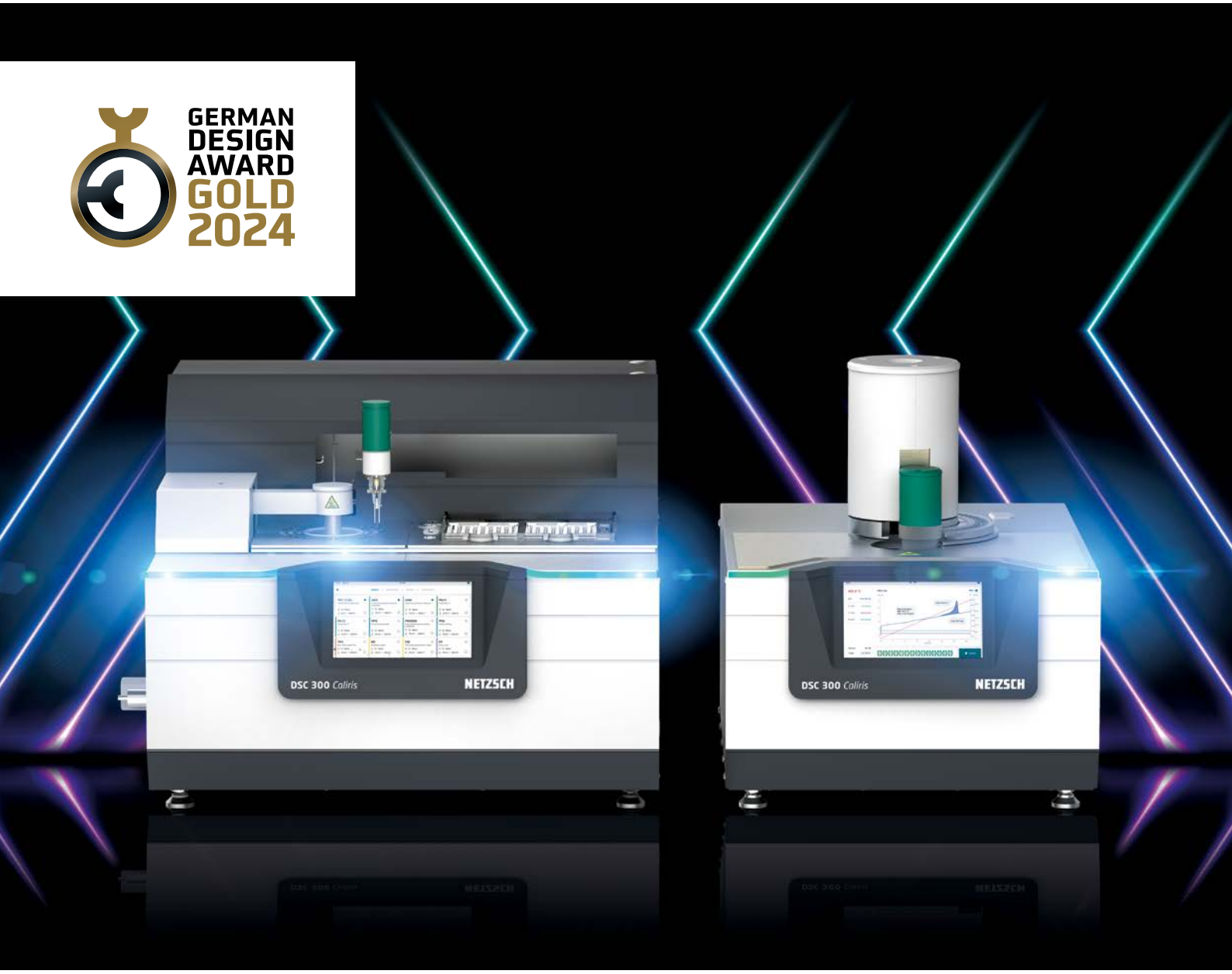
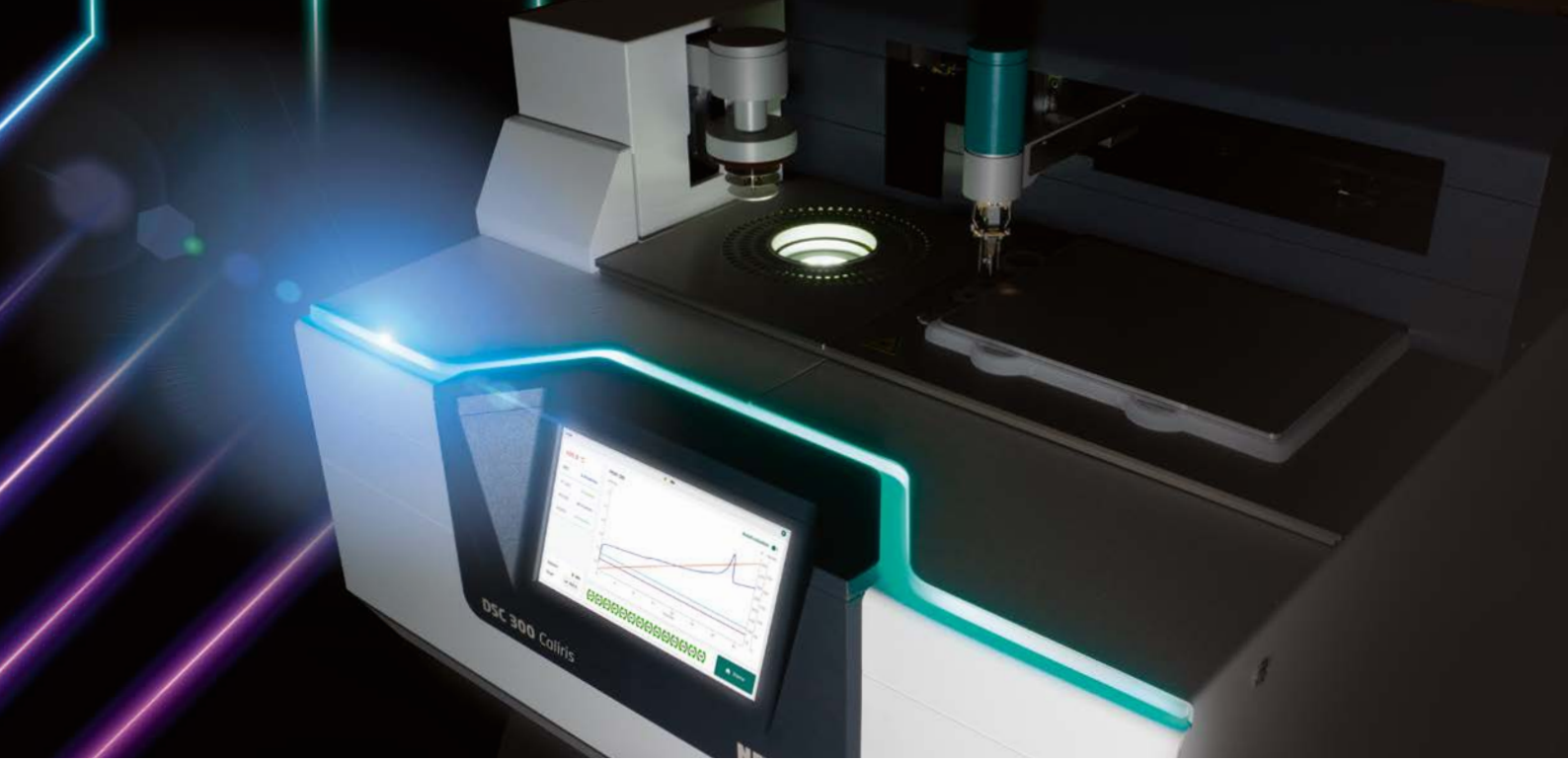
NETZSCH
Proven Excellence.



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, the way a material behaves under changing temperature and different atmospheres is a matter of importance.

The DSC 300 *Caliris*® can support:

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

Typical DSC Results

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

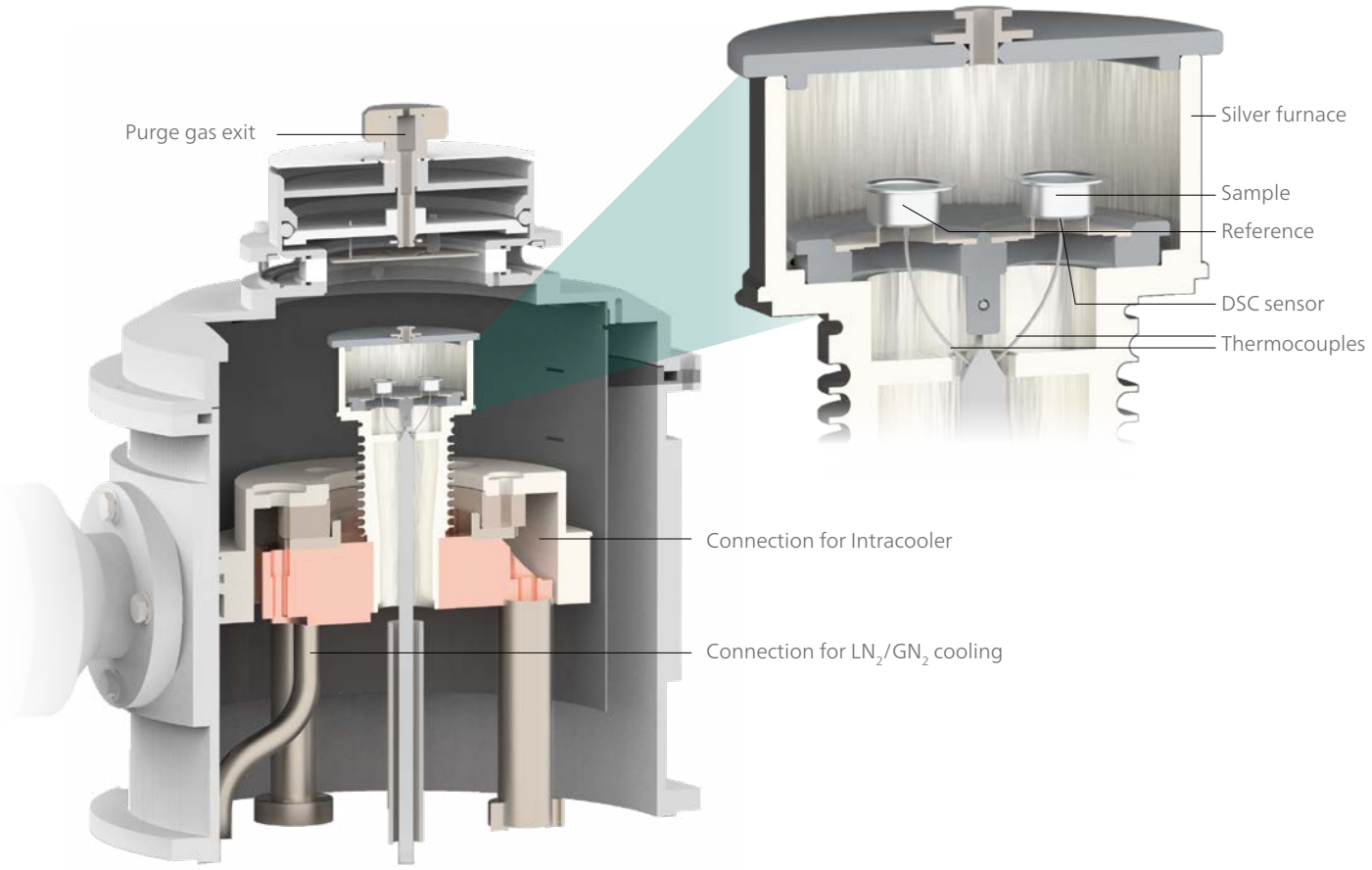
The DSC 300 Caliris® Is the Most Comprehensive, Reliable and Versatile DSC for Material Characterization on the Market!

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!

DSC 300 *Caliris*® Series

Next Generation NETZSCH DSCs – to Suit Every Budget and Demand

Classic

The DSC 300 *Caliris*® – Open for Change

The ever-accelerating development of new materials, fueled by fast-moving technical trends, requires continuous adaptability. The new generation of NETZSCH DSCs is based on a modular concept. The DSC 300 *Caliris*® *Select* and *Supreme* are the only instruments of their kind with interchangeable and/or exchangeable sensor-furnace modules.

- -170°C to 600°C
- Measuring range: ± 650 mW
- Cooling options: LN_2, Intracooler (-70°C/-40°C), compressed air
- 20-position ASC (optional)

The DSC 300 *Caliris*® *Classic* – Robust instrument with attractive price-performance ratio

The DSC 300 *Caliris*® *Classic* offers a quick, user-friendly introduction to Differential Scanning Calorimetry. Its *SmartMode* interface simplifies measurement setup, while the *AutoEvaluation* and *Identify* software features streamline results analysis, comparing data with references for quality assurance.
The gas-tight DSC 300 *Caliris*® *Classic* is ideal for routine industrial measurements, educational projects, and QA/QC purposes. Its slim, space-saving design is perfect for labs with limited space and at-line investigations.

LabV®-ready

Select

- -180°C to 750°C*
- Measuring range: ± 750 mW**
- Cooling options: LN_2, Intracooler (-90°C*/-70°C/-40°C), compressed air
- 204-position ASC (optional)
- Initial choice of modules

Supreme

- -180°C to 750°C*
- Measuring range: ± 750 mW**
- Cooling options: LN_2, Intracooler (-90°C*/-70°C/-40°C), compressed air
- 204-position ASC (optional)
- Full modularity

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 -180°C to 750°C. Modules of the same type can get exchanged, for example, during service to avoid down time.

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

This is 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 benefit from the latest technological developments or to change your application. The choice of module you use remains unrestricted.

* H-Module only
** H- and P-Modules only

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 and electronic 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 quickly be freely changed by the user. In addition, with the high-performance module, the temperature range of the *Supreme* version is the widest on the market at -180°C to 750°C.

The *Select* version of the *Caliris*® requires selection of one of the modules at the time of ordering. The maximum temperature range can be selected from among -180°C to 650°C and -180°C to 750°C.

Three Modules for Different Needs

H-Module

The High-Temperature Module

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

The premium module impresses with a perfect baseline and outstanding reproducibility. The very small peak-to-peak noise ratio allows for the detection of even the smallest of 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 with its sensitive sensor is ideal 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 via the monolithic DSC sensor.

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

MOVING TOWARDS A MORE EFFICIENT AND SUSTAINABLE LABORATORY

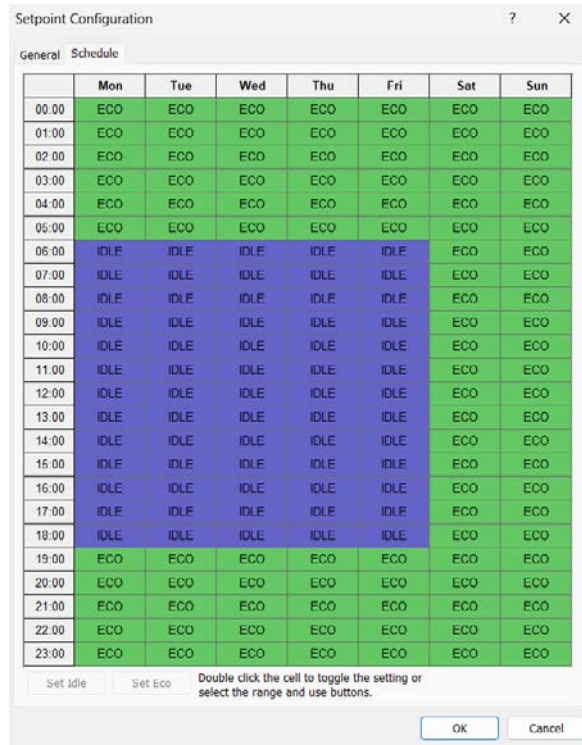
Boost Energy Efficiency – Automatically and Efficiently

On a typical lab day, DSC instruments run for 10 to 12 hours but are often shut down outside working hours, leading to long warm-up times and delayed results; or they are left running, thus leading to energy waste.

Our innovative Eco Mode changes the game. This intelligent, software-controlled feature automatically powers down the chiller in idle mode and seamlessly reactivates the gas flow and thermostat according to your custom schedule—eliminating unnecessary restarts and ensuring your instrument is ready exactly when you need it.

By switching to Eco Mode, you can save over 700 watts during idle periods and up to 1,800 kWh annually when used through weekends. That means lower operating costs, significant energy savings, and a smaller carbon footprint—making your lab greener and more cost-effective than ever before.

Example of a Setpoint Eco/Idle Configuration



Instrument in Idle Mode
Instrument in Eco Mode

Smart Cooling Solutions Tailored to Your Lab's Needs

The DSC 300 *Caliris*® offers three cooling options to perfectly match your temperature needs: air cooling, mechanical intracoolers, and liquid nitrogen (LN_2) for ultra-low temperature applications.

Designed for ultimate flexibility, the LN_2 option seamlessly operates in both liquid and gaseous nitrogen (GN_2) modes, reducing coolant consumption when full power isn't required. For extended measurement sequences, especially when paired with the Automatic Sample Changer (ASC), the standard 60 L Dewar easily connects to a larger 300 L tank for automatic refills – even during ongoing experiments.

Powered by the intelligent *AutoCooling* feature in the NETZSCH *Proteus*® software, the DSC 300 *Caliris*® smartly detects your cooling setup and optimizes operation in real time – effortlessly switching between LN_2 and GN_2 modes using the CC 300 cooling device. The result? Efficient, hands-free cooling perfectly aligned with your workflow, maximizing productivity and minimizing downtime.

Efficiency Tip: Hybrid Cooling Setup

The liquid nitrogen cooling device can be connected in parallel with the mechanical intracooler. Since LN_2-based cooling is only needed below the minimum temperature supported by the respective intracooler (-40°C, -70°C, or -90°C), this hybrid setup significantly reduces liquid nitrogen consumption – saving resources without compromising performance.

Unlimited Warranty

At NETZSCH, our commitment to quality extends well beyond the instruments themselves. We understand that your investment in advanced technology is a long-term one, and that's why we offer something truly unparalleled – our Unlimited Warranty.

What Does Unlimited Warranty Mean?

Unlike other warranties that may have hidden limitations, NETZSCH's Unlimited Warranty proves our dedication to your success. For as long as it is technically possible, we stand by our instruments and support you with:

- **Attractive Contract Pricing:** Take advantage of the extraordinary price/performance ratio of our NETZSCH Unlimited Warranty.
- **Comprehensive Coverage:** From day one and throughout the lifetime of your instrument.
- **Expert Service:** Receive high-quality service directly from NETZSCH or our authorized dealers.
- **Predictable Costs:** With our maintenance contracts, you can plan your expenditures more reliably.
- **Long-Term Reliability:** Our Unlimited Warranty ensures that your instruments maintain their value and performance.

You can rely on our unparalleled support for your thermal analysis, rheology and fire testing needs.

https://netzs.ch/unlimited-warranty

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

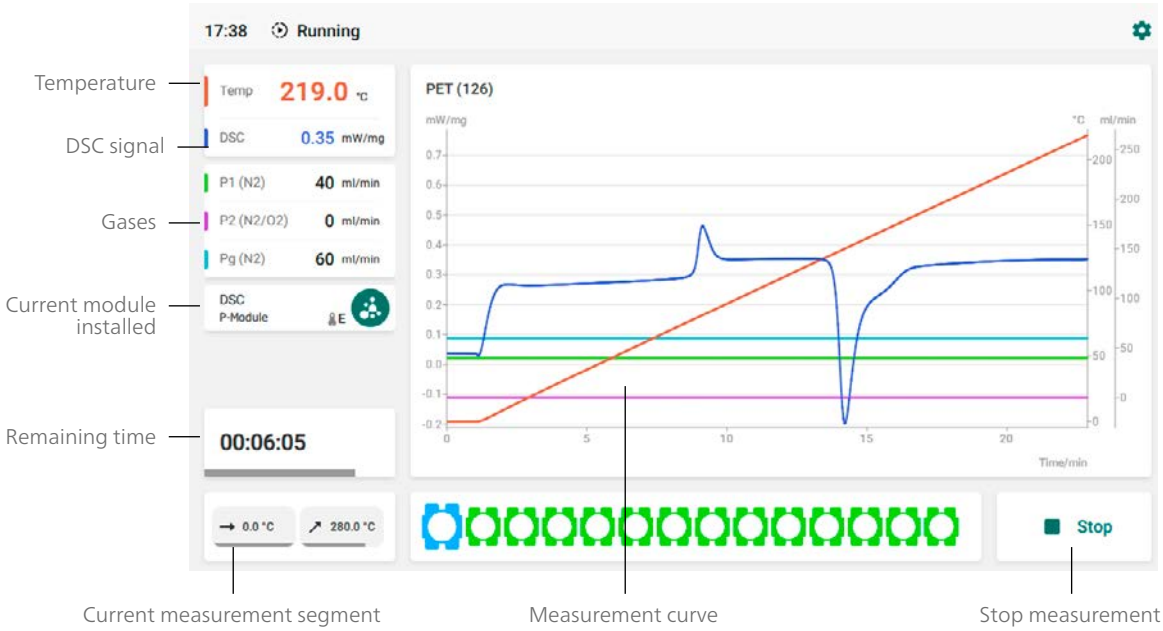
Improving Your Productivity and Workflow Using the New User Interface

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 the ability to:

- 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

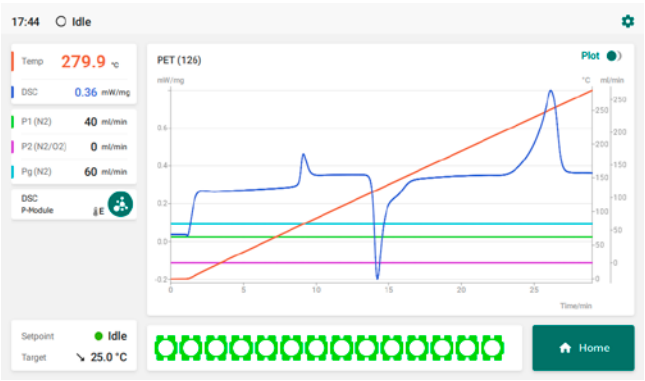
The illuminated cell of the DSC 300 *Caliris*® *Supreme* makes crucible placement easy. Reliable measurement results also depend on the correct positioning of the sample and reference crucibles on the sensor. Lighting conditions in the laboratory are not always ideal. This is where illuminating the sensor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

When *AutoEvaluation* has been activated in the measurement setup, the measurement data will be evaluated immediately and objectively within the blink of an eye. The original plot will still be accessible.



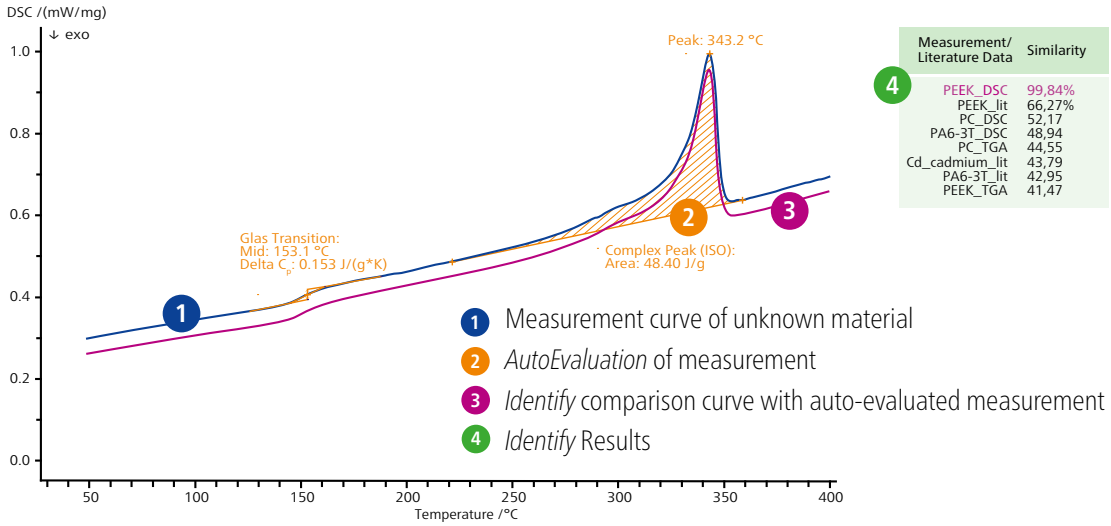
Measurement plot, current temperature and gases are displayed during measurement.

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 Control

Proteus® Software

AutoEvaluation and *Identify* – Speed Up Results



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

AutoEvaluation

Results Immediately 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.

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

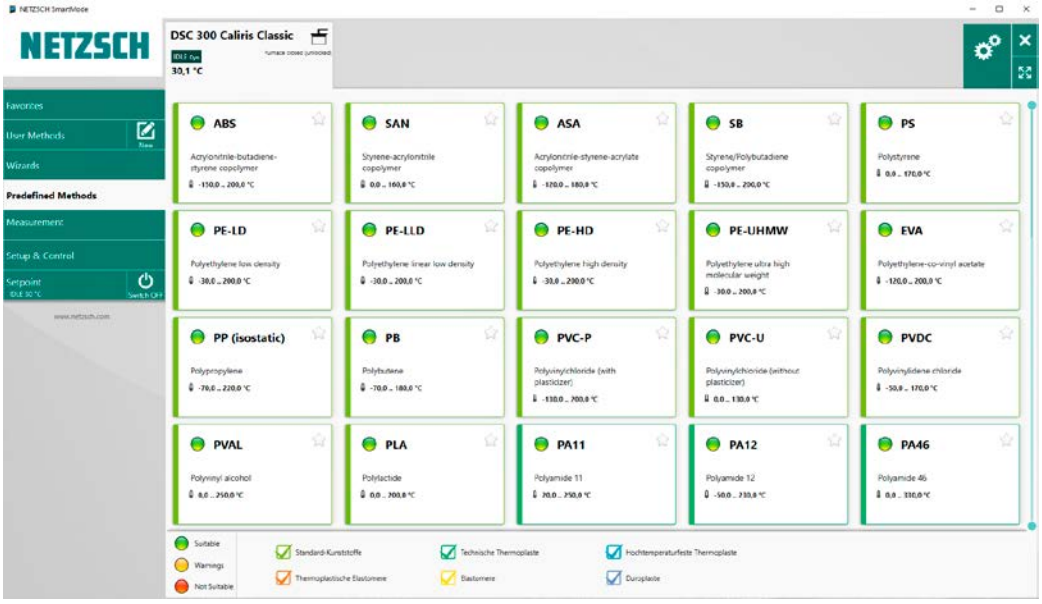
Material Identification via Database Comparison

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 1350 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 1250 commercially available polymer products. Users can expand *Identify* as desired, adding unlimited amounts of their own data.

* KIMW = Kunststoff-Institut Lüdenscheid, Germany

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, *SmartMode* is especially designed for routine measurements, as often needed as 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 functionalities available. 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.

Proteus® Search Engine and LabV®

Advantages of LabV®

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

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 by such criteria as instrument name, method, operator, file and signal type, date, measurement conditions or evaluated effects

ADDITIONAL SOFTWARE CAPABILITIES

Temperature-Modulated DSC

Temperature modulation in DSC separates reversible effects, such as glass transitions, from non-reversible processes, such as relaxation or evaporation. It involves applying a sinusoidal temperature modulation to a linear heating rate, resulting in a modulated heat-flow signal. This allows calculation of both reversible and non-reversible DSC signals.

Peak Separation

Peak Separation is a key tool for determining peak areas and temperatures of overlapping caloric effects with greater precision. It utilizes profiles from various peak types, including Gaussian, Cauchy, Pseudo-Voigt (an additive mixture of Gaussian and Cauchy), Fraser-Suzuki (an asymmetric Gaussian), modified Laplace (a double-sided rounded profile), and Pearson.

Purity Determination

For crystalline substances with known molar mass, *Purity Determination* uses the Van't Hoff equation to calculate the percentage of eutectic impurities, based on evaluation of the DSC melting peak.

2DTemperatureCalibration

This advanced temperature calibration, which conforms to international standards, is not only temperature-dependent, but also heating rate-dependent. This software option is especially beneficial for temperature accuracy when different heating rates are used in the same measurement.

Specific Heat Capacity c_p

The specific heat capacity, $c_p(T)$, can be calculated using the ratio and stepwise methods in accordance with the ASTM E1269, DIN 51007, or DIN 11357-4 standards. Additionally, c_p can be automatically determined directly from the DSC heat flow in accordance with DIN 51007.

Peak-End Detection

Peak-End Detection is used to automatically detect endothermic and/or exothermic peaks during a measurement. It triggers either a jump to the next measurement segment or the end of the measurement. *Peak-End Detection* is configurable and can be selected on a segment-by-segment basis. It is beneficial for instrument safety and can reduce measurement time.

Kinetics Software

Kinetics Lite allows you to quickly and efficiently analyze time- and temperature-dependent processes using DSC or TG data. Ideal for beginners to kinetic analysis, this software allows you to make predictions for custom-defined temperatures or heating rates.

Kinetics Neo takes it a step further. This powerful software offers comprehensive analytical methods for complex, multistage reactions, helping you gain targeted insight into and optimize industrial temperature processes. Together, these two solutions lay the foundation for informed decision-making in development, research, and application.

Termica Neo is simulation software for thermal behavior and thermal safety in chemical reactions and crystallization processes involving solids or liquids in volumes ranging from a few centimeters to a few meters.

From Recyclate Confusion to Recyclate Clarity

Proteus® Now Quantify is your smart companion for rapid, AI-powered composition analysis for polymers. Simply upload your NETZSCH DSC data to the cloud-based platform – and receive accurate, reproducible results within seconds.

Software Features	*Supreme*	*Select*	*Classic*
AutoCooling	■	■	■
AutoCalibration	■	■	■
Report Generator	■	■	■
SmartMode	■	■	■
ExpertMode	■	■	■
Predefined Methods	■	■	■
TauR	■	■	■
OIT/OOT	■	■	■
Peak-End Detection	■	■	■
AutoEvaluation	■	■	□
Identify	■	■	□
Temperature-modulated DSC (TM-DSC)	■	□	□
Specific heat capacity (c_p)	■	□	□
2DTemperature Calibration	■	□	□
Peak Separation	■	□	□
Proteus® Search Engine	■	□	□
LIMS support	■	□	□
KIMW polymer database	□	□	□
Proteus® Now Quantify	□	□	□
Purity	□	□	□
Kinetics Lite	□	□	□
Kinetics Neo	□	□	□
Termica Neo	□	□	□
Proteus® Protect (21 CFR 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 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 – such as humidity – whilst waiting in the queue, the ASC is equipped with a tray cover. The interspace between the sample trays and the cover is purged with gas to prevent contact with unwanted atmospheres.

DSC 300 *Caliris® Classic*

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 pan from the magazine and gently places it in position on the sensor. The reference pan 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 continuous operation, previously measured samples can be replaced during operation by adding new crucibles to the carousel in combination with new measurement methods.

Piercing Device

An automatic piercing device attached to the gripper is optionally available; this opens the lids of aluminum pans shortly before the measurement starts.

DSC 300 *Caliris*® plus installed UV-Curing unit.

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*® *Select* and *Supreme* 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 UV-DSC accessory allows for the selection of temperature, atmosphere, light intensity, and exposure time. The *Classic* version is equipped with a UV option, which allows for the integration of light guides or LED heads directly onto the cell cover, facilitating manual operation.

Recommended UV lamps*	Wavelength 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

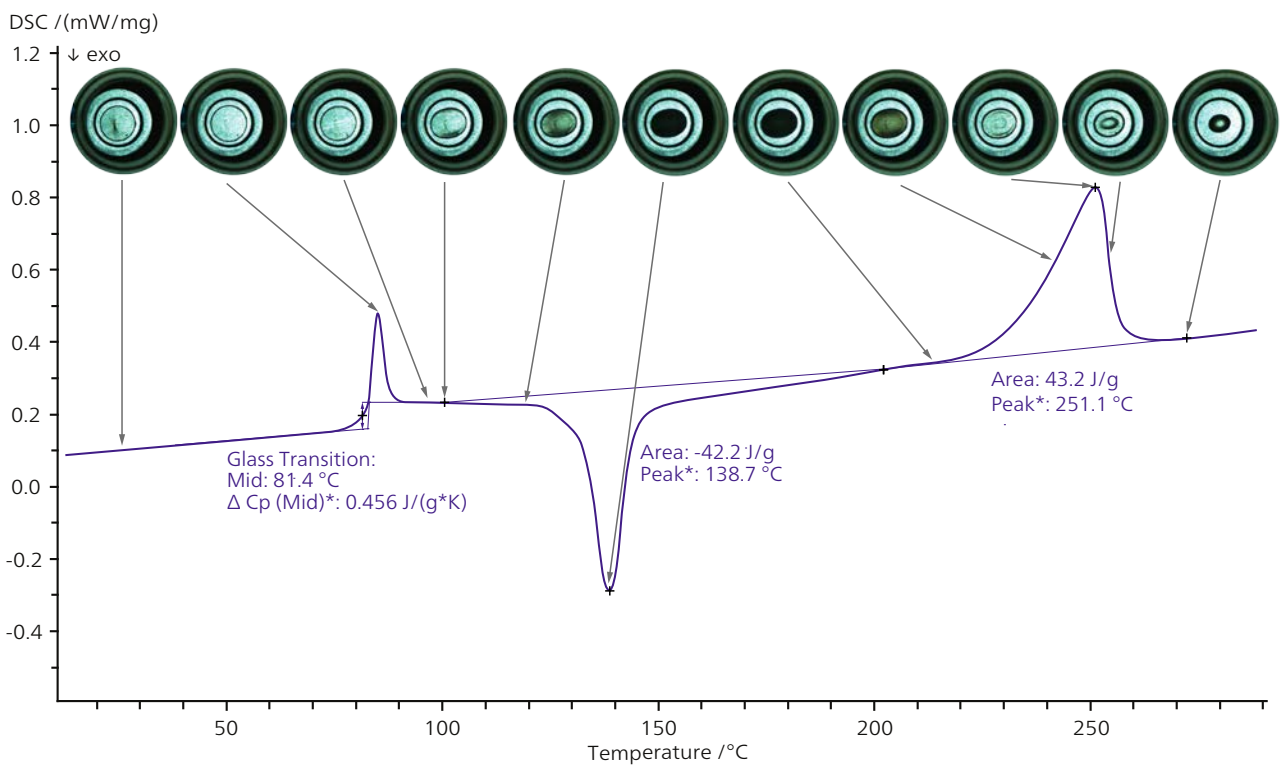
Your Benefits

- Studying 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

Your Benefits

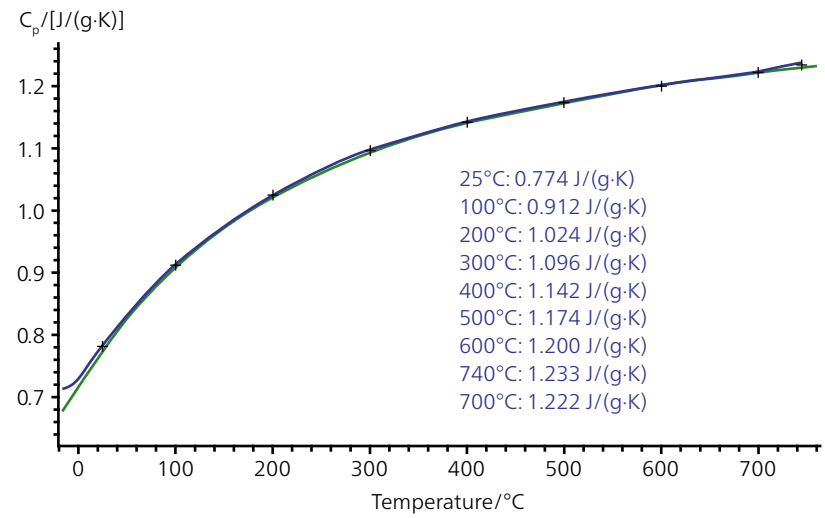
- **Improved data interpretation:** Observe physical changes in your samples.
- **Real-time quality control:** Instant visual confirmation of sample integrity and behavior.
- **Improved sample preparation:** Identify any sample preparation or positioning issues that may affect your results.

Real-Time Visual Insights
THE DSC CAMERA



APPLICATIONS

c_p Determination of Sapphire

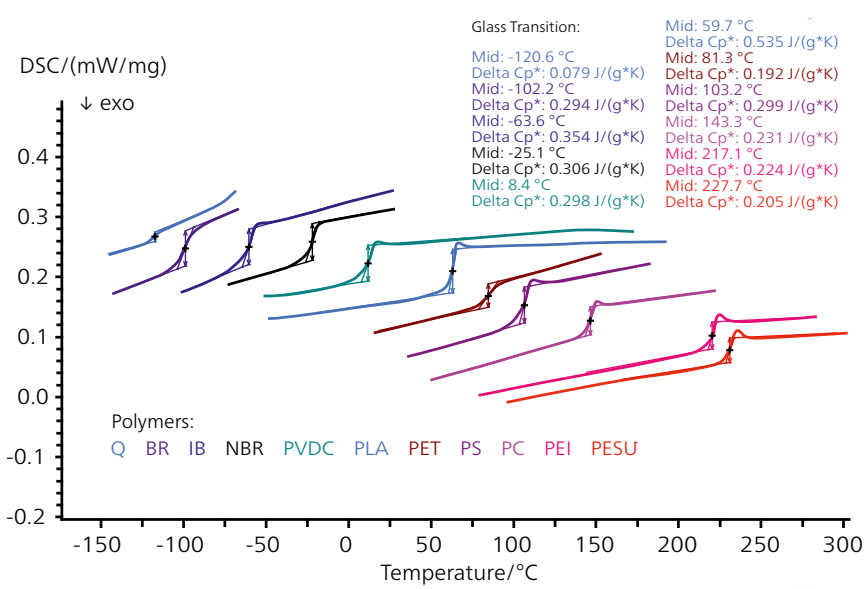


Specific heat capacity of a sapphire disk (84 mg); measurements at heating rates of 20 K/min in an N_2 atmosphere (20 ml/min); the measurement was carried out with the H-Module

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 literature data. Even at the highest temperature, the deviation is less than 1%.

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: approx. 10 mg; heating rate: 10 K/min.

Measured with the DSC 300 Caliris® Classic

The glass transition temperature (T_g) of a polymer impacts its usability, especially in elastomers. Understanding T_g is key to quality control, process optimization, performance, and material consistency. This improves final product quality and reliability.

The T_g varies with the polymer type (e.g., elastomer, thermoplastic, thermoset), affecting specific heat capacity and thus making it measurable with DSC.

The DSC 300 *Caliris® Classic*, equipped to connect multiple cooling devices simultaneously, efficiently measures the T_g in a wide range of polymers without hardware modifications.

Curing and Post-Curing of a UV Adhesive

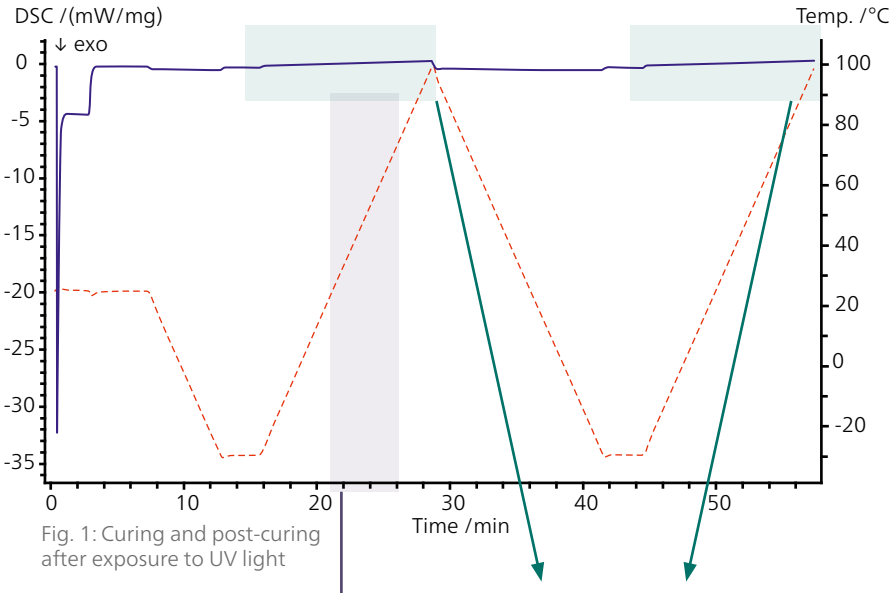


Fig. 1: Curing and post-curing after exposure to UV light

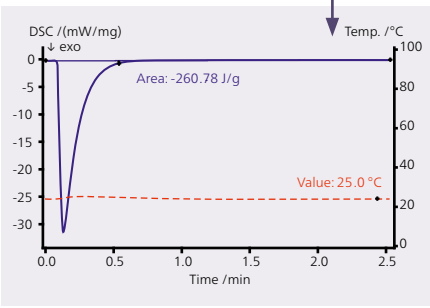


Fig. 2: Exposure of sample to UV light at room temperature

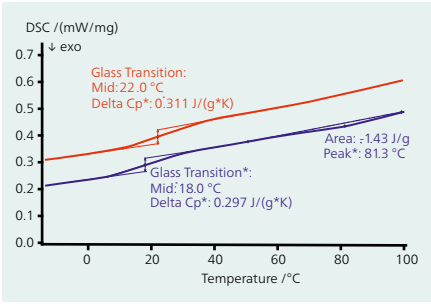
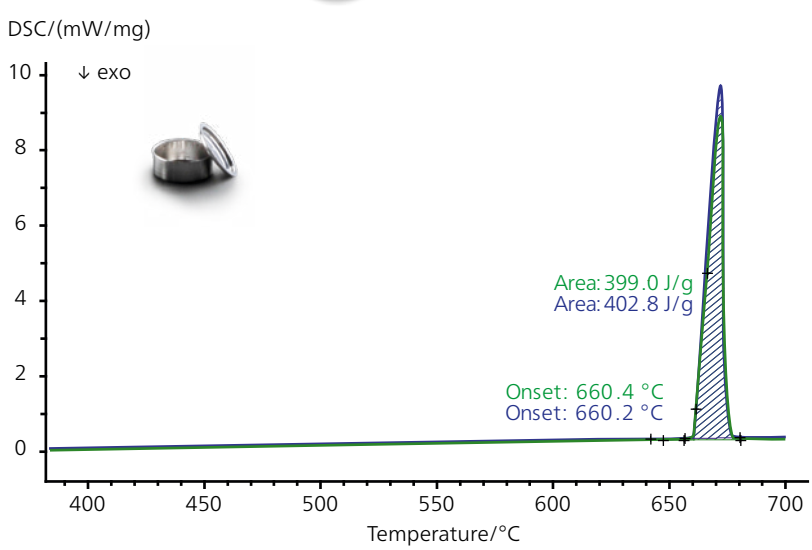


Fig. 3: Glass transition and post-curing effect during the first heating (blue curve) and final glass transition (determined in the second heating curve, red curve)

UV adhesives, based on acrylate or epoxy resins, are widely used in medical and electronics applications. They cure under UV light, often followed by thermal post-curing for optimal properties, including chemical resistance, broad temperature tolerance, 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 2½ minutes at room temperature (see fig. 2). The subsequent first heating to 100°C (blue curve in fig. 3) exhibits a glass transition at 18°C and post-curing at 60°C. In the second heating (red curve in fig. 3), no more post-curing occurs and the glass transition can finally be determined at 22°C.

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.

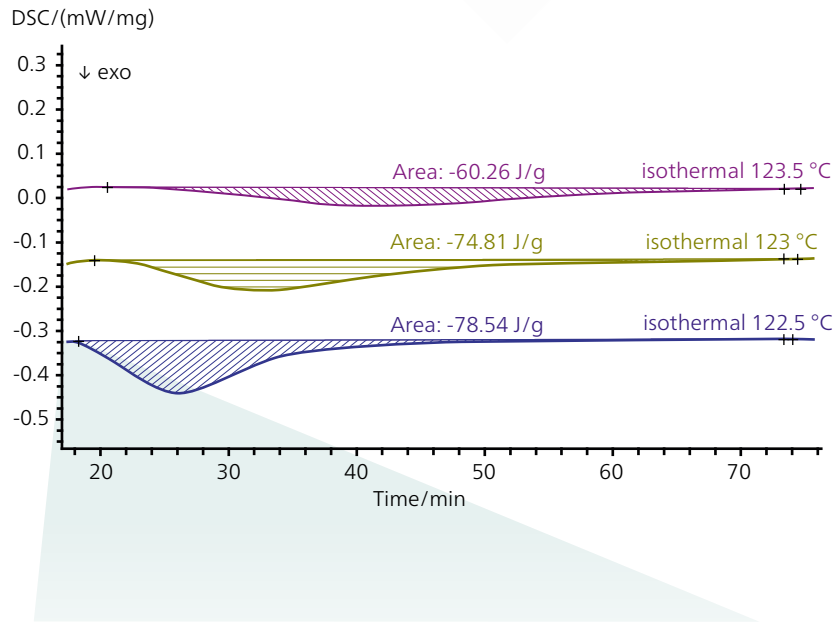
In this example, a metallic sample was measured in a platinum crucible. To prevent any reaction between the two metals, an Al_2O_3 liner was used in the Pt crucible. Despite the influence on the time constant and the caloric sensitivity, the two measurements exhibit very good reproducibility – below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

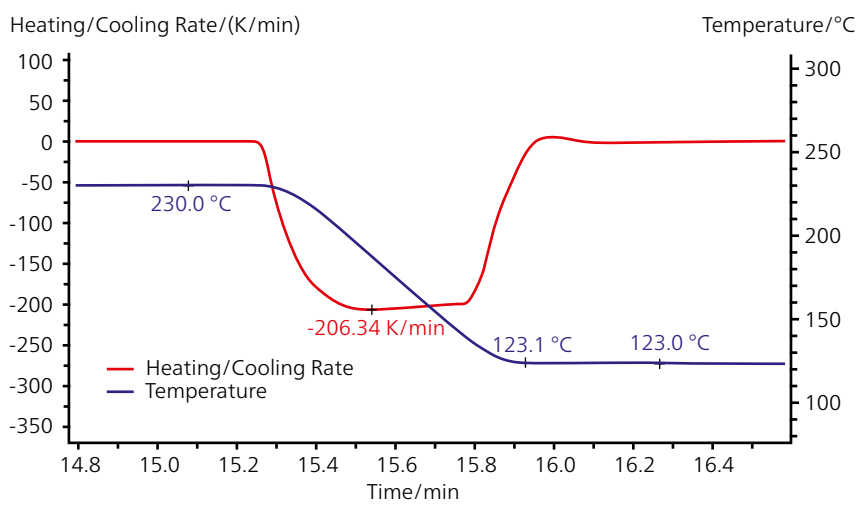
Isothermal Crystallization of PE-HD

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.

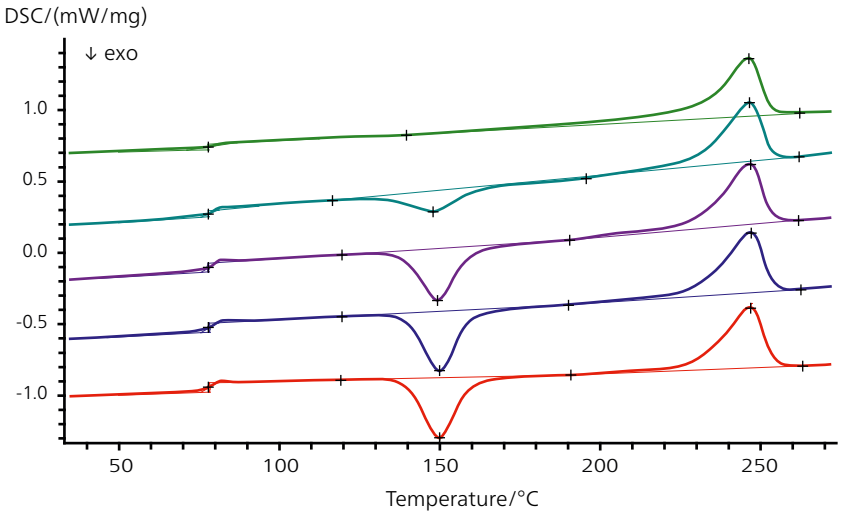
Such measurements require a DSC which allows for very fast cooling (see image below). This can be achieved with the DSC 300 *Caliris*® with P-Module.





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 at 10 K/min

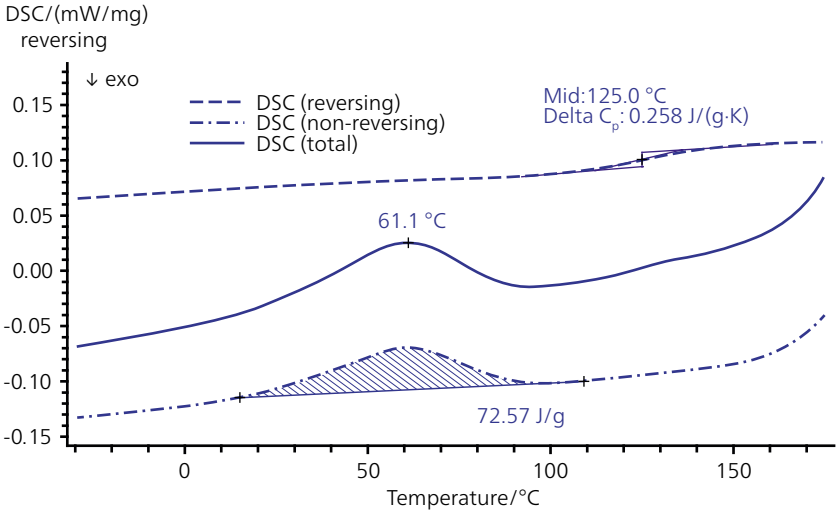
The crystallinity of the semi-crystalline thermoplastic PET is influenced by the crystallization rate. This means that if cooling occurs fast enough, post-crystallization will show up in the subsequent heating.

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 (see table below).

Evaluation of the DSC Measurements on PET

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

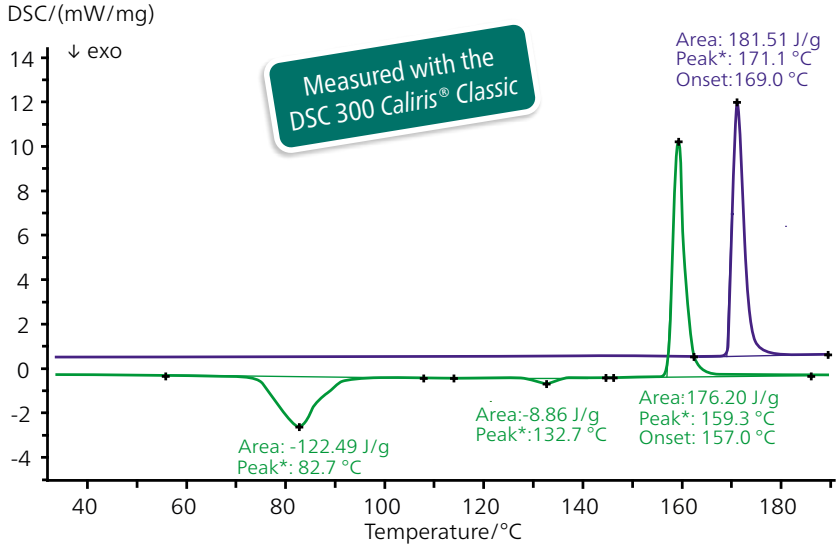


Sample mass: 3.02 mg, underlying heating rate: 3 K/min, amplitude: ± 0.5 K, period: 60 s, crucibles: Al crucibles with pierced lid and measurement with S-Module

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 used as an enteric coating.

A temperature-modulated DSC test, applying sinusoidal modulation to the heating ramp, separates the total signal into reversing (heat capacity, T_g) and non-reversing (water release) components.

Polymorphism of Paracetamol



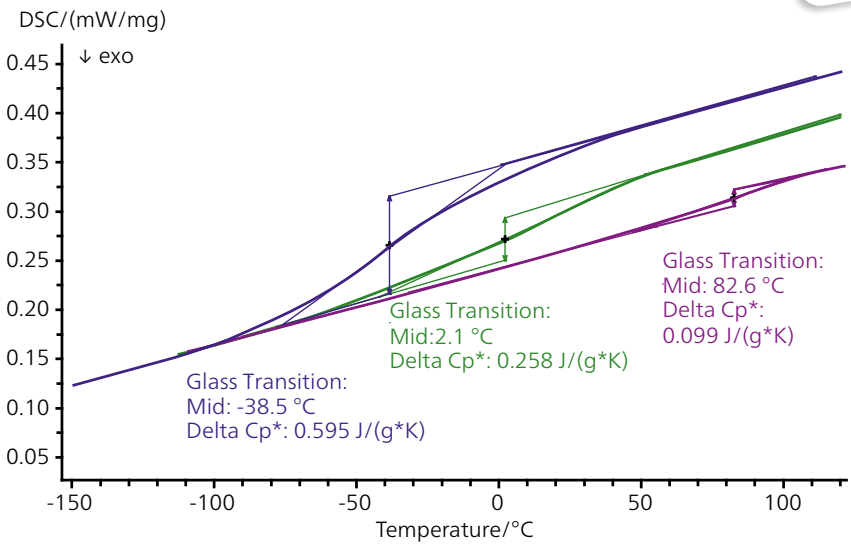
DSC results for paracetamol (blue curve: 1st heating; green curve: 2nd heating). Sample mass: 1.54 mg; 1st heating from 25 to 190°C at 10 K/min, cooling to 25°C at 10 K/min, 2nd heating from 25 to 190°C at 10 K/min; atmosphere: N_2 , *Concavus*® Al crucible with pierced lid.

Paracetamol, or acetaminophen, displays polymorphism, which refers to the ability of a chemical compound to exist in two or more different crystalline structures.

There are three known forms: 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

Measured with the DSC 300 Caliris® Classic



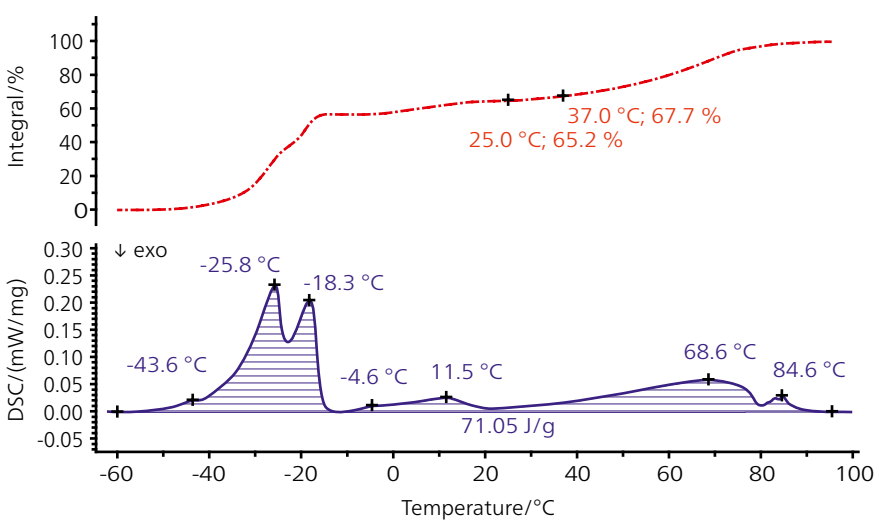
DSC results for turmeric with different water content; sample weight: 10.71 mg, 10.05 mg and 11.03 mg; *Concavus* Al crucible, hermetically sealed: heating from -170 to 120°C at 10 K/min; green curve: powder (as received); purple curve: dry powder (powder dried for 45 min at 80°C); blue curve: wet powder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

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. The T_g influences quality and shelf life, causing softness and stickiness above it, and leading to particle clumping during storage. Knowledge of the T_g is essential for processing – such as for drying and grinding to prevent clumping.

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

DSC Measurements on a Commercial Lipstick



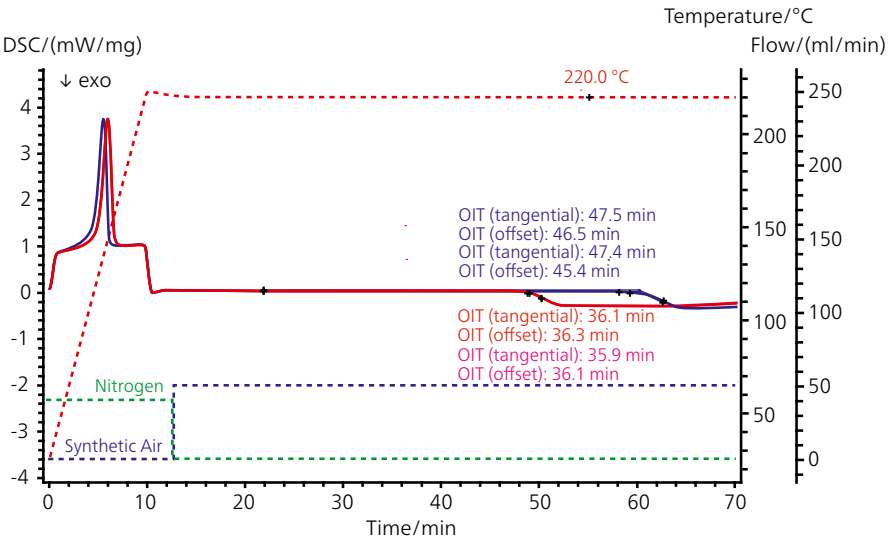
DSC measurements on lipsticks using the S-Module
Sample masses: 10.28 mg; heating rate: 5 K/min; Al crucibles, closed; nitrogen atmosphere; displayed is the 2nd heating step (blue) together with the integral of the DSC curve (red)

Lipsticks contain fats, waxes, oils like castor oil, coconut oil, carnauba wax, and beeswax, along with cosmetic additives like emollients and color pigments. High-melting ingredients 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 "solid-fat-content" of 35% at 25°C and of around 42% at 37°C (body temperature). This is relative to the total oils, fats, and waxes melting in this range.

OIT Measurement on Two Grades of PE-HD

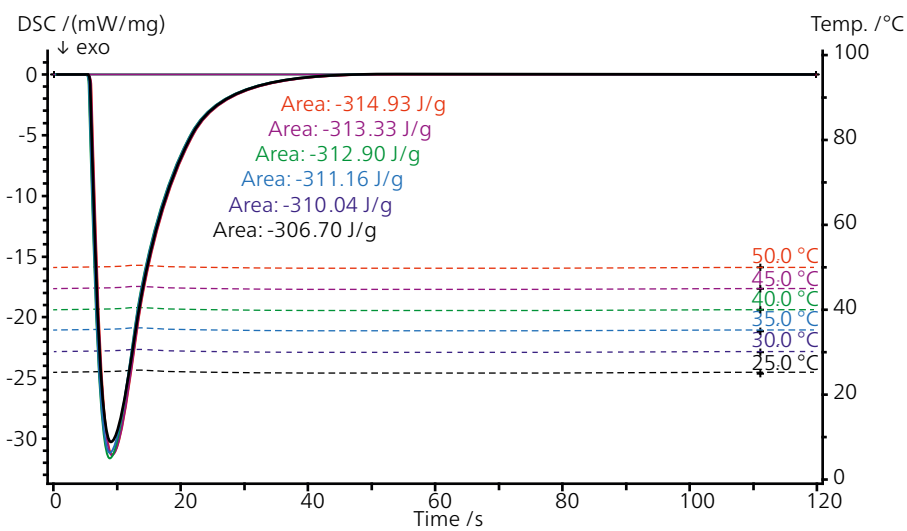
Measured with the DSC 300 Caliris® Classic



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.

Oxidation Induction Time (OIT) measures a material´s resistance to oxidative decomposition using calorimetry. To measure OIT, the temperature is raised to a target temperature in an inert atmosphere, the temperature is maintained (isothermal segment), and then, the inert atmospheric gas is replaced with oxygen or air. The OIT is the time interval between the initiation of oxygen or air flow and the onset of the oxidative reaction (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, which is valuable for assessing organic materials or polymers like PE pipes.

Curing of UV Ink Measured at Different Temperatures



UV ink exposed to UV light source for 10 seconds at different isothermal temperatures

In this example, 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.

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	650/750	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***	□	□	□	-	-	-	-
ASC	□	□	□	□	□	□	□
Piercing device	□	□	□	□	□	□	□
100 Hz data acquisition	■	■	■	□	□	□	-
Enthalpy accuracy/%	< 1 for adamantane, indium, zinc						
Measuring range/mW	± 750	± 750	± 650	± 750	± 750	± 650	± 650
Magnetic feet	□	□	□	□	□	□	□
Coupling	□	-	-	-	-	-	-
Unlimited warranty****	□	□	□	□	□	□	□

* deviation of the measured value from the "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.

When it comes to Thermal Analysis, Calorimetry (adiabatic & reaction), the determination of Thermophysical Properties, Rheology and Fire Testing, NETZSCH has it covered. Our 60 years of applications experience, broad state-of-the-art product line and comprehensive service offerings ensure that our solutions will not only meet your every requirement but also exceed your every expectation.

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