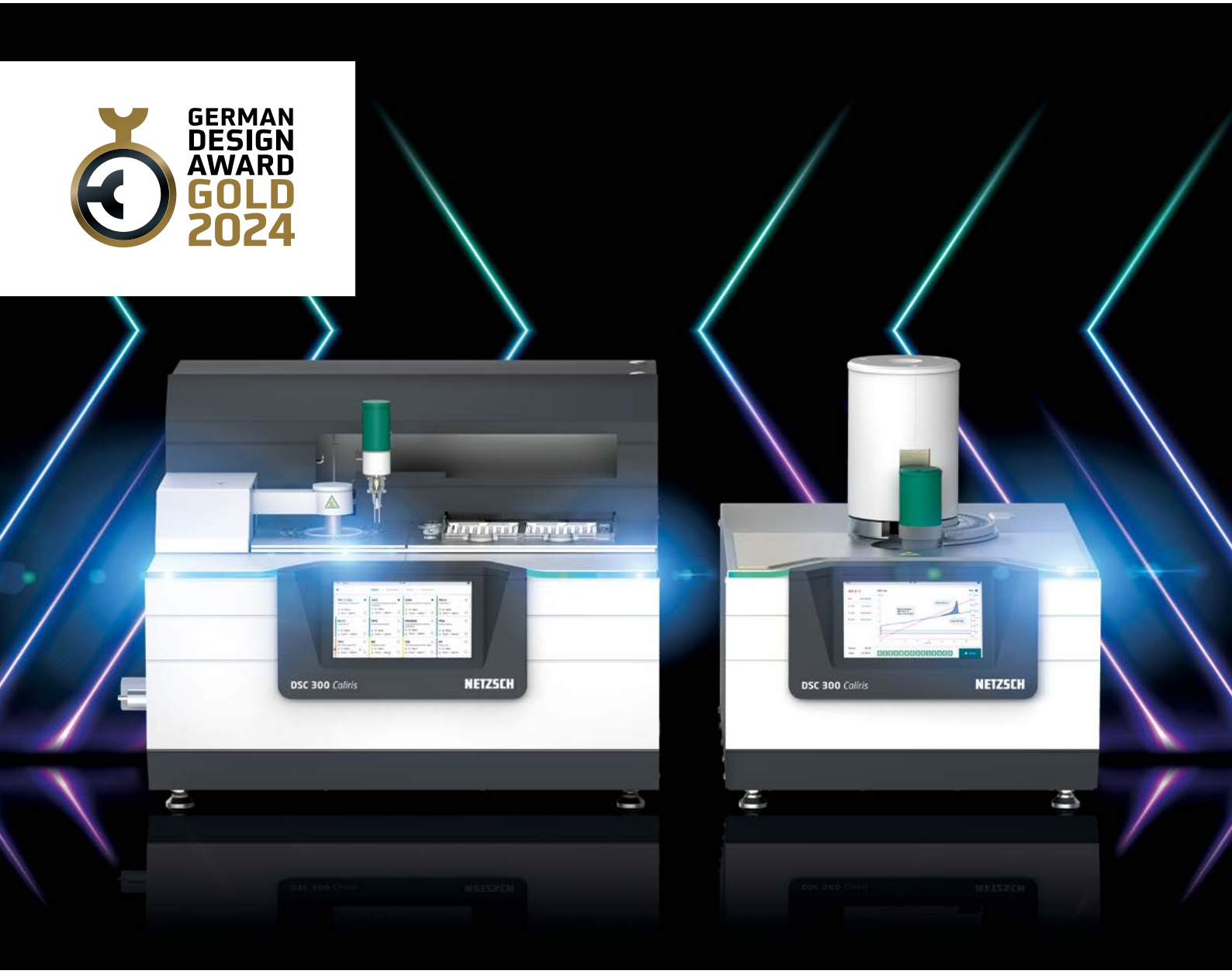
NETZSCH

Proven Excellence.

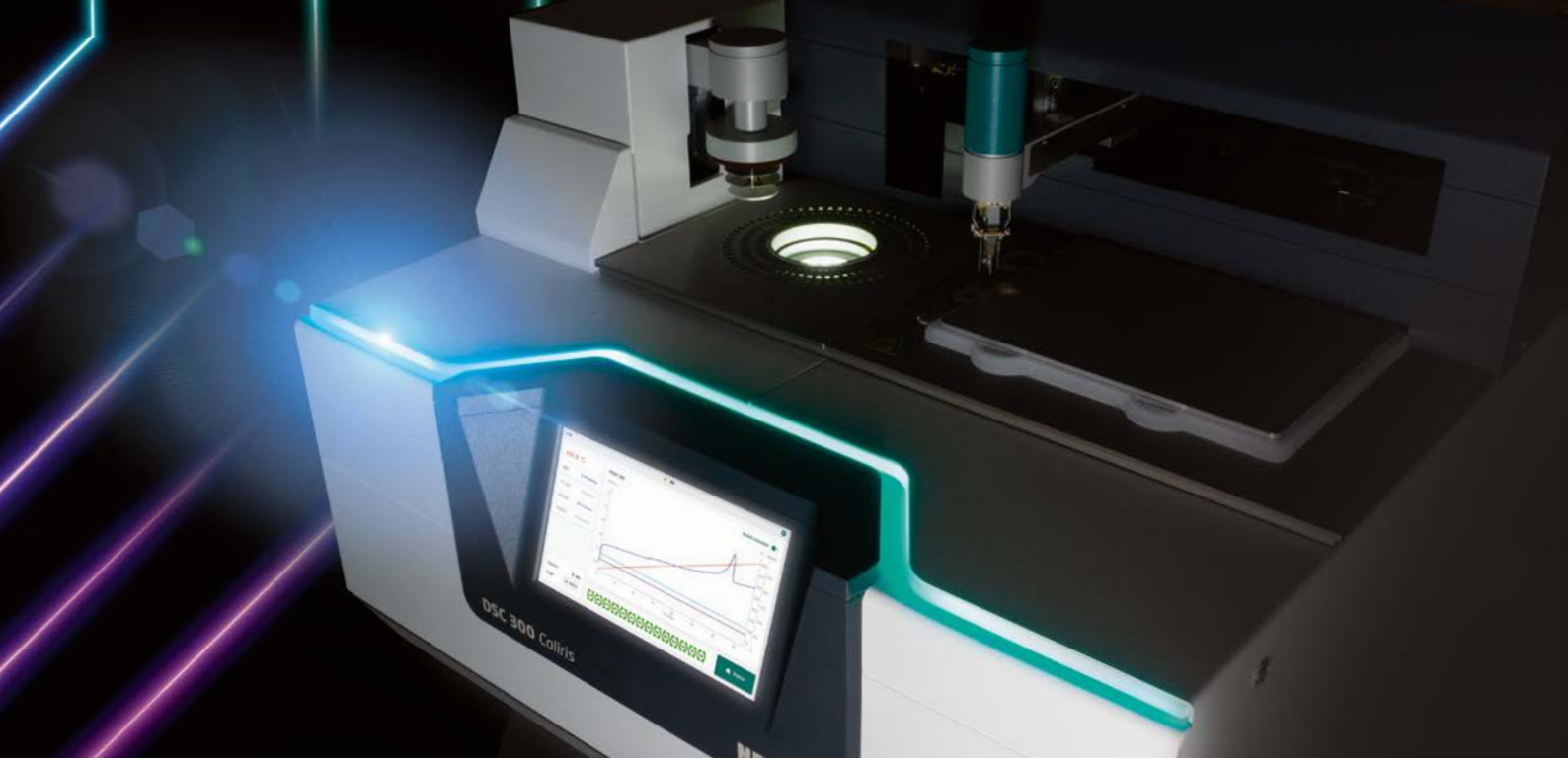
GERMAN DESIGN AWARD GOLD 2024



Differential Scanning Calorimetry – DSC 300 *Caliris*® Series

Method, Technique, Applications

Analyzing & Testing



DSC 300 *Caliris*® Series

Whether you are working in research & development, quality control, contract testing or the specification of materials for applications, information about a material's behavior under changing temperature and different atmospheres is important.

The DSC 300 *Caliris*® can support:

- Material identification
- Process optimization
- Quality control
- Phase diagrams
- Kinetic analysis
- Compatibility
- Failure Analysis

Typical DSC Results

- Melting temperature and enthalpy
- Crystallization temperature and enthalpy
- Specific heat capacity
- Solid-liquid ratio (solid-fat content)
- Polymorphism
- Solid-solid transitions
- Liquid crystal transition
- Degree of crystallinity
- Curing, degree of cure
- Glass transition
- Oxidative stability
- Aging
- Purity
- Decomposition onset

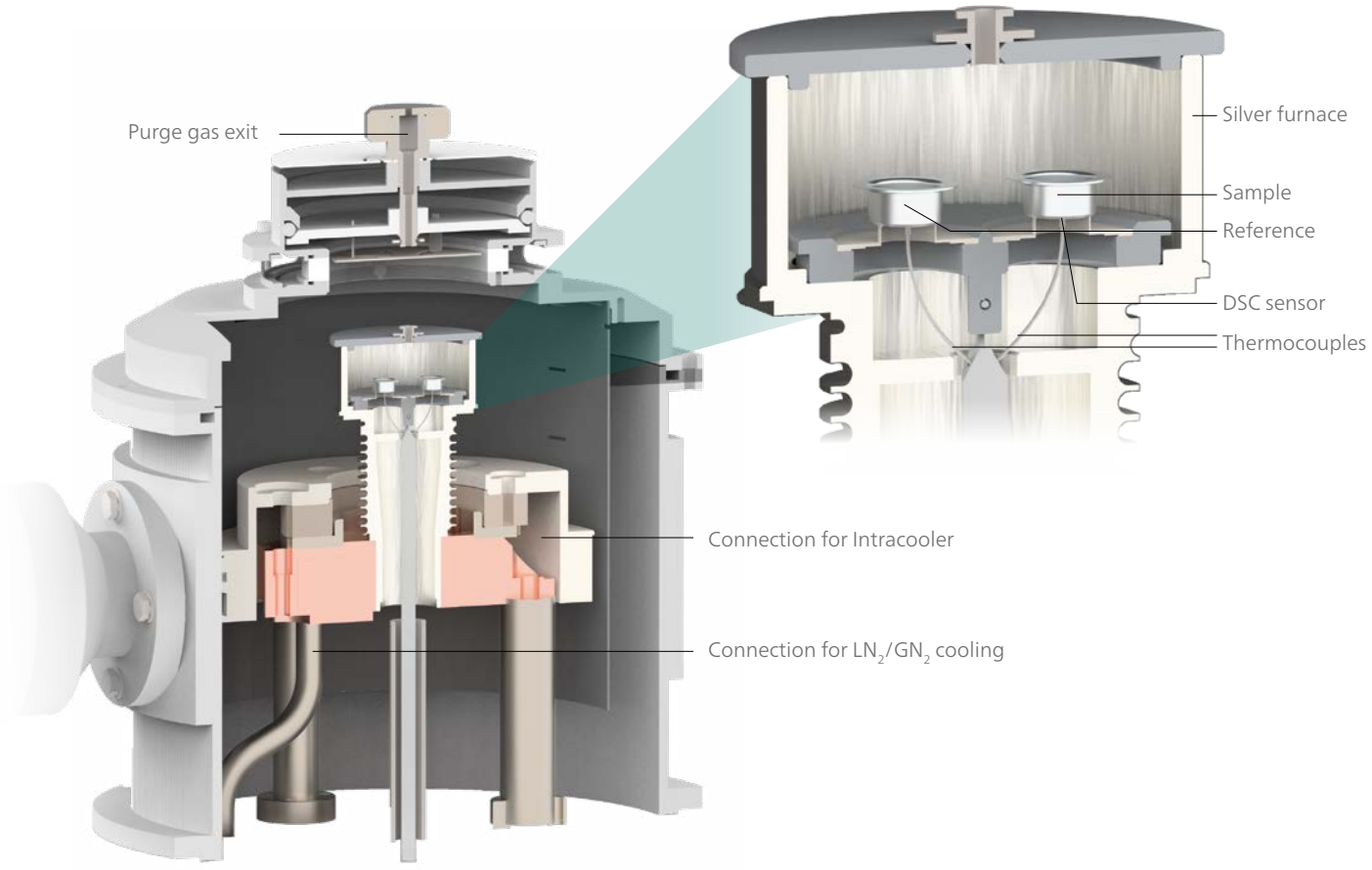
The DSC 300 Caliris® is the Most Comprehensive, Most Reliable and Versatile DSC for Material Characterization on the Market!

DIFFERENTIAL SCANNING CALORIMETRY (DSC) –

The Most Widely Used Thermal Analysis Technique

Based on ISO 11357, heat-flux DSC is a technique in which the difference between the heat flow rate into a sample crucible and that into a reference crucible is determined as a function of temperature and/or time. During such a measurement, the sample and reference are subjected to the same controlled temperature/time program and atmosphere.

The DSC 300 *Caliris*® is in line with all relevant DSC standards, such as ASTM E793, ASTM E967, ASTM E968, ASTM E794, ASTM E1356, DIN 51007, etc.



DSC Provides Quick, Reliable Measurement Results on a Sample's Endothermic and Exothermic Caloric Effects!

Modular Design – Change the Setup if You Need to

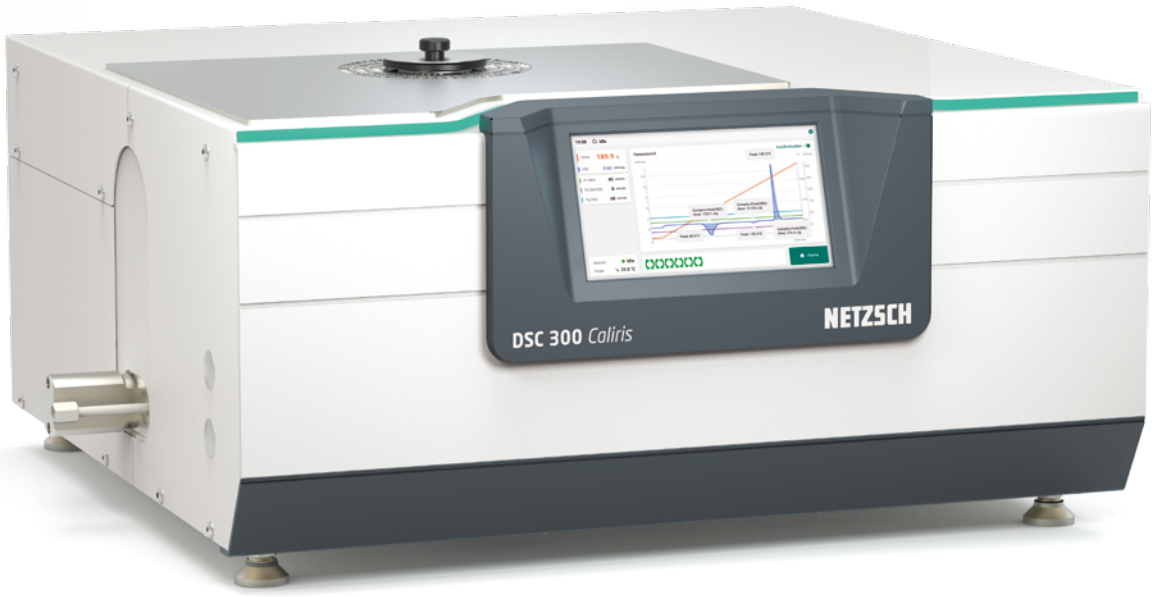
Ever-accelerating new material developments, triggered by fast-moving mobility and technical trends, require continuous adaptability. The new generation of NETZSCH DSCs is based on a modular concept. The DSC 300 *Caliris*® the only instrument of its kind with interchangeable and/or exchangeable sensor-furnace modules.

The *Supreme* version of the DSC 300 *Caliris*® allows the exchange of modules, to be able to adapt to current and future needs. Just choose between broad temperature range, fast heating rates and high sensitivity as needed, whereas the *Select* version lets you determine your module at time of purchase.

DSC 300 *Caliris*® *Supreme* and *Select*

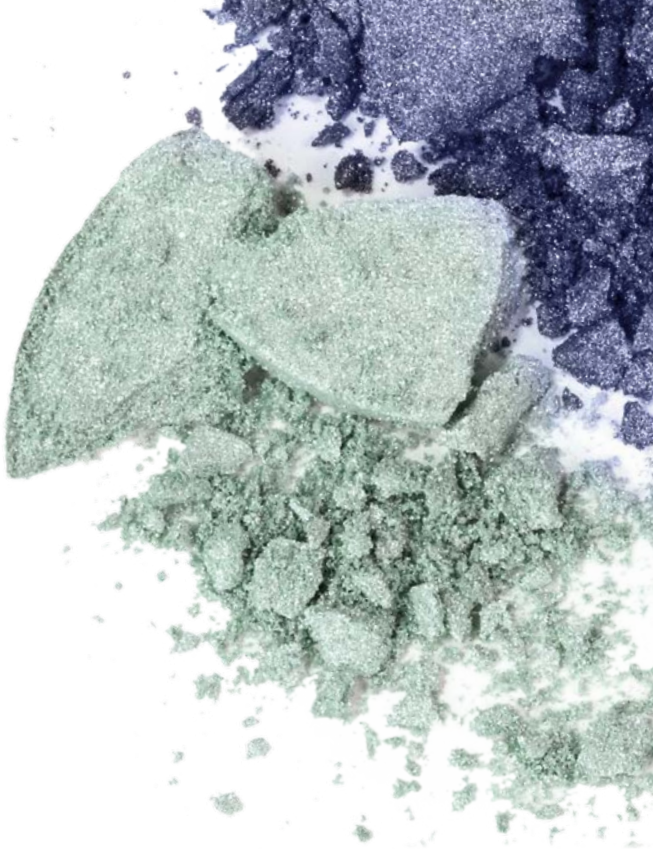
Next Generation NETZSCH DSCs – Two Premium Instruments to Suit Every Budget and Demand

LabV®-primed



The DSC 300 *Caliris® Supreme* – The Future-Proof Choice

The only multi-module instrument on the market – making your investment truly future-proof. This instrument offers a choice of three modules and can be configured to achieve an unrivaled maximum temperature range of -180°C to 750°C. New modules to fit the DSC 300 *Caliris® Supreme* will be launched in the future and will be compatible with the current base unit. It is possible to update your device at any time to take advantage of the latest technological developments or to change your application. The choice of module you use remains unrestricted.



The DSC 300 *Caliris® Select* – Tailor-Made for Your Applications

With the *Select* version of the DSC 300 *Caliris®* initially there is a choice between modules. The maximum temperature range available in the *Select* is -170°C to 650°C. Modules of the same type can get exchanged, for example during service, to avoid down time.

Improved Status Information and Control – Even from Afar

The DSC 300 *Caliris®* offers complete information about your current measurement. You can check the general instrument status at a glance via the LED status bar. The integrated color touch display shows the important information and enables you to:

- Start measurements with the tap of a finger
- See the progress of your measurement and time remaining
- Check gases, idle states and the current temperature
- Check the execution list on recently finished and newly added measurements

Both versions of the instrument come with integrated color touch display. They also have an LED status bar and have the option of an automatic sample changer.

Improving Your Lab Work Flow

The volume of data recorded in analytical laboratories is growing continuously. Keeping track of, and organizing, collected data to be available for future experiments or final reports is key for a smooth laboratory workflow. Also, evaluation and comparison of measurement plots can be tricky. NETZSCH offers powerful software evaluation algorithms and data-based comparison tools, making your workflows more efficient. Furthermore, the DSC 300 *Caliris®* comes with perfect connectivity and is LabV®-primed for sharing data between multiple locations and over different methods.

Now as Easy as Slipping on a Different Pair of Shoes

CHANGING YOUR DSC'S CAPABILITIES

The NETZSCH DSC 300 *Caliris*® currently offers a choice of three modules. Modules are furnace/sensor combinations and are compatible with the DSC 300 *Caliris*® *Supreme* and *Select* alike. The different modules change the instrument's performance.

The *Supreme* version of the instrument is fully flexible. Modules can be exchanged freely by the user in a matter of minutes. New modules are going to be available in the future, so you can make sure that the DSC 300 *Caliris*® is, and stays, the most current DSC on the market. Furthermore, with the high performance module the temperature range of the *Supreme* version is the broadest on the market at -180°C to 750°C.

The *Select* version of the *Caliris*® requires the selection of one of the modules at time of order. The maximum temperature range available is -170°C to 650°C.

Three Modules for Different Needs

H-Module

The High-Temperature Module

Supreme: -180°C to 750°C
Select: - 170°C to 650°C

The premium module impresses with a perfect baseline and outstanding reproducibility. The very small peak-to-peak noise ratio allows the detection even of the smallest peaks. It is the gold standard for most DSC applications. In combination with the *Supreme* version, this module offers a short time constant with a simultaneously high sensitivity and, on top of that, covers the entire available temperature range from -180°C to 750°C. The H-module also offers an illuminated measuring cell for easy placement of crucibles and to ensure the sensor is clean.

The H-Module and its sensitive H-sensor is an ideal complement for advanced materials research and development in both industry and academia.

P-Module

The Polymer Module

-170°C to 600°C

This module is perfect for all tasks in the polymer field. Its optimized low-mass furnace allows for heating rates of up to 500 K/min over a wide measurement range. Temperature profiles simulating real processing conditions can be realized. Additionally, one can speed up the measurements and thus save valuable time.

The P-Module is perfect for research and development or quality control in the polymer processing industry.

S-Module

The Standard Module

-170°C to 600°C

This module combines high stability and optimized resolution of thermal effects. Laser-guided welding processes for the sensor disks and thermocouple wires yield true sensitivity and robustness. The monolithic DSC sensor features high metrological stability and optimal resolution.

The easy to handle S-Module is the module of choice for industry and contract laboratories when routine measurements are the main task.

DSC 300 *Caliris*® *Classic*

Ideal for Quality Control and Teaching

Perfect Measurement Conditions, Even in Less Than Perfect Environments

The gas-tight measurement cell provides optimal atmospheric conditions for precise measurements. The gas flow is regulated by three magnetic valves that can be turned on or off programmatically. Mass flow controllers are also available as an option. This is of particular advantage for measuring the oxidative induction time/temperature (OIT).

Moreover, the gas-tightness of the cell ensures that environmental humidity does not affect the DSC system. This is particularly useful in regions with high humidity, as it largely minimizes problems caused by condensation.

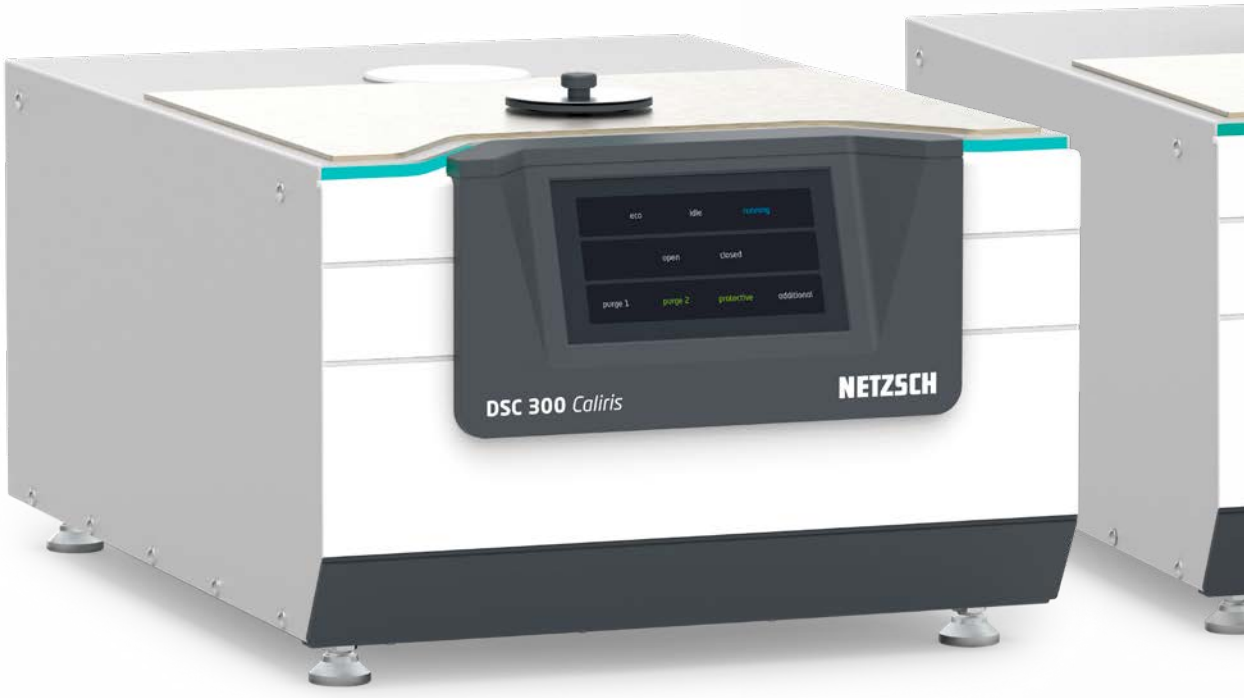
Excellent Performance and Competitively Priced

The monolithic DSC sensor is stable even under harsh environmental conditions and offers optimal resolution. The sensor disks and thermocouple wires are laser-welded, resulting in high sensitivity and robustness.

In the event of unwanted contamination of the cell or sensor, the temperature range of up to 600°C makes it easy to clean by baking out the contaminants. In addition, cleverly designed connectors allow for quick and easy installation of various cooling systems.

Compact Design for More Space in Your Lab

The DSC 300 *Caliris*® *Classic* boasts a slim design that requires minimal space. As laboratory space is often limited, the compact design of the DSC 300 *Caliris*® *Classic* with a cooling accessory, such as the intracooler, makes it an excellent choice. It is perfect for at-line investigations and can be easily set up in a production environment for QA/QC purposes.



More Than a DSC – A Smart, Easy-to-Use Quality Control System

Making Routine Easy

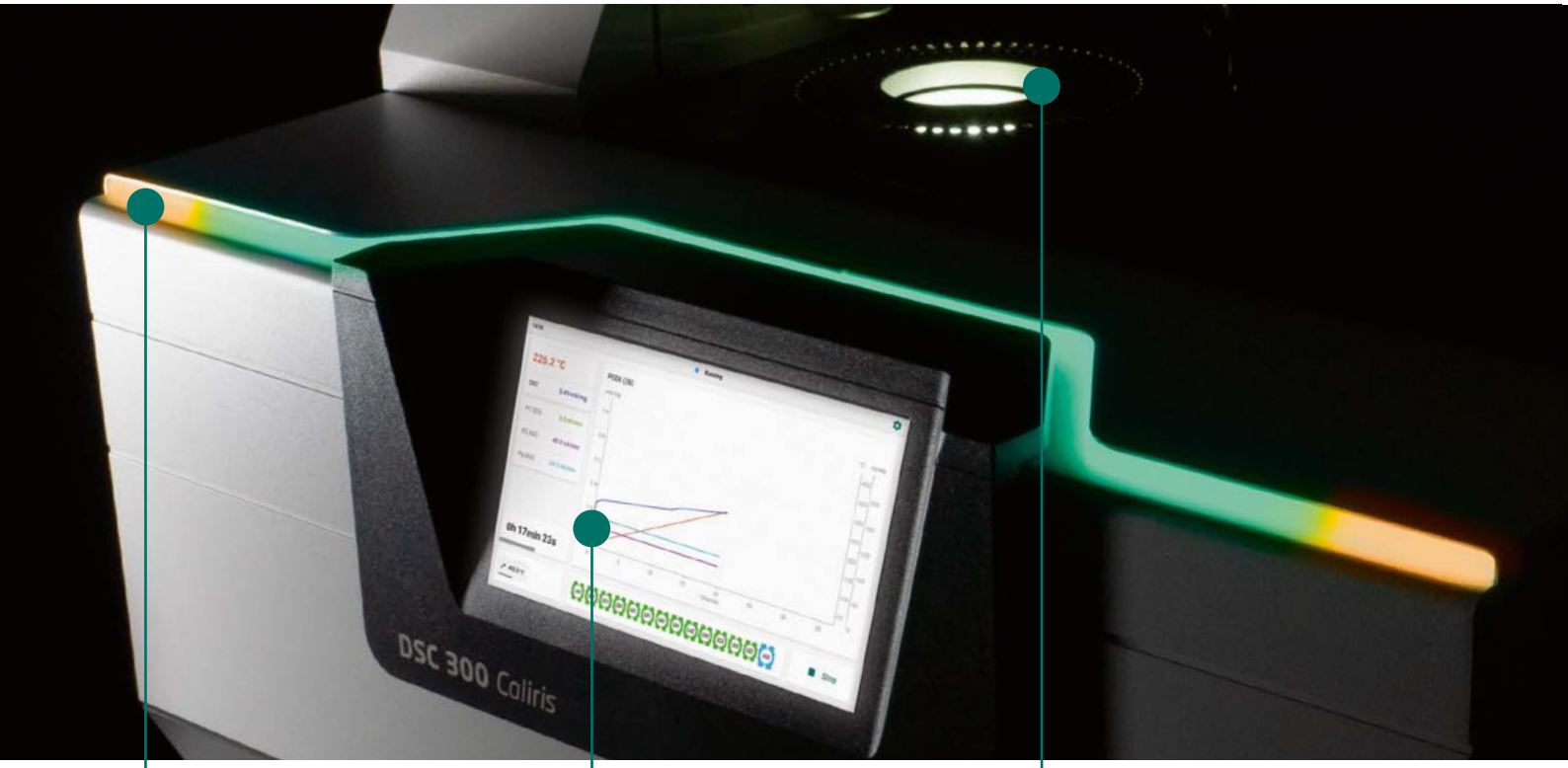
The gas-tight DSC 300 *Caliris® Classic* is the preferred choice for routine measurements in industry and contract laboratories, and is ideal for projects within the scope of education. It combines the advantages of a highly sensitive, high-tech analysis device with a rugged, easy-to-use work-horse.

The Quick-Start System for DSC Measurements

The DSC 300 *Caliris® Classic* offers a quick way to introduce Differential Scanning Calorimetry to your lab. After the instrument has been set up and calibrated, the simplified and intuitive *SmartMode* user interface will guide you through defining your measurement parameters.

After the measurement is complete, the *AutoEvaluation* and *Identify* software features will take care of the time-consuming task of comparing your results to known references or literature values. These routines offer support in the evaluation of measurement curves and serve as a second opinion for assessing unknown samples. The *Identify* database system is capable of verifying materials and allows for quality assurance tests.

ROBUST INSTRUMENT WITH ATTRACTIVE PRICE-PERFORMANCE RATIO



Measurement Update in Passing – LED Status Bar

The DSC 300 *Caliris*® series provides an LED light bar that allows you to check the status of your instrument as you walk by, with different colors representing different statuses. It is reassuring to see from afar, without having to log into your PC, that your measurement is running smoothly and to be able to read instrument status notifications such as:

- Instrument is ready
- Measurement is running
- Measurement progress
- Heating/Cooling to setpoint
- User interaction needed
- A problem occurred

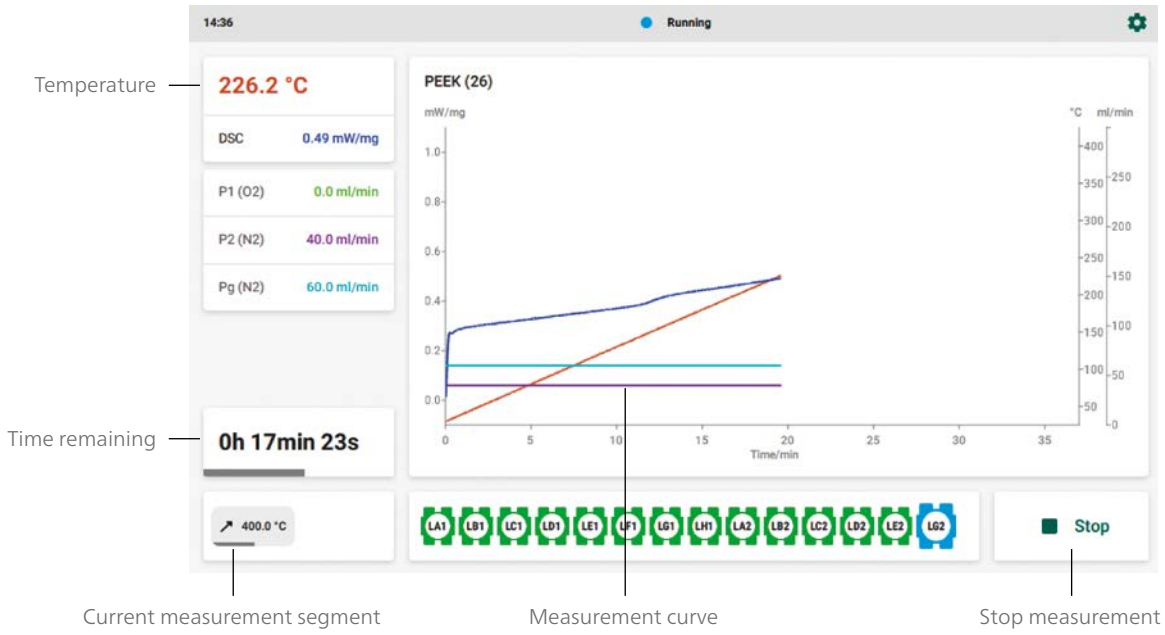
Improving Your Productivity and Workflow Using the New User Interface

The integrated color display allows you to start a measurement that was previously prepared in the NETZSCH *Proteus*® software. Just touch the prepared measurement button on the display and you will be informed about the setup of the measurement. This moves the final check before you start a new measurement directly onto the instrument. The color touch display offers:

- Start measurements by the touch of a finger
- Follow measurement progress
- Check recently finished measurements
- See the progress of your measurement and time remaining
- Check gases, idle state and current temperature
- Get an immediate overview of the evaluated measurement

Sensor Guide Light – Correct Crucible Positioning Made Easy

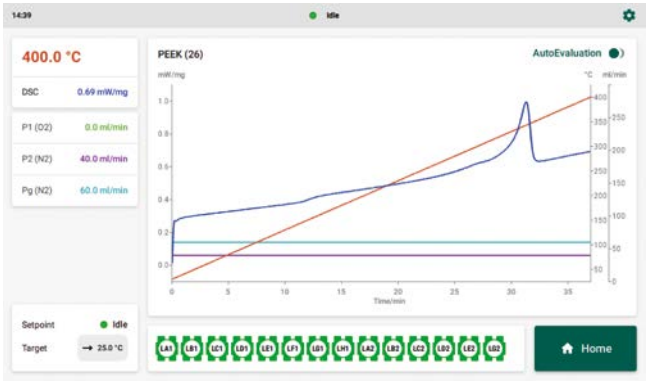
The illuminated cell of the DSC 300 *Caliris*® *Supreme* makes crucible placement easy. Reliable measurement results also depend on the correct positioning of the sample and reference crucibles on the sensor. Lighting conditions in the laboratory are not always ideal. This is where illuminating the sensor makes placing the sample on the sensor much easier.



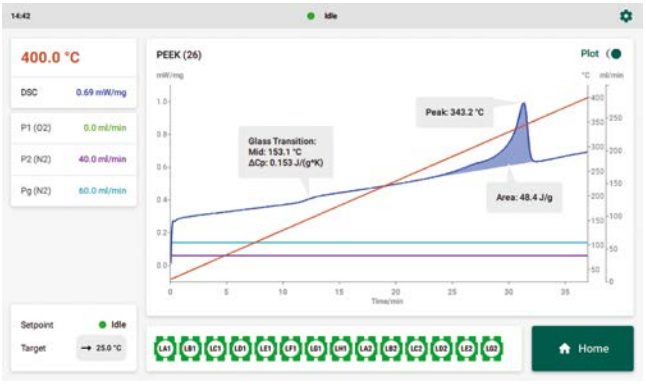
Control over your measurements without logging into a PC

AutoEvaluation: Objective Results Available After the Measurement Has Finished

If *AutoEvaluation* has been activated in the measurement setup, the measurement data will be evaluated immediately and objectively within the blink of an eye. An objective evaluation of the measurement curve will be available in an analysis window after the measurement has finished. The original plot will still be accessible.



Measurement plot, current temperature and gases are displayed during measurement

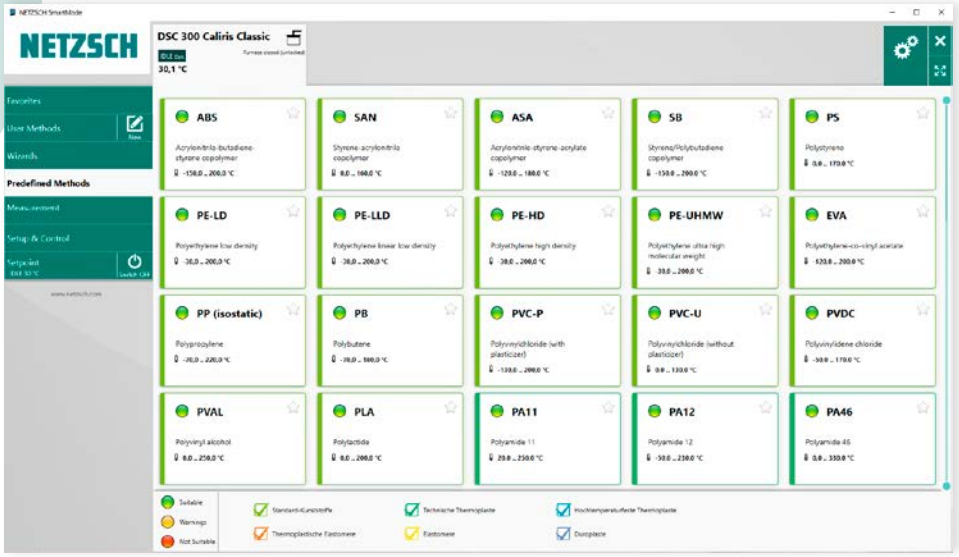


When *AutoEvaluation* is defined, the autonomous evaluation is available on the display after the measurement.

The DSC 300 *Caliris*® – Designed to Keep the User Thoroughly Informed and in Full Control

Proteus® Software

GET STARTED QUICKLY WITH SMARTMODE



Pre-defined methods in the *Proteus*® software

SmartMode for Routine Tasks – No More, No Less

An intuitive interface for fast measurement setup, the *SmartMode* is designed especially for routine measurements as are often needed in quality control. It allows for the quick and easy preparation and start of measurements for tasks using clearly defined measurement procedures. Wizards (quick-start routines), user-defined measurement methods and pre-defined measurement methods are helpful assistants.

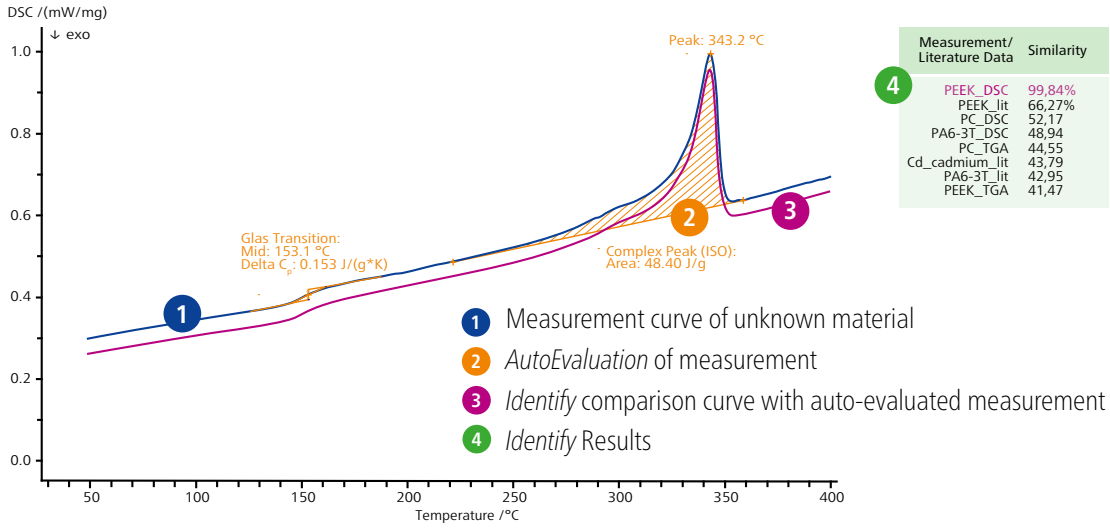
ExpertMode – the Sky is the Limit

This mode is designed for users preferring to access the full scope of *Proteus*® possibilities. It is perfect for advanced measurement tasks and offers infinite potential.

Workspaces – the Full Scope of *Proteus*® Analysis, but the Way You Prefer It

When working regularly with *Proteus*® Analysis, it can be overwhelming to deal with all of the available functionalities. Take advantage of *Proteus*® *Workspaces* to tailor the *Proteus*® Analysis menu and tool bar icons to your daily routine. Move all your frequently used items to the front, hide options you rarely or never use and save your preferred setup as your personal workspace. This is especially useful for workstations used by more than one person. Users can easily switch between custom and joint workspaces.

AutoEvaluation and *Identify* – Speed Up Results



Points 1 to 4 show the results of *AutoEvaluation* and *Identify* applied on a PEEK sample.

AutoEvaluation

Objective Results Seconds After the Measurement End

AutoEvaluation is the first self-acting evaluation routine for DSC curves on the market. Fully autonomously and without user intervention, it evaluates all effects such as glass transition temperatures, melting temperatures, and melting enthalpies of unknown substances. Oxidative Induction Time/Temperature (OIT/OOT) also gets evaluated for isothermal and dynamic tests, using the Tangent and Offset method in accordance with standards.

Experienced users can take the automatic evaluation result as a second opinion – and, of course, recalculate values if desired. When *AutoEvaluation* is selected in the chosen method, the evaluated curve will be shown automatically after the measurement has ended.

Report Generator

Each operator can easily create personal report templates – including logos, tables, description fields and plots. Several report examples are already included as templates within the *Proteus*® software.

Identify

Material Identification and Comparison Database

Identify is a unique software tool within the thermal analysis field for the identification and classification of measurements via database comparison. In addition to allowing one-on-one comparisons with individual curves and literature data, it can also check whether a particular curve belongs to a certain class. These classes can consist of curves of the same material type (material identification) or of reference curves for Pass/Fail testing (quality control).

The provided NETZSCH libraries contain about 1300 entries related to different application areas such as polymers, organics, pharmaceuticals, inorganics, metals/alloys or ceramics. The additionally available KIMW* database includes the DSC curves of another 1150 commercially available polymer products. Users can expand *Identify* as desired, adding unlimited amounts of their own data. In general, all database entries serve as a pool of results and useful measurement conditions.

* KIMW = Kunststoff-Institut Lüdenscheid, Germany

Proteus® *Search Engine* – Smart Data Management

When working with measurement and evaluation data for different materials and different measurement setups, it is enormously helpful to be able to directly access and sort data by certain criteria. *Proteus*® *Search Engine* automatically synchronizes your measurement data with pre-defined directories and filters it in a matter of seconds. Previews of measurement curves or analysis status are available with just one click.

Users are able to create individual searches, for example "MyPolymers", and switch easily between different existing searches. This makes *Proteus*® *Search Engine* a very powerful data management tool.

Advantages of *Proteus*® *Search Engine*

- Efficient data management
- Directly access and sort data by criteria
- Preview your stored data
- Quickly view measurement and analysis previews without opening files
- Retrieve data quickly and easily
- Search, e.g., by instrument name, method, operator, file and signal type, date, measurement conditions or evaluated effects

Proteus® *Search Engine* and LabV®

LabV®-primed

LabV® – Taking Advantage of the Digital Lab

NETZSCH instruments are compatible with the LabV® data management platform, a user-friendly software that automates data collection, regardless of method or device, and provides a centralized view for organizing, analyzing, and exploring your data. LabV®'s AI-powered digital assistant simplifies data analysis, allowing labs to easily find insights with no effort. It uses natural language processing, similar to ChatGPT, making it easy for labs to create visualizations, spot trends, and uncover complex correlations with straightforward commands.

Advantages of LabV®

- **Laboratory Automation**
  Streamline your testing process and connect all your testing devices
- **Cloud Solution**
- **Improved Quality Control**
  Improve the quality of your materials with insights, intelligent alerts and intuitive data management
- **Faster Development**
  Leverage your lab data to accelerate material development

ADDITIONAL SOFTWARE CAPABILITIES

Temperature-Modulated DSC

Temperature modulation is a software feature that separates reversing effects related to changes in the heat capacity of a sample from non-reversing, time-dependent processes. For example, it is possible to see a glass transition superimposed on a relaxation effect or evaporation. In a temperature-modulated DSC measurement, a sinusoidally modulated temperature profile is superimposed on the underlying average linear heating rate. The result is a heat flow signal that is also modulated (the oscillatory portion) and a total heat flow curve that is the standard DSC signal without modulation. From this, the reversing and the non-reversing DSC signal can be calculated. Successful separation requires that the sample material can follow the imposed temperature change.

Peak Separation

Peak Separation serves for the more precise determination of individual peak areas and the temperatures of overlapping caloric effects based on selectable mathematical algorithms. This program allows for the separation of overlapping peaks, using the profiles from the following peak types: Gaussian, Cauchy, Pseudo-Voigt (additive mixture of Gaussian and Cauchy), Fraser-Suzuki (asymmetric Gaussian), modified Laplace (double-sided rounded) and Pearson.

Purity Determination

For crystalline substances with known molar mass, *Purity Determination* serves to determine the percentage of eutectic impurities on the basis of the Van't Hoff equation. The DSC melting peak is evaluated for this purpose.

Kinetics Neo

The NETZSCH Kinetics Neo software is used to analyze temperature-dependent processes. The result of such analysis is a kinetics model correctly describing experimental data under different temperature conditions. The model allows for the prediction of a chemical system's behavior under user-defined temperature conditions. Alternatively, such models can be used for process optimization.

Software Features			
	Supreme	*Select*	*Classic*
AutoCooling	■	■	■
AutoCalibration	■	■	■
Report generator	■	■	■
SmartMode	■	■	■
ExpertMode	■	■	■
Predefined Methods	■	■	■
TauR	■	■	■
OIT/OOT	■	■	■
AutoEvaluation	■	■	□
Identify	■	■	□
Temperature-modulated DSC (TM-DSC)	■	□	□
Specific heat capacity (c_p)	■	□	□
Peak Separation	■	□	□
Proteus® Search Engine	■	□	□
LIMS support	■	□	□
KIMW polymer database	□	□	□
Purity	□	□	□
Kinetics Neo	□	□	□
ASC (Automatic Sample Changer) support	□	□	□
Proteus® Protect (CFR 21 part 11)	□	□	□

■ included
□ optional

more features on request

Accessories

Unique Automatic Sample Changer (ASC)

DSC 300 *Caliris® Supreme* and *Select*

Improving Your Efficiency with the Support of a Dependable Sample Robot

Removable Sample Trays Making Preparation and Storage Easy

The DSC 300 *Caliris® Select/Supreme* with ASC is designed to hold two interchangeable sample trays in microplate format, each holding 96 samples. This allows for the clear assignment of the samples when they are prepared away from the instrument. On one side of each standardized sample tray, a 2-D code is printed which identifies the tray. This is especially helpful when several people are using the same DSC but have separate sample trays in use.

Reducing Environmental Influences while Waiting

In order to prevent sample materials from being affected by the surrounding conditions, whilst waiting in the queue – such as humidity – the ASC is equipped with a tray cover. The interspace between the sample trays and the cover is purged with gas to stop contact with unwanted atmospheres.

DSC 300 *Caliris® Classic*

Up to 20 Samples

For high throughput applications and routine work, an automatic sample changer (ASC) is available for the DSC 300 *Caliris® Classic* for up to 20 samples and references. The gripper safely removes the crucible from the magazine and gently places it in position on the sensor. The reference crucible can also be changed as often as the application requires.

The ASC is easily programmed using the *SmartMode* of the *Proteus®* software. A specific measurement program (method) can be assigned to each sample on the tray. Different crucible types, different gas atmospheres and individual calibration curves can be handled within the same carousel run. Used samples are automatically disposed of in the integrated waste bin. For 24/7 operation, previously measured samples can be continuously replaced by adding new crucibles to the carousel in combination with new measurement methods.

Option and ASC available for all three DSC 300 *Caliris*® variations

Photo-Calorimetry with Automatic Sample Changer – Perfect UV-Curing of Reactive Polymers

A photo-calorimeter or UV-DSC is the right instrument for investigating curing reactions which are initiated by irradiation (UV or light). In the DSC 300 *Caliris*® equipped with the UV accessory, the light guides are permanently installed in the automatically moving furnace lid; this allows the DSC to be immediately ready for UV measurements. It is easy to exchange the lid to switch back to conventional DSC measurements, thus covering the entire temperature range. The photo-DSC system allows for the selection of temperature, atmosphere, light intensity, and exposure time.

Recommended UV lamps*	Wave length range
OmniCure® S2000	320 nm to 500 nm
LX500	365 nm, 385 nm, 395 nm, 405 nm

* It is also possible to adapt other commercial lamps

The Benefits to You

- Study of the influence of UV stabilizers in pharmaceuticals, cosmetics and foods (aging effects)
- Measuring the (UV) light-induced curing of polymer resins, paints, inks, coatings and adhesives
- Only photo-DSC that offers an Automatic Sample Changer (ASC)

Curing of UV Ink Measured at Different Temperatures

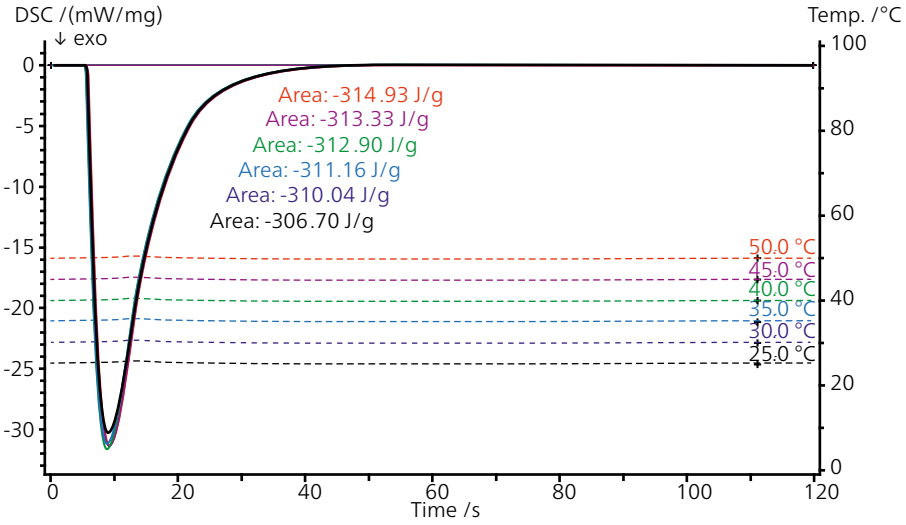


Fig. 1: UV ink exposed to UV light source for 10 seconds at different isothermal temperatures

In figure 1, the sample and reference were irradiated with UV light at different isothermal temperatures until the sample was cured. In this case, the curing is almost unaffected by different temperatures. Thus, the reactivity of this sample just depends on the irradiation. Furthermore, it is possible to carry out such photo-DSC experiments with different irradiation intensities.

Curing and Post-Curing of a UV Adhesive

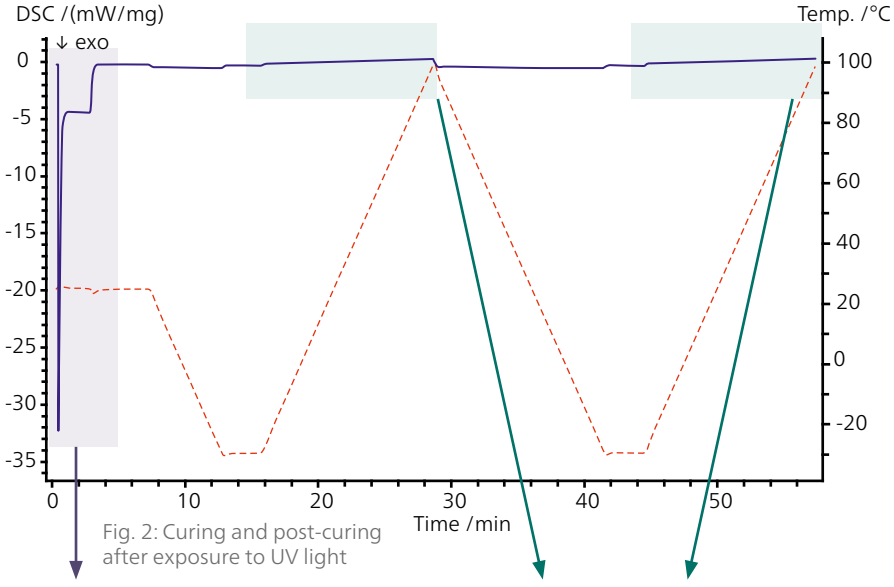


Fig. 2: Curing and post-curing after exposure to UV light

UV adhesives are acrylate- or epoxy-based resins often used in the medical and electronics industries. They polymerize and cure by irradiation with a special UV light source. Additionally, quite often a thermal post-curing process is required to achieve the best material properties. This allows them to offer functionalities that are important in manufacturing processes, like superior resistance to chemicals (e.g., solvents), a wide operating temperature range, low shrinkage, and strong, tack-free finishes.

With the NETZSCH photo-DSC 300 *Caliris*®, it is possible to monitor such curing processes within a single measurement. Firstly, the sample was cured for 2 ½ minutes at room temperature (see fig. 3). The subsequent first heating up to 100°C (blue curve in fig. 4) exhibits a glass transition at 18°C and post-curing at 60°C. In the second heating (red curve in fig. 4), no more post-curing occurs and the glass transition can be finally determined at 22°C.

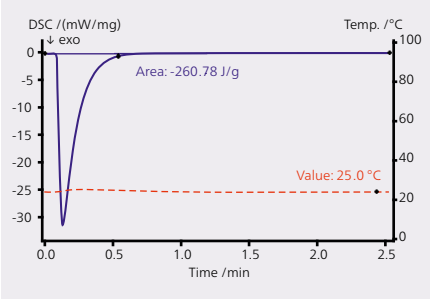


Fig. 3: Exposure of sample to UV light at room temperature

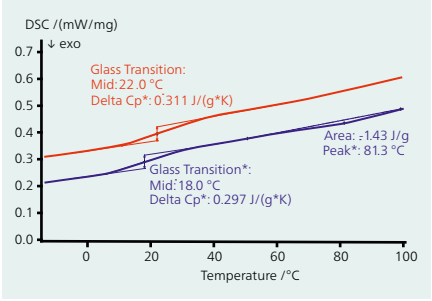


Fig. 4: Glass transition and post curing effect during first heating (blue curve) and final glass transition (determined in the second heating curve, red curve)

Effective and Highly Economic Cooling Systems

Tailored to specific temperature ranges, four different cooling options are available (depending on instrument configuration), ranging from air cooling devices to liquid nitrogen cooling. The liquid nitrogen cooling option can be operated in LN_2 (liquid nitrogen) as well as in the GN_2 (gaseous nitrogen) mode. This helps to save coolant.

Mechanical cooling allows for a maximum temperature range of -70°C/-90°C to 600°C. Liquid nitrogen cooling offers the widest temperature range of -180°C to 750°C without changing the instrument setup (e.g., furnace, lid, etc.) in the premium specification of the DSC 300 *Caliris® Supreme*.

Connecting the standard 60-liter Dewar to a large LN_2 tank (e.g., containing 300 liters), automatic refilling is enabled during long measurement series or even during a running measurement. This allows many measurements using the Automatic Sample Changer (ASC) to run without interruption.

The *AutoCooling* function of the NETZSCH *Proteus®* software detects the cooling unit present and automatically selects the optimum cooling parameters, e.g., LN_2 or GN_2 in case the CC300 cooling device is used.

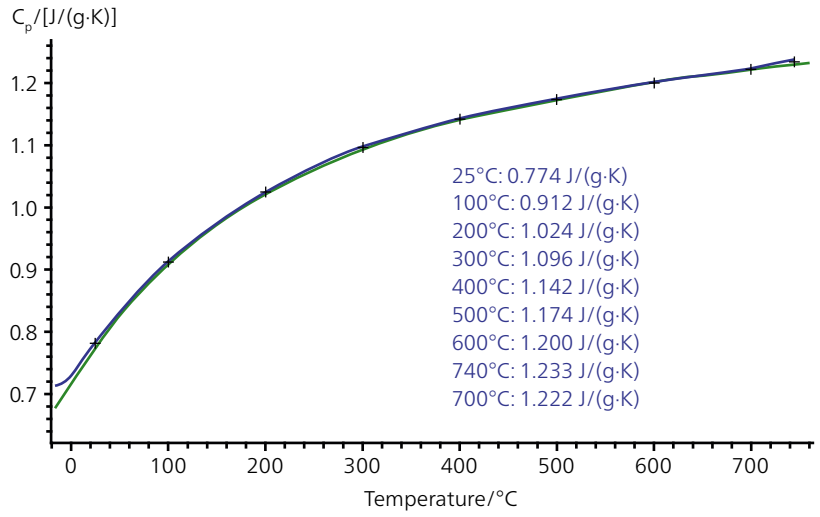
The liquid nitrogen cooling device can be connected to the DSC at the same time as the intracooler (mechanical cooling). Since this cooling is only required below -40°C/-70°C or -90°C, depending on the connected Intracooler, this results in a reduction in liquid nitrogen consumption.

	Supreme			*Select*			*Classic*
	H-Module	P-Module	S-Module	H-Module	P-Module	S-Module	
LN_2/GN_2* Cooling	-180°C to 750°C	-170°C to 600°C	-170°C to 600°C	-180°C to 650°C	-170°C to 600°C	-170°C to 600°C	-170°C to 600°C
Intracooler	-90°C to 600°C	-70°C/ -40°C** to 600°C	-70°C/ -40°C** to 600°C	-90°C to 600°C	-70°C/ -40°C** to 600°C	-70°C/ -40°C** to 600°C	-70°C/ -40°C** to 600°C

* cooling by GN_x restricted
** depending on the intracooler version

APPLICATIONS

c_p Determination of Sapphire

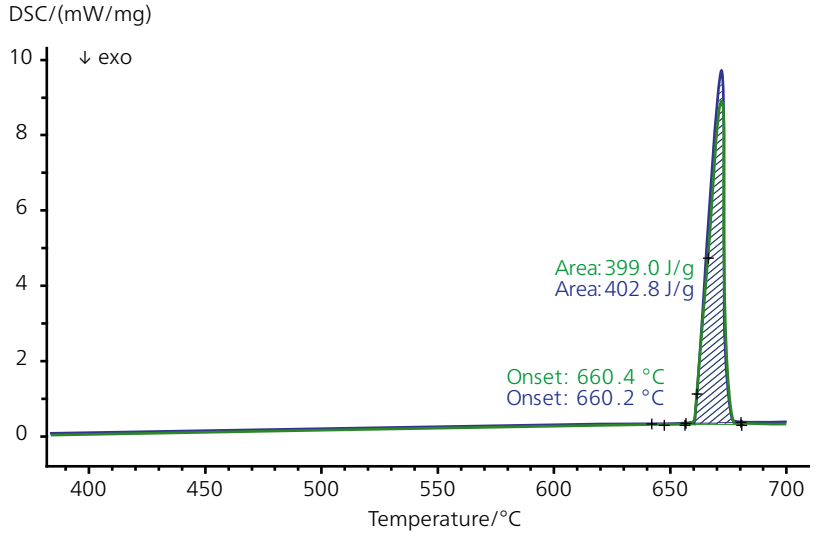


Specific heat capacity of a sapphire disk (84 mg); measurements at heating rates of 20 K/min in N_2 atmosphere (20 ml/min); measurement was carried out with H-Module

Specific heat capacity (c_p) is a decisive thermal property of a material. It is an essential parameter for many thermal simulations.

This example shows the specific heat capacity of sapphire up to 740°C. The determination was carried out in accordance with DIN EN ISO 11357-4. The blue curve represents the measured data; the green curve, literature values. The data shows a good correlation between the measurement and the literature data. Even at the highest temperature, the deviation is less than 1%.

Melting of Aluminum

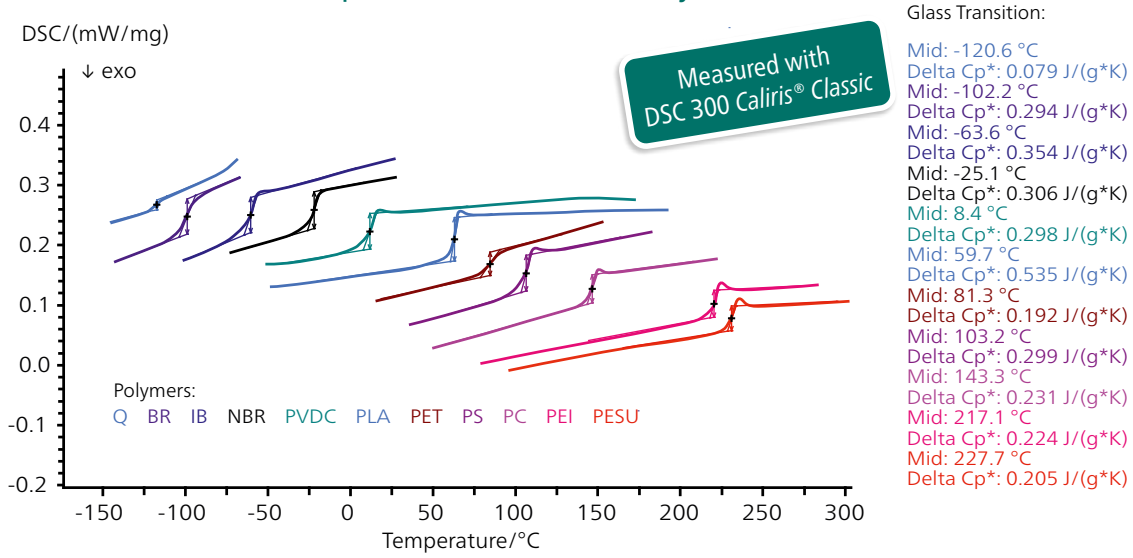


DSC measurements on aluminum with the H-Module.
Sample mass: approx.12 mg; atmosphere: N_2.

Measurements above 600°C require crucible materials other than aluminum, which melts at 660°C.

In this example, a metallic sample was measured in a platinum crucible. To avoid any reaction between the two metals, an Al_2O_3 liner was used in the Pt crucible. Despite the influence on the time constant and the caloric sensitivity, the two measurements exhibit very good reproducibility – below 1% with respect to onset and enthalpy of fusion.

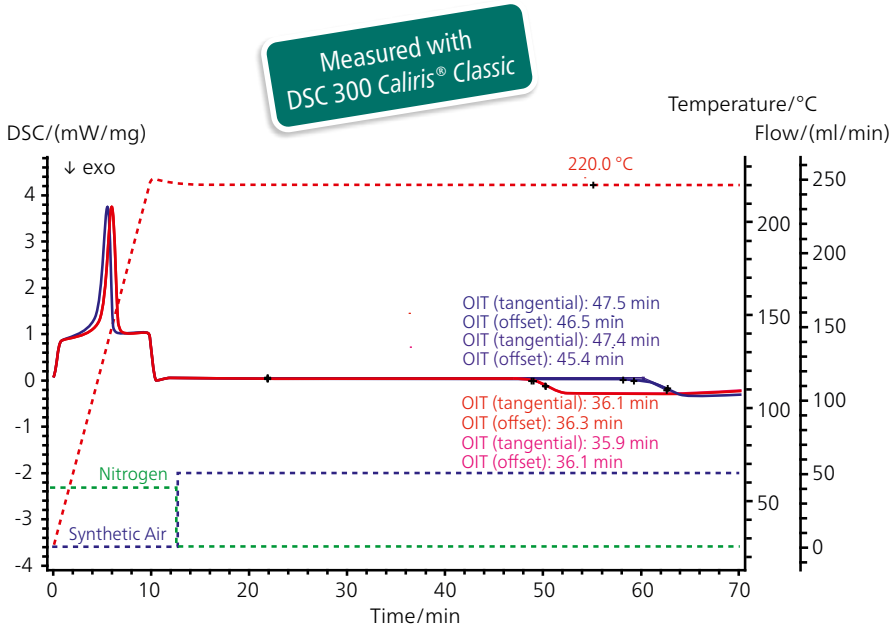
Glass Transition Temperatures of Different Polymers



Glass transition temperature of the 2nd heating, measured by DSC; curves shifted along the y-axis for clarity; sample weight: app. 10 mg; heating rate: 10 K/min.

The glass transition temperature (T_g) of a polymer is the temperature range when it shifts from a rigid "glassy" state to a flexible "rubbery" state, impacting its usability, especially in elastomers. Understanding T_g is crucial for quality control, optimizing processing, ensuring product performance, and maintaining material consistency. This improves final product quality and reliability.
T_g varies with polymer type (e.g., elastomer, thermoplastic, thermoset), affecting specific heat capacity, making it measurable with DSC. The DSC 300 *Caliris® Classic*, equipped to connect multiple cooling devices simultaneously, efficiently measures T_g in a wide range of polymers without hardware modifications.

OIT Measurement on Two Grades of PE-HD



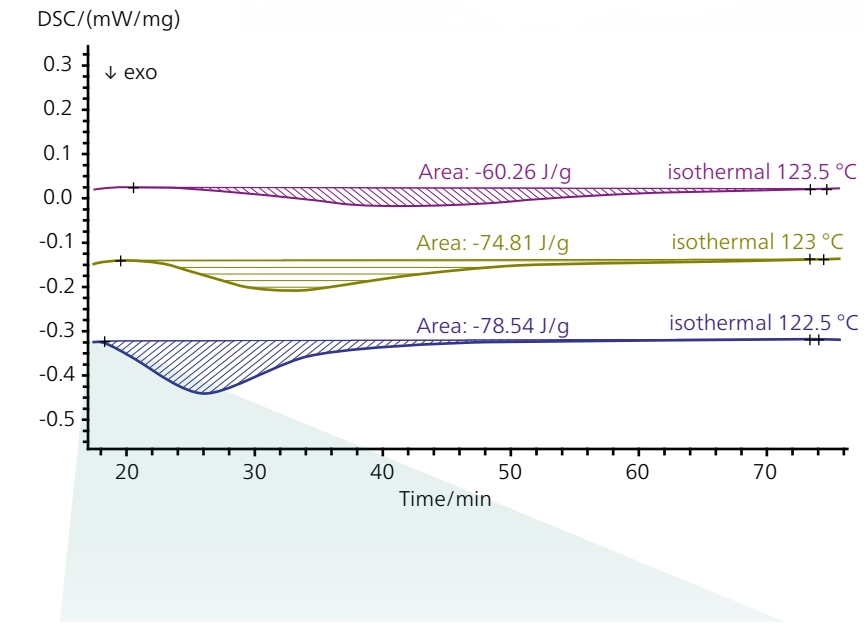
OIT measurement on two different PE-HD grades indicating significant differences in the stability against oxidation. Sample mass: 10.5 mg ± 0.2 mg; heating rate: 20 K/min; open Al crucible; nitrogen atmosphere switched to synthetic air at 220°C.

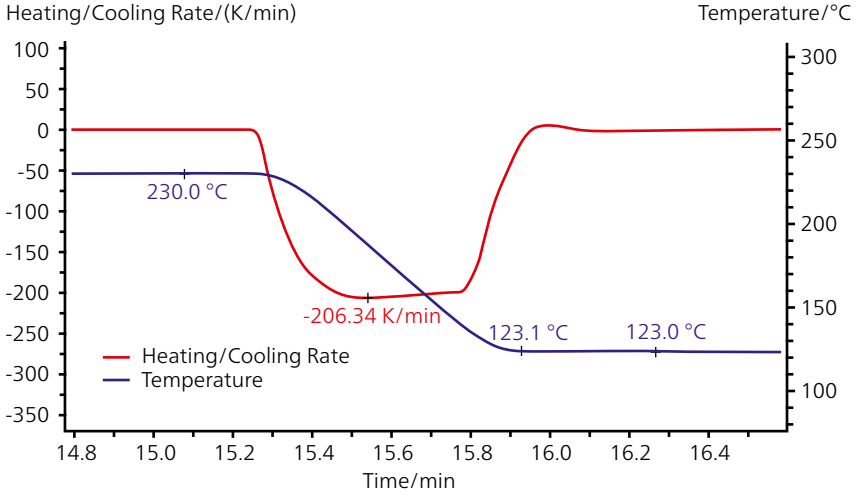
Oxidative-Induction Time (OIT) measures a material's resistance to oxidative decomposition using calorimetry. A sample is heated steadily in inert gas, then exposed to oxygen or air at the same rate. OIT is the time from airflow start to the exothermic DSC heat-flow curve deviation (in accordance with DIN EN ISO 11357-6 or ASTM D 3895).
The figure on the left displays OIT results for two samples. At 220°C in air, differences in oxidation stability are evident. The blue sample has higher oxidative stability, valuable for assessing organic materials or polymers like PE pipes.

Isothermal Crystallization of PE-HD

Isothermal crystallization measurements deliver deep insights into the crystallization behavior of thermoplastic materials. This information can be used to determine appropriate processing conditions.

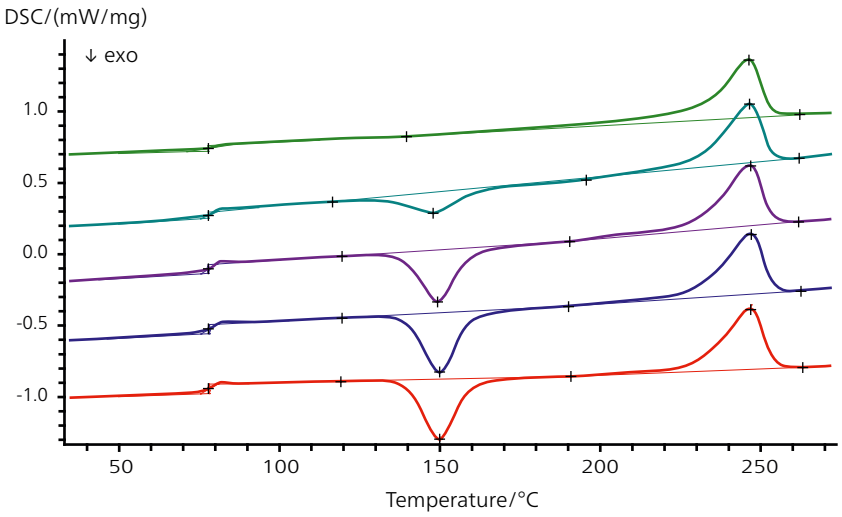
As expected, the slope of the crystallization peak is steeper with decreasing isothermal temperature, so the peak minimum is reached faster. This signifies a faster crystallization. Also, the crystallization enthalpy (peak area) increases as the temperature of the isothermal segment decreases, indicating a higher degree of crystallinity in the final product. Such measurements require a DSC, which allows for very fast cooling (see image below). This can be achieved with the DSC 300 *Caliris*® with P-Module.





Crystallization at different temperatures measured with the P-Module. Sample mass: approx. 5.5 mg,; aluminum sample pans: *Concavus* with pierced lid; atmosphere N_2.

Influence of Cooling on the Crystallinity of PET



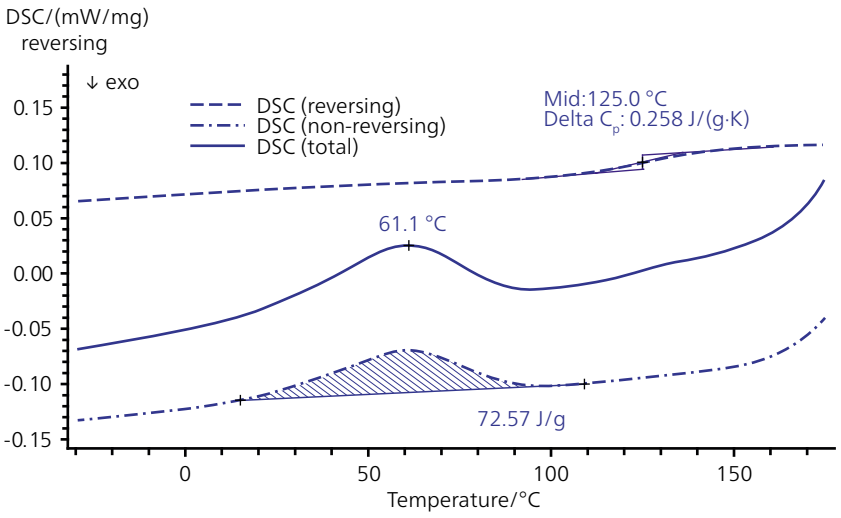
PET measurements with the P-Module. Sample mass: approx. 5.5 mg; aluminum pans: *Concavus* with pierced lid; atmosphere: N_2; 2nd heating with 10 K/min

The crystallinity of the semi-crystalline thermoplastic PET is influenced by the crystallization rate. This means that if cooling occurred fast enough, post-crystallization will show up in the subsequent heating.

In the DSC experiments shown here, various effects are evident: endothermic DSC steps representing the glass transition (around 80°C), exothermic effects for post-crystallization (peak temperature at around 150°C) and endothermic melting effects (peak temperature around 247°C). The crystallinity of the material is determined from the enthalpy of melting and post-crystallization. The amorphous portion of the material is represented by the glass transition. At the glass transition of the sample, the specific heat capacity changes: the greater the change, the greater the amorphous fraction.

Cooling Rate (prior to heating)	Glass Transition		Post-Crystallization		Melting		Crystallinity
[K/min]	Δc_p [J/(g·K)]	Midpoint [°C]	Enthalpy [J/g]	Temperature [°C]	Enthalpy [J/g]	Temperature [°C]	[%]
10	0.240	77.7			42.49	246.4	30.35
20	0.253	77.8	-18.11	147.7	38.44	246.7	14.35
50	0.368	77.9	-32.68	149.5	38.61	246.8	4.24
100	0.379	78.1	-34.15	150.1	38.42	247.0	3.05
200	0.394	78.2	-34.48	150.0	38.38	246.9	2.79

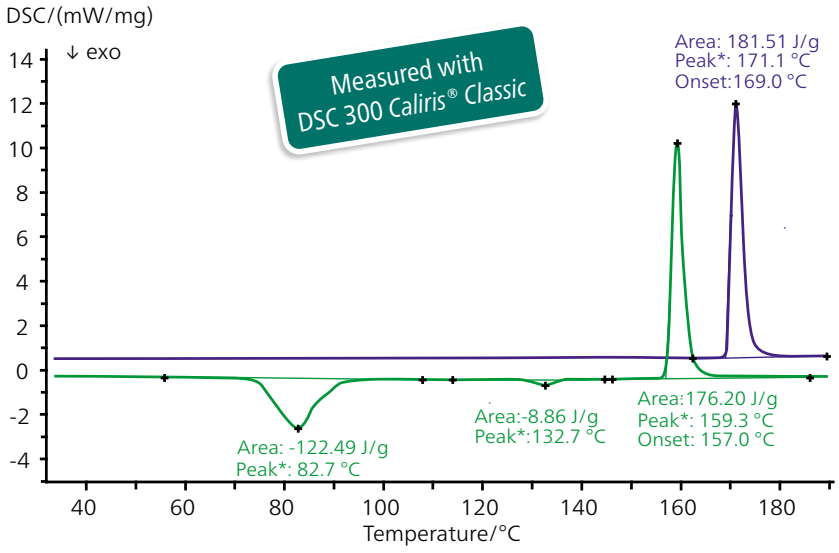
Temperature-Modulated DSC Measurement on Eudragit® L100-55



Sample mass: 3.02 mg, underlying heating rate: 3 K/min, amplitude: ± 0.5 K, period: 60 s, crucibles: Al crucibles with pierced lid and measurement done with S-Module

Eudragit® is an amorphous copolymer brand derived from acrylic and methacrylic acid esters. The copolymer's functional and physical attributes depend on monomer choice and proportions, affecting its glass transition temperature. Eudragit® L100-55 is the specific sample discussed here, used as an enteric coating. During heating, various effects occur. To investigate further, a temperature-modulated test was conducted. It involves applying a sinusoidal modulation to the linear heating ramp, splitting the total DSC signal into a reversing DSC signal (dashed line) and a non-reversing DSC signal (dash-dotted line). The non-reversing DSC curve detects water release, while the reversing signal precisely evaluates Eudragit®'s glass transition through its heat capacity change.

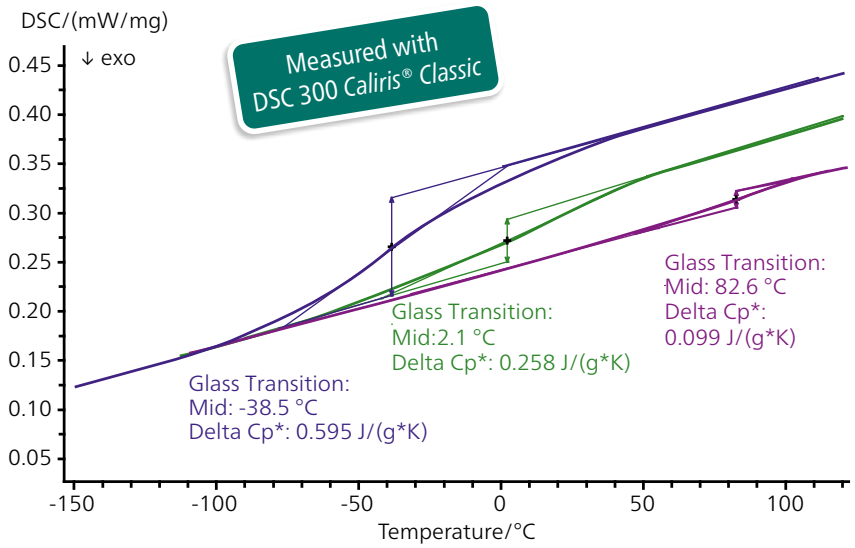
Polymorphism of Paracetamol



DSC results for Paracetamol (blue curve: 1st heating; green curve: 2nd heating). Sample mass: 1.54 mg; 1st heating from 25 to 190°C at 10 K/min, cooling to 25°C at 10 K/min, 2nd heating from 25 to 190°C at 10 K/min; atmosphere: N_2 , *Concavus*® Al crucible with pierced lid.

Paracetamol, or acetaminophen, a common over-the-counter pain reliever and fever reducer, displays polymorphism. This means it can exist in various crystal structures with the same composition. There are three known forms: Forms I, II, and III. Form I is the most stable, offering good solubility and dissolution rates. In a heating and cooling experiment, the first heating reveals a melting point of Form I at 169°C. No crystallization occurs during controlled cooling, indicating amorphous paracetamol. In the second heating, a cold- or post-crystallization process creates Form III at 82.7°C. Form III transforms into Form II (peak temperature 132.7°C) and eventually melts at 157°C.

Finding the Right Storage Conditions for Spices



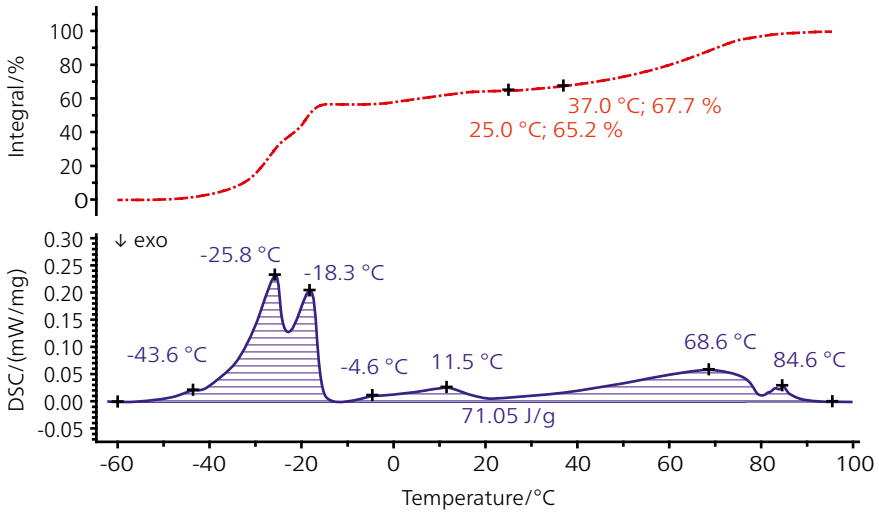
DSC results of tumeric with different water content; sample weight: 10.71 mg, 10.05 mg and 11.03 mg; *Concavus* Al crucible, hermetically sealed: heating from -170 to 120 °C at 10 K/min; green curve: powder (as received); purple curve: dry powder (powder dried for 45 min at 80°C); blue curve: wet powder (stored for 20 min at RT at 100% rel. humidity)

Curcuma, also known as turmeric, is a spice derived from the ginger family's rhizome. It serves as food additive E 100, a yellow pigment with anti-inflammatory and antioxidant properties.

Commercial turmeric powder has a glass transition temperature (T_g) of -2.1°C (midpoint), reflecting its amorphous nature. T_g influences quality and shelf life, causing softness and stickiness above it, leading to particle clumping during storage. Knowledge of T_g is crucial for processing like drying and grinding to prevent clumping.

When curcuma aborbs moisture, the T_g will be lowered. In this case, 100% humidity shifts T_g to -39°C, while prior drying sets T_g at 83°C.

DSC Measurements on Commercial Lipstick



DSC measurements on lipsticks using the S-Module
Sample masses: 10.28 mg; heating rate: 5 K/min; Al crucibles, closed; nitrogen atmosphere; displayed is the 2nd heating step (blue) together with the integral of the DSC curve (red)

Lipsticks contain fats, waxes, oils like castor oil, coconut oil, carnauba wax, and bee wax, along with cosmetic additives like emollients and color pigments. High-melting ingredients, e.g., carnauba wax (above 80°C), provide long-lasting properties, while lower-melting ones ensure smoothness and even application.

In this thermal analysis of a commercial lipstick from -60°C to 100°C, we observe seven endothermal effects, reflecting the complex formulation. The integral curve (red) shows that at 25°C, 65% of the mixture is molten (liquid fraction), while 35% remains solid, equivalent to a 35% "solid-fat-content" at 25°C and around 42% at 37°C (body temperature), relative to the total oils, fats, and waxes melting in this range.

DSC 300 *Caliris*®							
	Supreme			*Select*			*Classic*
Color touch display	■			■			□
Modules	freely selectable and upgradeable			fixed selection			-
Module type	H	P	S	H	P	S	-
Max. T/°C	750	600	600	650	600	600	600
Temperature accuracy/K (indium)*	± 0.05	± 0.1	± 0.1	± 0.05	± 0.1	± 0.1	± 0.1
Heating/cooling rates K/min**	0.001 to 200	0.001 to 500	0.001 to 100	0.001 to 200	0.001 to 500	0.001 to 100	0.001 to 100
Cooling with LN_2, min. T/°C	-180	-170	-170	-180	-170	-170	-170
Cooling with intra-cooler, min. T/°C	-90	-70/-40	-70/-40	-90	-70/-40	-70/-40	-70/-40
Cooling with pressurized air, min. T/°C	<0	<0	<0	<0	<0	<0	<0
Gas-tight design	■	■	■	■	■	■	■
Gas atmospheres	inert/oxidizing, static/dynamic						
Integrated 3-fold MFC	■	■	■	■	■	■	□
4-fold MFC***	□	□	□	-	-	-	-
192+12-position ASC	□	□	□	□	□	□	-
20-position ASC	-	-	-	-	-	-	□
Piercing device	□	□	□	□	□	□	-
100 Hz data acquisition	■	■	■	□	□	□	-
Enthalpy accuracy/%	< 1 for adamantan, indium, zinc; < 2 for most materials						
Measuring range/mW	± 750	± 750	± 650	± 750	± 750	± 650	± 650
Unlimited warranty****	□	□	□	□	□	□	□

* deviation of measured value from "true value" (literature value)
** depending on the cooling device
*** for gas mixtures
**** In connection with maintenance contract

■ included
□ optional

Technical Specifications

The owner-managed NETZSCH Group is a leading global technology company specializing in mechanical, plant and instrument engineering.

Under the management of Erich NETZSCH B.V. & Co. Holding KG, the company consists of the three business units Analyzing & Testing, Grinding & Dispersing and Pumps & Systems, which are geared towards specific industries and products. A worldwide sales and service network has guaranteed customer proximity and competent service since 1873.

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NETZSCH-Gerätebau GmbH
Wittelsbacherstraße 42
95100 Selb, Germany
Tel.: +49 9287 881-0
Fax: +49 9287 881-505
at@netzsch.com
https://analyzing-testing.netzsch.com

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