Thermal Analysis Excellence

Excellence
Microscope Hot-Stages

HS82

HS84

Temperature Control and Heat Flow

Simple, Accurate, and Flexible

METTLER TOLEDO

Temperature Control Under Microscopes
Simple and with Excellent Accuracy

Hot-stage microscopy is a powerful method which is widely used to visually examine all kinds of thermal transitions. In the HS82, samples are heated or cooled while they are observed under the microscope. The HS84 DSC hot-stage can even simultaneously measure heat flow.

Characteristics and advantages of the METTLER TOLEDO hot-stage systems:

- **One Click™ and unsurpassed ergonomics** – easy to understand, simple to operate
- **Heating above and below the sample** – reliable results thanks to outstanding temperature homogeneity
- **High sensitivity** – visual behavior independent of heating or cooling rate
- **Interactive control using manual keys** – gives the user manual temperature control
- **Real DSC (HS84)** – facilitates temperature control, observation, and measuring of a DSC curve
- **Modern evaluation software** – leads to the most accurate results as quickly as possible

The heart of all hot-stage systems is the furnace with a heating element beneath and above the sample, which guarantees outstanding temperature uniformity in the sample.

Simple Solutions
for Convenient Operation

Unsurpassed ergonomics

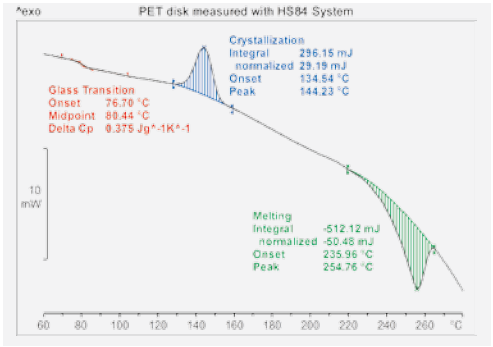
When the system was designed, great emphasis was put on satisfying the highest demands in terms of ergonomics. As a result of this unique concept, features like the small footprint of the measurement cell and control unit, the color touchscreen and control of the temperature program using manual keys offer important advantages. Access to the sample chamber from above means that the sample can be easily inserted and, if necessary, mechanically manipulated.

One Click™ – get results with just one click

The control unit is equipped with a wide color touchscreen. This allows intuitive operation with your finger, delivers clear information to the user, and is clearly visible from a distance. If repetitive measurements are required, one press of a key (One Click™) is sufficient to start a stored method – the system looks after the rest. There is a choice of languages so you can work in your mother tongue.

Maximum information

The hot-stage systems show temperature programs, marked temperature events and in the case of the HS84, the DSC curve on a wide color screen with excellent resolution. When measurement is complete, all data can easily be transferred to a computer by using the Ethernet connection, a SD card or an USB flash drive.



Evaluation of HS84 curves

Evaluation of the DSC curves measured with the HS84, graphical processing, and documentation are extremely easy using the evaluation window of the STAR[e] software.

The Right System
for All Requirements

The HS82 hot-stage system offers the best solution in all situations where the temperature of very small samples has to be regulated in a limited space and where the samples have to be observed at the same time. If you want to simultaneously record changes in the appearance of the sample and the calorimetric behavior, the HS84 DSC hot-stage system is the right choice.

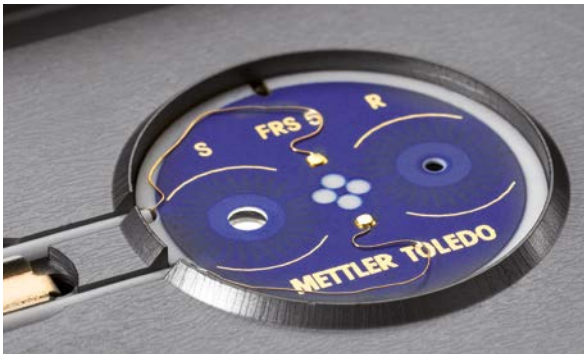
HS82 hot-stage system
Consists of a HS 1 control unit and a HS82 microscope hot-stage and facilitates temperature control of samples in small spaces. The samples are placed between slides and top glass. A standard, built-in xy table is used to bring several interesting areas of the sample into focus. On the measurement cell there is a cooling fan which ensures that no valuable time is lost between experiments.

HS84 DSC hot-stage system
Consists of a HS 1 control unit and a HS84 DSC hot-stage and in addition to temperature control and observation of the sample, it also facilitates simultaneous measurement of the DSC heat flow. The samples are measured in glass or sapphire crucibles. You can thereby obtain qualitative and quantitative information on chemical or physical changes in the sample. As a result, the HS84 need not necessarily be used under the microscope, but can be used as a mini DSC, for example in an IR or RAMAN spectrometer, in a glove box or with aluminum crucibles in the beam of an electron synchrotron.

Accessories
Accessories and expendable items are provided in a well-designed accessories box. Another option is a professional image analysis system which consists of a camera and software. A liquid nitrogen cooling option is available for the HS82.

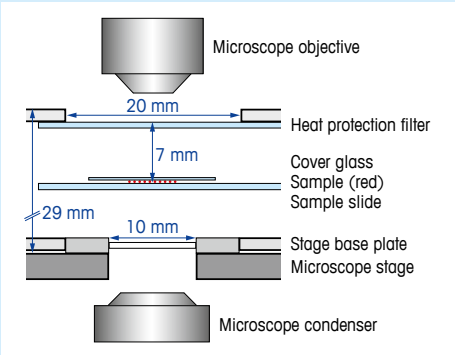
Flexible method programming

Methods consisting of up to 99 different isothermal or dynamic segments can be created. During measurement, the temperature program can be stopped, accelerated, or switched to cooling using the buttons on the touch screen or the manual keys. Thermal events can be marked on the temperature curve.



FRS 5 DSC sensor

With 56 thermal elements, the new, robust FRS 5 ceramic sensor in the HS84 is highly sensitive and has unprecedented temperature resolution. It is therefore ideally suited to all possible applications of the DSC hot-stage.



Microscope requirements

Microscopes and stereo microscopes must fulfill the following conditions:

- A microscope stage diameter or side length of at least 125 mm.
- The distance between the front lens of the objective and the microscope stage must be greater than 29 mm, when this is on the lower stop.
- The free working distance of the objective must be at least 7 mm.
- If the working distance of the lens is less than 12 mm, its diameter should not be more than 19 mm. Otherwise, the lens will not fit into the upper opening of the hot-stage housing.
- Lenses with higher magnifications should have a long working distance.

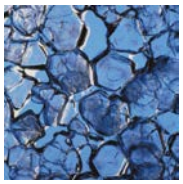
Extremely Broad Range of Applications

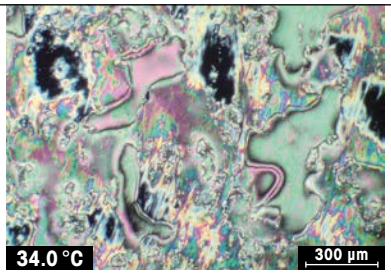
Hot-stage microscopy can be used to quickly obtain information about the physical nature of the smallest samples. This technology is therefore widely used in Research & Development as well as in Quality Control.

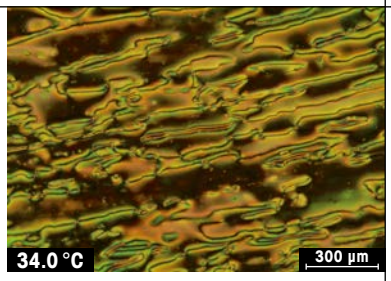
The technique is very sensitive. The visual changes are more independent of the heating and cooling rates applied than changes that occur in comparable pure thermal analysis. Using a DSC hot-stage, you can obtain qualitative and quantitative information about physical or chemical changes in the sample, for example, color changes, melting, polymorphism, crystal transformations, or decomposition.

Choice of thermal events and operations which can be defined using the HS82/HS84

Industry	Thermal events	HS82	HS84
Pharmaceutical, petro, food, cosmetics, academia	Melting characteristics	•	•
Pharmaceutical, food, cosmetics	Polymorphism	•	•
Chemicals, cosmetics	Liquid crystal transitions	•	•
Polymers, pharmaceutical	Crystallization and nucleation	•	•
Chemicals, petro	Cloud point	•	
Chemicals, academia, test laboratories	Purity		•
Pharmaceutical, chemicals, polymers	Decomposition temperature	•	•
Polymers	Curing		•
Pharmaceutical, polymers, chemicals, academia, test laboratories	Reaction and transformation enthalpy		•
Forensic science	Oil immersion / temperature variation method	•	

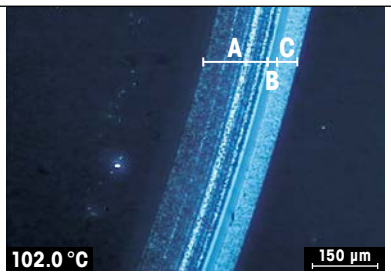


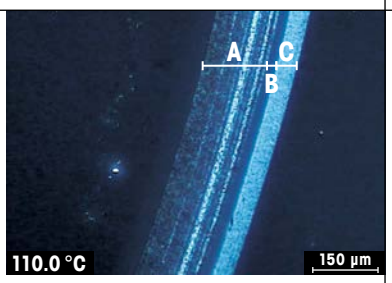


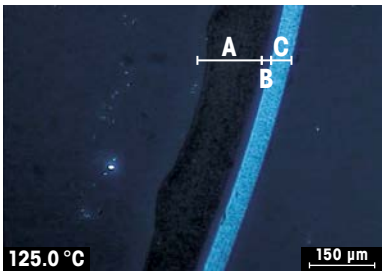


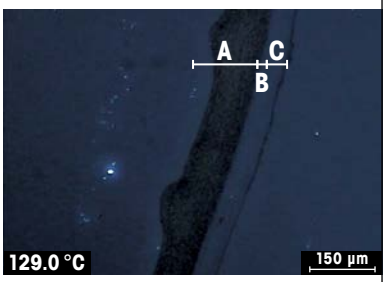
Liquid crystals

The phase transition temperatures and phase types of liquid crystals can be determined by means of polarization hot-stage microscopy. Depending on the thermal history various forms can be observed. The left picture shows the compound 5CB as received at 34 °C, the right picture shows the same substance heated to 34 °C after it was quenched.



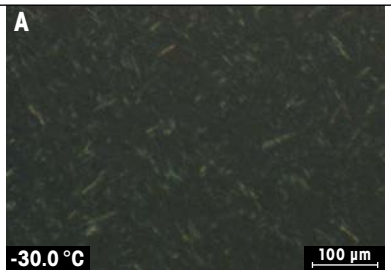


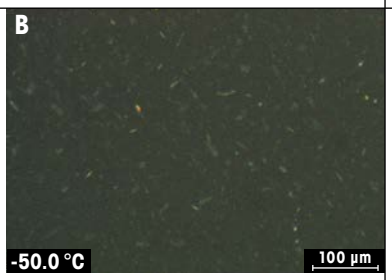


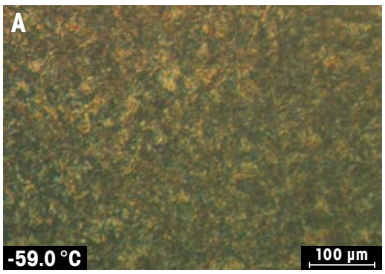


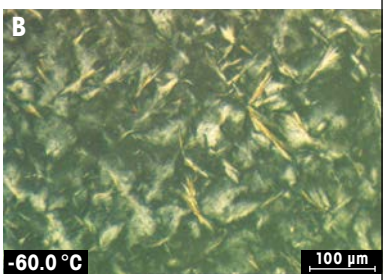
Polymer films

A cross section of a multi-layer polymer film is prepared on a slide and heated at a constant rate. At 102 °C the multi-layer structure of the film (A, B, C from left to right) in the initial state of the sample can be seen. The second layer from the right (B) melts at 110 °C. Then all layers on the left (A) melt, which is almost completed by 125 °C. The last whole right layer (C) finally melts, this is more or less completed by 129 °C. No other analysis technology shows the order of melting as clearly as hot-stage microscopy.



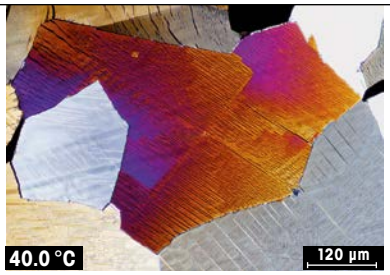


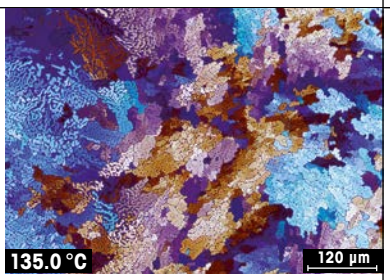




Bio diesel

Investigation of the cooling behavior of fuels is important in order to decide temperature limits which are given by crystallization. Two different bio diesel mixtures were cooled to -60 °C in the hot-stage. At -30 °C, sample A begins to crystallize noticeably and then forms very small crystallites. Sample B does not crystallize until -50 °C and forms large crystallites. Due to the low cloud point, sample B can therefore be used at lower temperatures. If this is however reached, the large particles will quickly block fuel lines and filters.





Polymorphism

Polymorphism is when a substance exists in several different crystal structures that also look different. Hot-stage microscopy is therefore an outstanding tool for showing different crystal forms and being able to determine their melting points. The image shows suberic acid which exists in form V at 40 °C. If this substance is heated slowly to 135 °C, it undergoes a transition to form I. Under polarized light, it is easily possible to differentiate between the various forms.

HS82 & HS84 Specifications

	HS82	HS84
Measurement technology	Microscope hot-stage	DSC hot-stage
Device assembly	Measurement cell with external control unit, heating above and beneath the sample for optimum temperature uniformity	

Load Cells		
Temperature range - with optional cooling	RT … 375 °C -90 °C … 375 °C	RT … 375 °C
Temperature accuracy	Between ± 0.4 °C and ± 0.8 °C according to the temperature range	
Heating rate	0.1 … 20 K/min	
Temperature resolution	°C, K / 0.1, °F / 0.2	
Measuring sensor type	–	DSC ceramic sensor, 56 thermocouples
Enthalpy reproducibility	–	5%
Sample carriers Dimensions L x W x H Base diameter / volume	Slides / Top glass 76 x 19 x 1 / 15 x 15 x 0.2 mm	Aluminum, glass, and sapphire crucibles 6 mm / 40 µL
Aperture	2 mm	
Objective working distance	At least 7 mm	
X-Y table	Max. 13 mm movement	–
Dimensions L x W x H / weight	195 x 85 x 28 mm / 1 kg	217 x 95 x 30 mm / 1.5 kg
Length of connection cable	140 cm	

Control unit		
Display	Touch-sensitive 7" VGA color screen	
Languages	German, English, French, Chinese, Japanese, Korean, Spanish, Russian	
User management	Yes	
Calibration/adjustment	With up to 3 melting point reference substances	
Max. number of method segments	99	
Max. number of methods	60	
Pre-programmed methods	3 calibration methods	
Stored results	Temperature program, events	DSC curves
- Quantity	Last 100	
- Export	To SD card, USB flash drive, or PC via Ethernet	
Shortcuts (One Click™)	12 per user	
Standards satisfied	ASTM F766, EN ISO 3146	
Dimensions L x W x H / weight	350 x 195 x 150 mm / 3 kg	
Manual keys	Supplied, cable length 91 cm	
Optional accessories	Barcode reader, keyboard, digital camera with recording software	

www.mt.com/ta-hotstages

For more information

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