analysis equipment.

The development of thermoanalytical testing machines requires significant research and a high degree of precision. LINSEIS Corp. invests in this research to the benefit of our customers.

CLAUS LINSEIS

CEO DIPL. PHYS.

Engineering & Innovation

To strive for the best due diligence and accountability is part of our DNA. Our history is affected by German engineering and strict quality control.

We want to deliver the latest and best technology for our customers. LINSEIS continues to innovate and enhance our existing thermal analyzers. Our goal is to constantly develop new technologies to enable continued discovery in Science.

High Temperature **Differential Scanning Calorimeter**

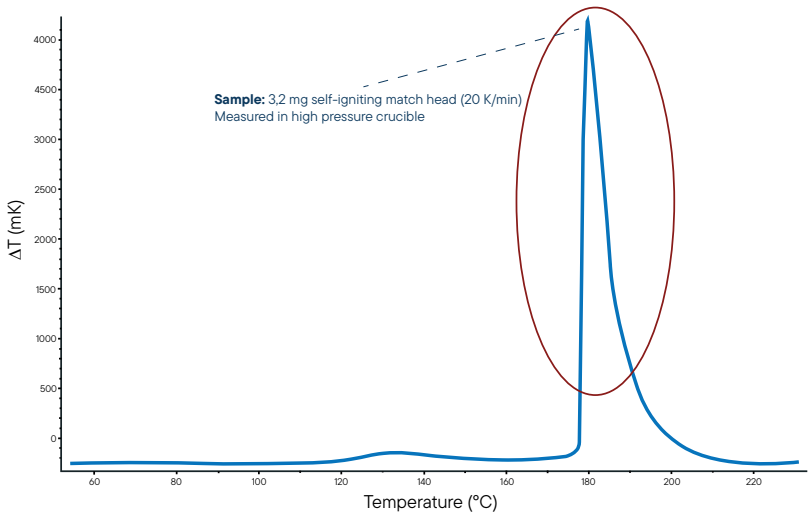
Differential Scanning Calorimetry (DSC) is one of the central methods of thermal analysis: Indispensable when it comes to precisely investigating endothermic and exothermic transitions. It provides detailed insights into the thermal behavior of materials – as a function of temperature and time with high significance.

The **LINSEIS HDSC L62** (High Temperature DSC) is designed to deliver highest calorimetric sensitivity, short time constants and a condensation free sample chamber. These features guarantee superior resolution and baseline stability over the entire instrument lifetime. This provides an indispensable tool for material development and quality control. The modular concept of the HDSC and DTA systems allows the use of different furnaces with a temperature range from -150 °C up to 1750 °C. The vacuum tight design enables quantitative enthalpy and Cp (Specific Heat) determination under the cleanest atmospheres and under vacuum of 10^{-5} mbar. The systems can be upgraded with an optional sample robot and coupled to a MS or FTIR.

Measuring System

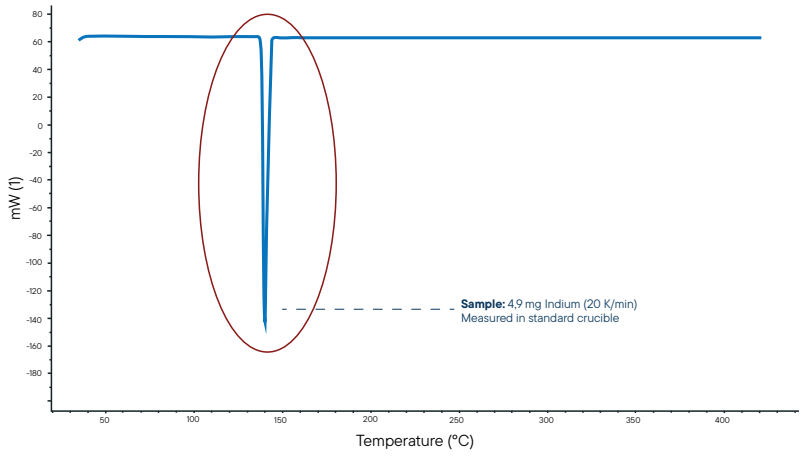
User friendly exchangeable measuring systems such as a DTA Sensor and two different DSC Sensors are available.
Each DSC Sensor is available as type E, K, S, B for the HDSC L62.
This allows the perfect choice for any application, temperature or atmosphere.

-150 °C up to 1750 °C



Exothermic Events

- Oxidation
- Cure Reactions
- Crystallization
- Polymorphic Transitions

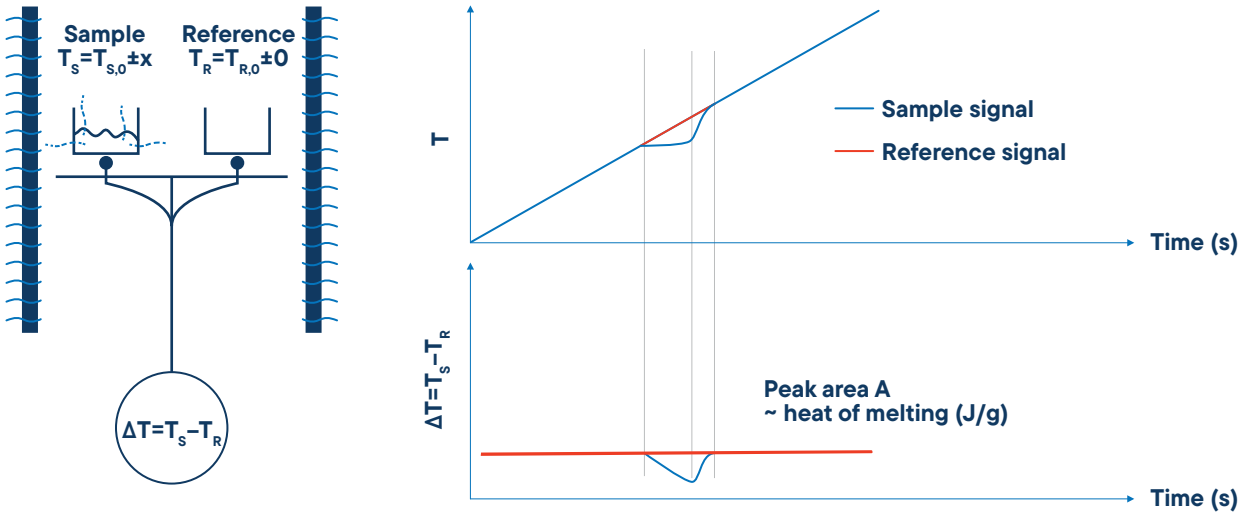


Endothermic Events

- Melting
- Glass transitions
- Enthalpic Recovery
- Polymorphic Transitions
- Evoration/Volatilization
- Decomposition

DSC-True Heat Flow measurement

Quantitative DSC-signal



Differential Scanning Calorimetry (DSC)

A technique in where the difference in energy input into a substance and a reference material is measured as a function of temperature, while the substance and reference material are subjected to a controlled temperature program.

Differential Signal

The differential signal is displayed as a baseline. Effects, for example the melting of a metal, can be observed as a peak. The area of the peak gives the amount of enthalpy and the direction of the peak indicates the way of heat flux – endothermic or exothermic.

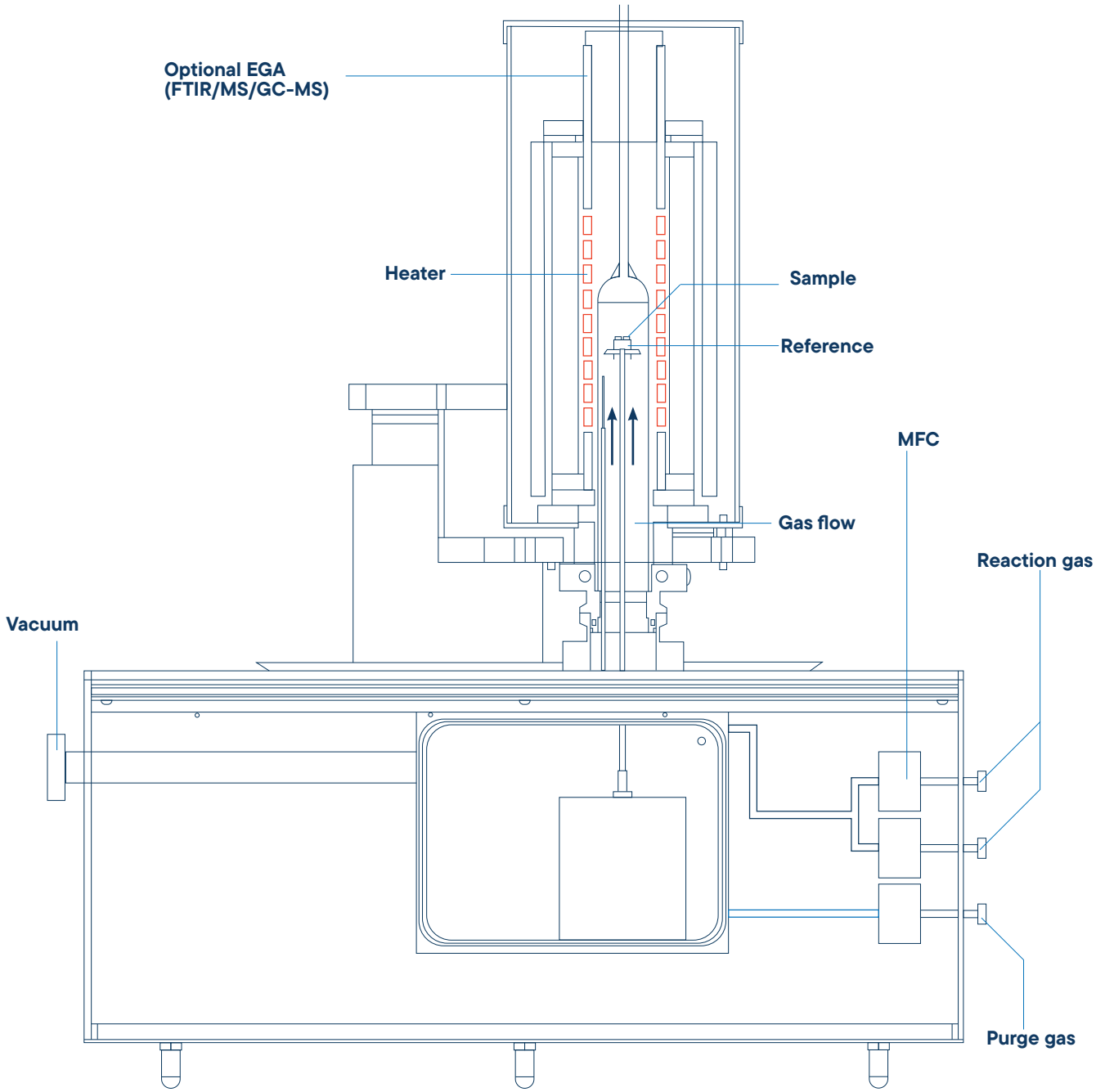
Temperature vs. Time

During an effect like a reaction, decomposition or phase transition, a temperature difference between the sample and the reference crucible can be measured by means of a thermocouples.

Measurable Properties

- Glass point
- Crystallinity
- Thermal stability
- Oxidation stability
- Purity
- Solidus relationship
- Liquidus relationship
- Product identification

Illustration of the HDSC L62



Unique features

Automatic Evacuation

The devices feature a built-in automatic evacuation capability, ensuring efficient processes and smooth operation.

Vacuum and controlled atmosphere

- Supports high vacuum, inert, reducing, oxidizing or humidified atmospheres
- Optional pressurization up to 5 bar overpressure
- Analysis of certain corrosive conditions with precautions
- Adaptability for residual gas analysis with optional heated capillary

Evolved gas analysis

Optional gas analysis with MS, FTIR or GCMS is possible, providing valuable additional information. The system can be configured with standalone and integrated MFC for gas dosing. Additionally, customer-specific options such as a heated inlet can also be integrated into the device.

Gas safety system

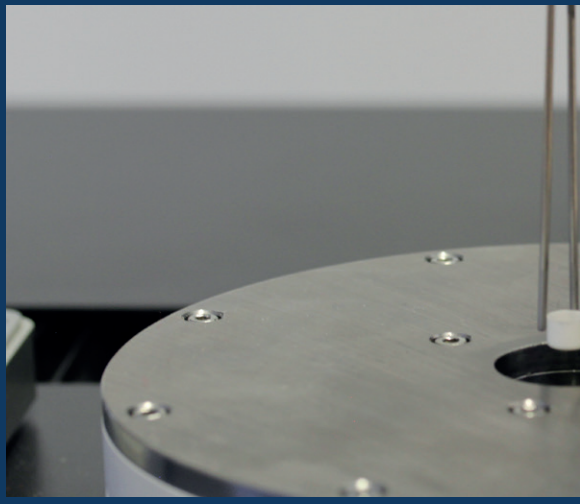
The gas safety system is designed to accommodate various gases such as hydrogen or carbon dioxide, ensuring secure operation and user safety.

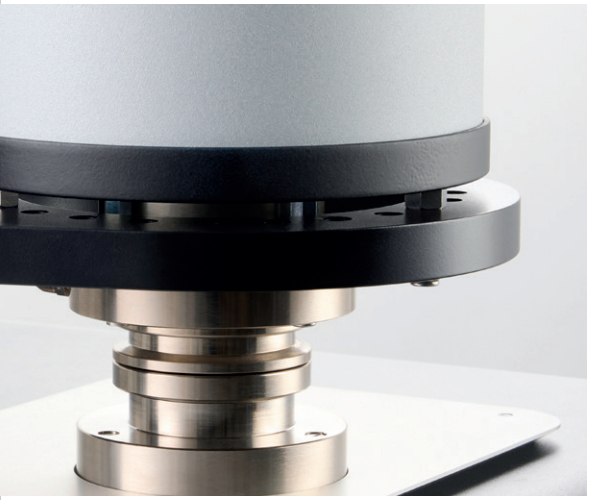
Controlled humidity and water vapor

The device can regulate the humidity and water vapor during the measurement.

Sample robot

Our **HDSC L62** can be equiped with a proven sample robot for unattended sample measurements for highest throughput.





Wide temperature range -150 °C to 1750 °C

The **LINSEIS HDSC L62** instruments can be equipped with up to two furnaces at the same time. A broad variety of different furnaces are available to enable measurements in the widest temperature range on the market.

Automatic calibration

We offer an automatic calibration function in the software and hardware. With this function, our HDSC automatically calculates a calibration factor, which is also displayed.

Integrated LINSEIS platform

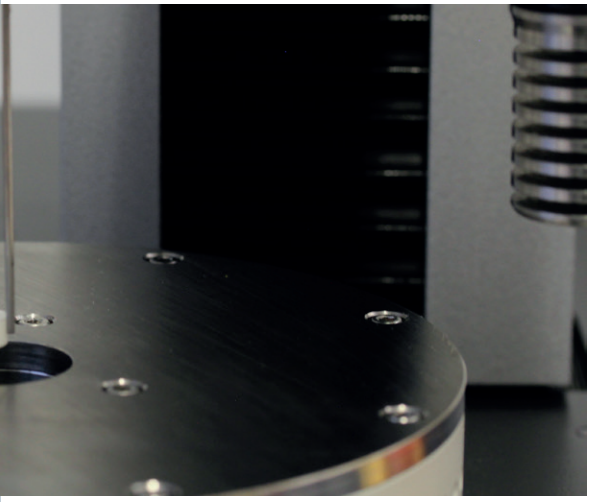
The integrated LINSEIS software offers a comprehensive solution, combining both hardware and software for maximum process security and precision. By providing a unified platform, it ensures seamless integration of components and devices from external partners, resulting in a highly robust system.

Customization

Close collaboration with the customers to tailor unique solutions, leveraging LINSEIS expertise to meet their specific needs.

Service

Our international presence across every continent enables us to deliver the best and fastest service possible.



Accessories starter kit

The starter kit guarantees fast and uncomplicated usage, serving as a complete system for instant application.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Equipment for gas control and safety (H_2, CO, CO_2, etc...)

All LINSEIS instruments can be prepared for the use in hydrogen atmosphere with just minor adjustments. The most important thing is a safety system that can ensure that there is no leakage and no explosive atmosphere generated outside of the instrument. Therefore, the Linseis safety system uses hydrogen sensors that are coupled to an automatic gas control panel. If there is a leakage or unwanted hydrogen release, the instrument is automatically flooded with inert gas and the hydrogen valves are closed. This ensures a minimum risk level during operation. Besides that, the system contains an optional burn off unit where the gas outlet is connected to, to ensure that also the used gas of the measurement chamber is not just released into the environment. The system can also be operated with several combinations of inert gases and even water vapor besides hydrogen.

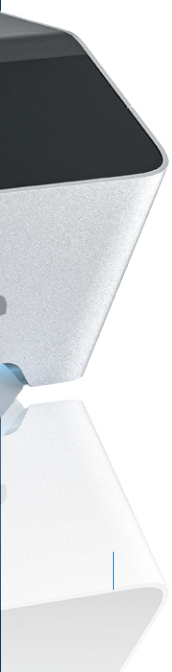
In summary, the Linseis safety system comes with the following benefits:

- Automatic evacuation function
- Gas flow control for multiple gases including water vapor and hydrogen
- Emergency shutdown function
- Gas detector system (H_2, CO, CO_2, etc...
- optional burn off unit
- Continuous monitoring to ensure safe operating conditions

Linseis equipment for operation under water vapor and controlled relative humidity

For many applications in thermal analysis, the atmosphere plays an important role as it may affect the sample behavior or activate reactions. Humidity influence on building materials, storage time of pharmaceuticals and foods or influence on mechanical properties of polymers are just some of the most common examples. Of course, the Linseis instruments are suitable for such experiments, however there is one fact that is often causing confusing and must be considered carefully: The difference between water vapor and relative humidty.

Relative Humidity Generators are most commonly used for experiments around room temperature, while water vapor applications are most often at higher temperatures. When water is heated to its boiling point or higher than that, the water changes its aggregate form from liquid to gaseous. It is then existing as water vapor (steam). If this steam is introduced into any kind of reaction chamber or instrument, it is called water vapor application. In contrast, every gas can transport and contain a certain amount of water at a given temperature. This is called humidity. Considering air as an example, there is always an amount of water contained in the air, even below the boiling point of water, which is defined as grade of humidity or relative humidity.

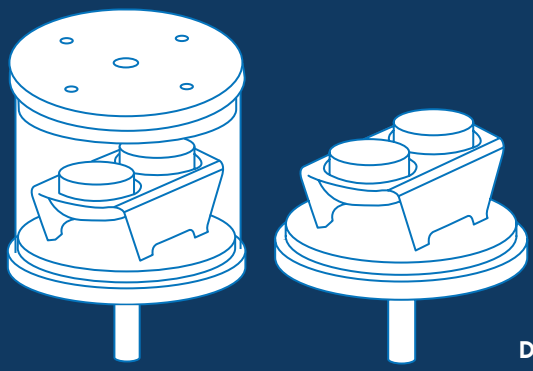


Sensors & Crucibles

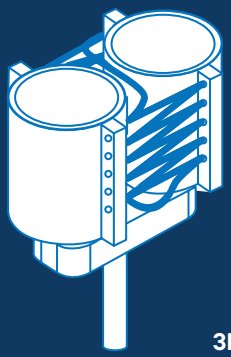
LINSEIS HDSC L62 can be equipped with an unmatched amount of different user exchangeable DSC sensors and crucibles. Each sensor is available with different thermocouples to provide the highest sensitivty for your desired temperature range.

- Al_2O_3
- Platinum
- Aluminium
- others

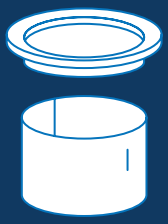
DSC



DSC Heat flux

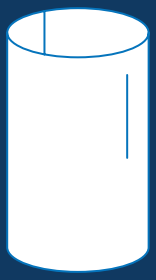


3D-Calvet-DSC sensor



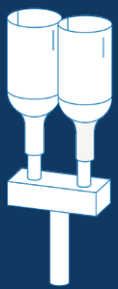
Crucible
0.12 ml

Crucible
0.12 ml



Crucible
custom volume

DTA

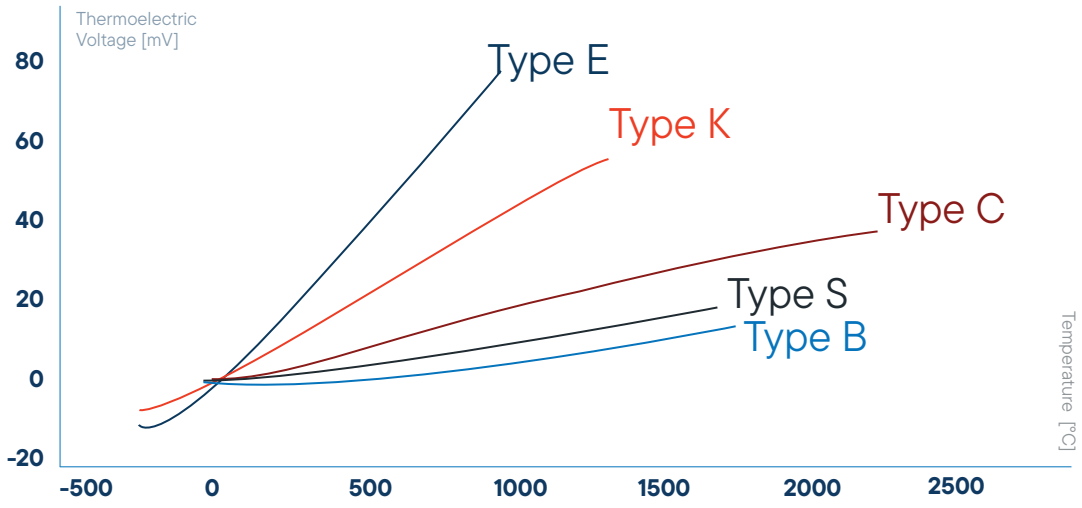


DTA-sensor

Cap

0.3 ml or
custom crucible
volume

Crucible



All sensors available with the thermocouples illustrated. LINSEIS sensor combinations cover the broadest temperature range in the market (-180 °C up to 2400 °C).

Thermocouple types:
Type E (Chromel)
Constantan: -50 °C up to 900 °C
Type K (Chromel)
Alumel: -180 °C up to 1100 °C
Type S (Platinum-Rhodium/10 %)
Platinum: 0 °C up to 1600 °C
Type B (Platinum-Rhodium/ 30 %)
Platinum-Rhodium (6 %): 25 °C up to 1800 °C
Type C (Tungsten/5 %)
Rhenium: Tungsten (26 %)
Rhenium: 20 °C up to 2300 °C

Sensor Type	(+) Leg	(-) Leg	Generated thermo voltage* change in µV (Reference junction at 0 °C)			Approx. working temperature	Notes
			100 °C	500 °C	1000 °C		
E	NiCr	CuNi	68	81	-	-200 °C up to 800 °C	Highest thermo voltage* per °C
K	Ni-Cr Cromel	Ni-Al Alumel	42	43	39	0 °C up to 1100 °C	
S	Pt10Rh Platin10% Rhodium	Platinum	8	9	11	0 °C up to 1550 °C	
B	Pt30Rh Platin30% Rhodium	Pt6Rh Platin6% Rhodium	1	5	9	0 °C up to 1750 °C	Most suited for oxidizing atmosphere

*Electro motive Force by seebeck coefficient

Software

The software greatly enhances your workflow as the intuitive data handling only requires minimum parameter input. LiEAP offers a valuable guidance for the user when evaluating standard processes such as melting and crystallization points.

The optional thermal library product identification tool, provides a database permitting an automatic identification tool for your tested materials such as polymers.

Data acquisition

- **Shared database:**
  One software for many devices
- Compatible with the latest Windows® operating systems
- Online updates
- Automatic gas control for multiple gases and hardware types (Optional)
- Unlimited heating, cooling and dwell time segments
- Multi-language versions such as English, German, French, Chinese, Japanese, etc. (user selectable)
- Optional password protection and user access levels
- Simultaneous data acquisition and evaluation

Data evaluation

- **Includes:**
  Signal correction and smoothing, derivate/integral, arithmetic operations for curves, peak evaluation, glass point evaluation, onset-point determination, multiple curve overlay, annotation and drawing tools, copy to clipboard function, multiple export features for graphic and data export, reference based correction.
- Undo and redo function for all steps
- Complete evaluation history
- Export to various data formats
- Extendable via Python plugins

The **LINSEIS Thermal Library** software package comes as an option for the well-known, user friendly LINSEIS LiEAP (Linseis Evaluation and Acquisition Platform) software that is integrated in almost all our instruments.
The Thermal Library allows the sample material identfication by comparing the measurement curve with a data base providing thousands of references and standard materials within only 1-2 seconds.

Multi-Instrument

LINSEIS instruments such as DSC, STA, TGA & LFA can be controlled with the same powerful LiEAP software platform.

Multi-User

The administrator can generate different user levels providing different rights to operate the instrument. A optional Log file is also available.

Report Generator

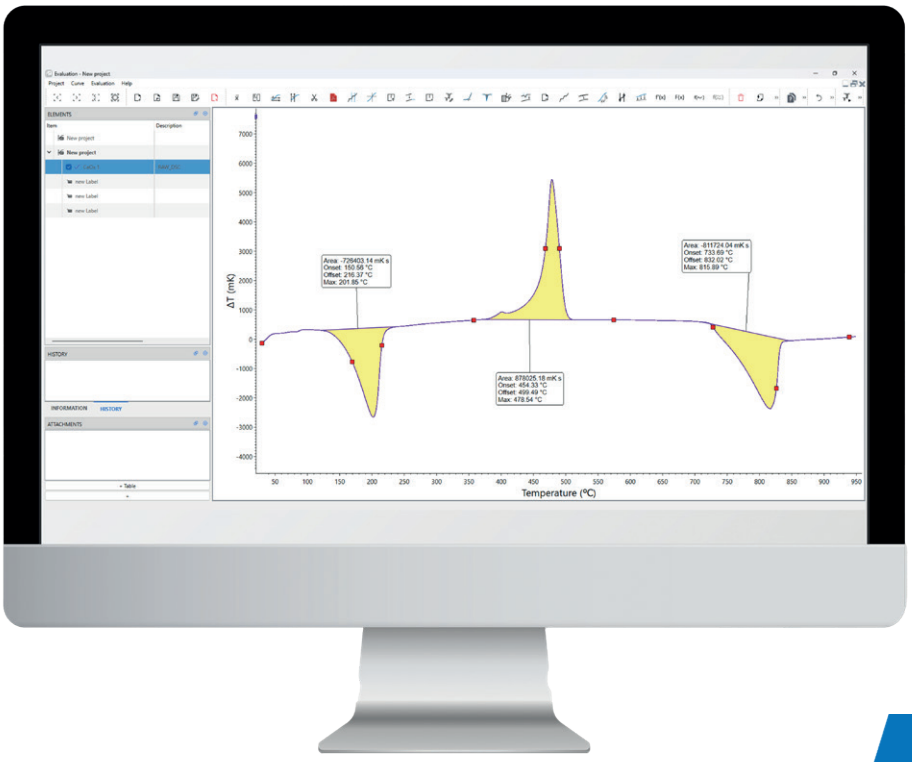
Convenient template selection to generate customized measurement reports.

Database

State of the art database design enables easy data handling.

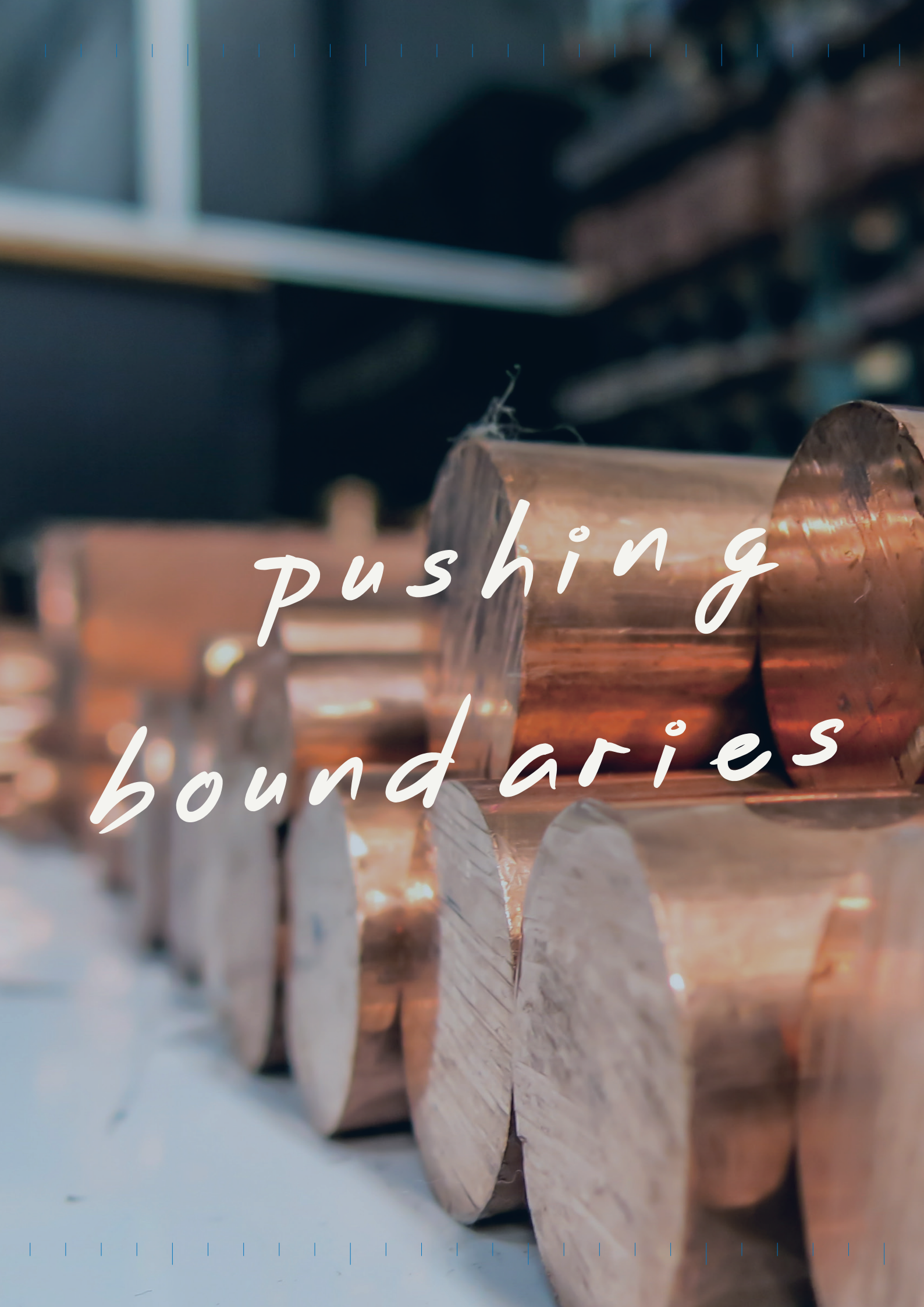
Kinetic software

Kinetic analysis of DSC, DTA, TGA, EGA (TG-MS, TG-FTIR) data for the study of the thermal behavior of raw materials and products.



Technical **Specifications**

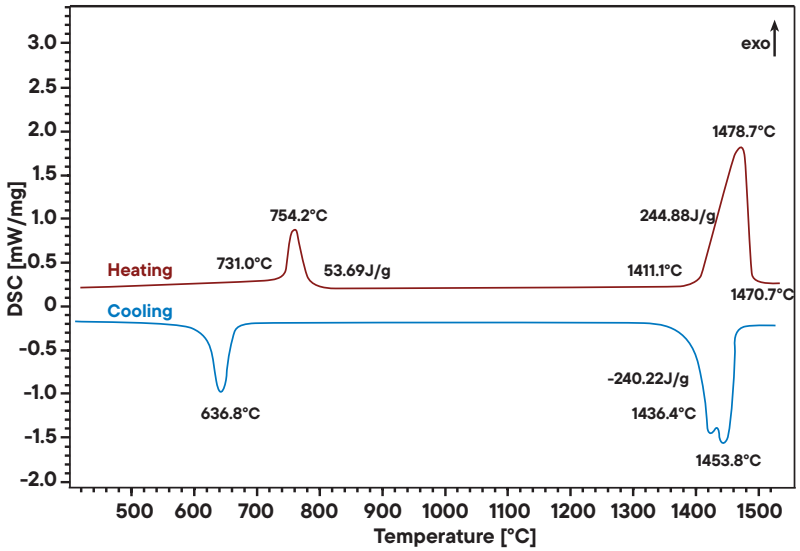
HDSC L62	
Temperature range	-150 °C up to 1750 °C
Vacuum	10^{-5} mbar (depends on vacuum pump)
Pressure	up to 5 bar (optional)
Heating rate	0.01 up to 100 °C/min (depends on furnace)
Temperature precision	0.01 °C
Sample robot	42 (optional)
DSC	
DSC-Sensors	E/ K/ S/ B/ C
DSC-Resolution	0.3/ 0.4/ 1/ 1.2 µW
Calorimetric sensitivity	approx. 4/ 6/ 17.6/ 22.5 µW
DTA	
DTA-Resolution	0.05 nV
Sensitivity	1.5 µV/mW
DTA-Measuring ranges	250 / 2500 µV


pushing
boundaries

HDSC L62

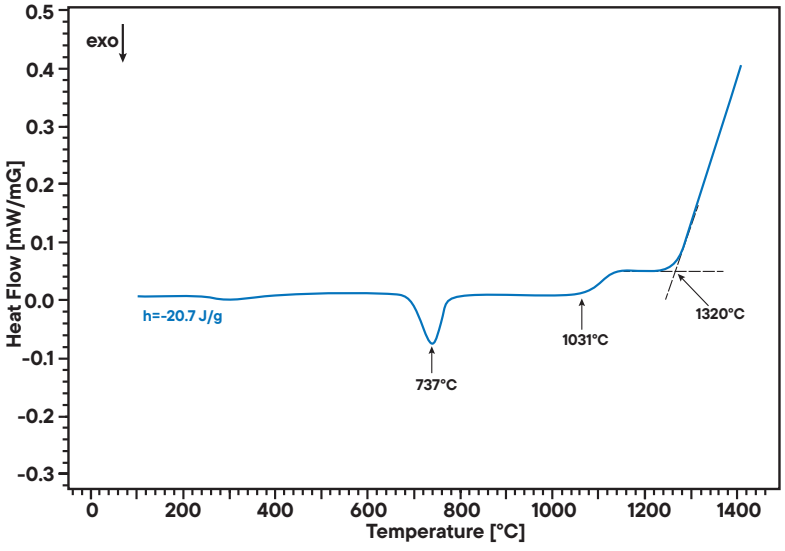
Applications

Steel (Low-Alloyed Steel)



The specific heat flow rate of a low-alloyed steel sample was measured by HDSC. At 734 °C a change in crystal structure from body-centered to face-centered cubic and a transition in magnetic properties from ferromagnetic to paramagnetic were observed. The melting point was detected at 1411 °C and the liquidus temperature at 1473 °C. All peaks are reversible and appear in the cooling segment as well. The phase transition back to the ferromagnetic state occurs at 637 °C and the crystallization range extends from 1454 °C to 1436 °C.

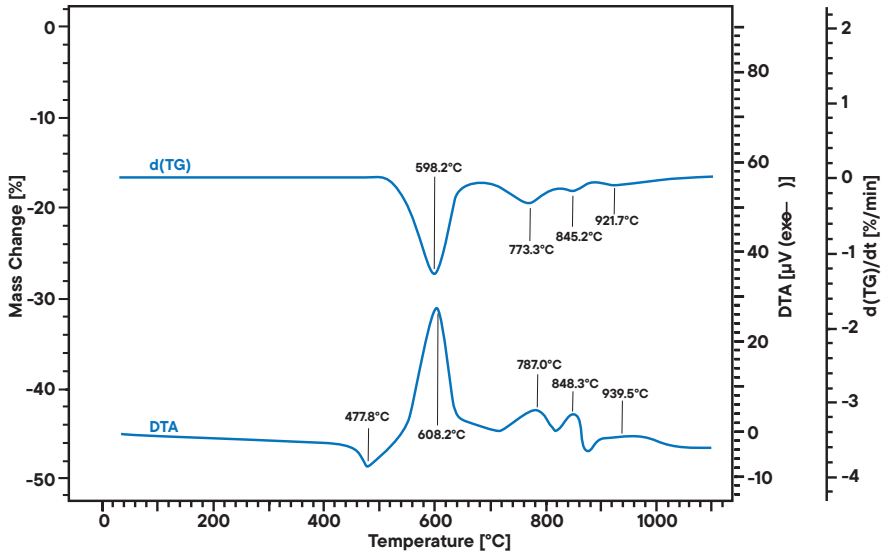
DSC DTA powder measurements of ferrites



The components used for production of magnetic ferrites are ZnO, Fe_2O_3 and Cr_2O_3. The Chrome oxide is added for modification of magnetic and electric properties. At 735°C the powder forms a mixed ferrite with a spinal structure (exothermal reaction: -20.6 J/g). Above 1034°C and 1321°C the heat flow changes into the endothermic direction due to melting of different phases. The LINSEIS HDSC L62 with type S measuring sensor provides a very stable baseline with an extremely low noise level up to 1600°C. This high sensitivity is essential to perform exact reaction enthalpy measurements and evaluations.

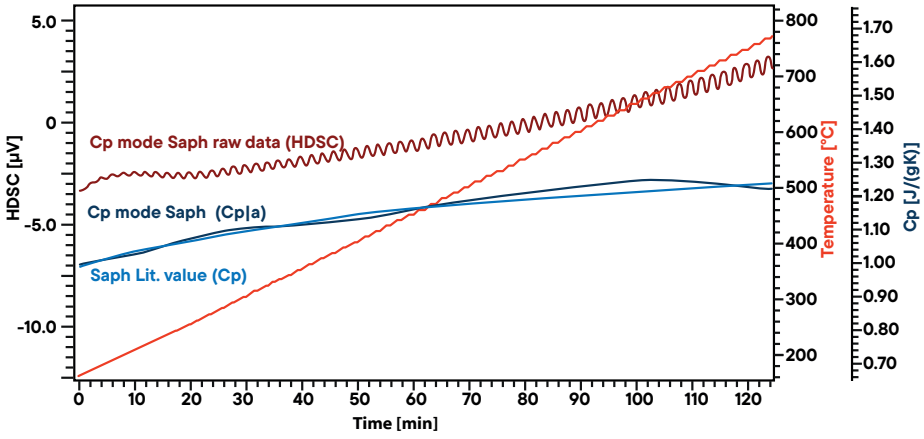
Applications

DSC Analysis of Talcum



Talcum ($Mg_3(OH)_2[Si_2O_5]_2$) is a mineral that consists of hydrated magnesium silicate. It is used for the production of steatite bodies used as isolators with high resistance and a low dielectric loss factor. Its impurities (chlorite, carbonates) can be determined and detected using DSC. The measurement shows the dehydroxylation of chlorite that appears at 608°C and 848°C as endothermal DSC signals. At 768°C the removal of CO_2 can be observed when the contained carbonates decompose into their oxides, releasing the CO_2. Finally the dehydroxylation of talc can be seen at 937°C as an endothermal peak as well.

Modulated Cp determination



For highest possible accuracy of Cp, the LINSEIS HDSC allows the usage of modulated heating rate temperature profiles. This method causes a continuous change in heat flow of the sample and the system can monitor the heat uptake much better than with a linear heating profile. The deviation from the literature value is much smaller than with linear DSC runs. The modulated heat flow signal (dark red) leads to a significant better Cp resolution (dark blue) that is only slightly different from the literature (bright blue) over the full temperature range. The bright red curve shows the modulated heating profile.

LINSEIS

pushing boundaries

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