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User Manual of

Differential Scanning Calorimeter

Operator's Manual

Read before Operation

Before operation this machine, please read this manual thoroughly, and keep a copy with the machine for future reference. This manual is to be considered part of your machine.

Model: DSC-100

Catalogue

I. Introduction and principle of the instrument

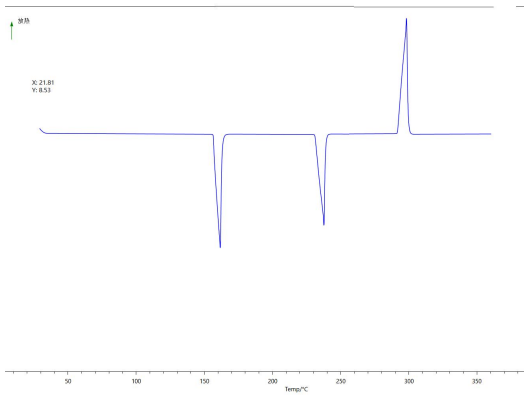
Differential scanning calorimetry (DSC) is a widely used technique. The differential scanning calorimeter is not only a common quality testing tool, but also an important research tool, which mainly measures the relationship between temperature and heat flow related to the internal thermal transition of materials.

Our company's differential scanning calorimeter (DSC) excels in high repeatability and precision, making it ideal for accurate specific heat measurements. This device features easy calibration, user-friendly operation, reliable performance, and rapid response, with extensive applications in material research and development, performance testing, and quality control. It effectively analyzes various material properties including glass transition temperature, cold crystallization, phase transitions, melting, crystallization, product stability, curing/cross-linking, and oxidation induction periods—all within the scope of DSC research.

Our company provides a variety of types of differential scanning calorimeter, customers can choose the appropriate model according to the specific experimental parameters and needs.

During operation, the sample and reference material are placed in separate crucibles and subjected to programmed heating in an oven, causing temperature changes in both. When the reference material and sample have identical heat capacities and the sample exhibits no thermal effect, the temperature difference between them approaches "zero", resulting in a smooth DSC curve. As temperature increases, thermal effects emerge in the sample while the reference material remains unaffected, creating a temperature difference that manifests as peaks on the DSC curve. The magnitude of the peaks correlates with the temperature difference: larger differences yield higher peaks, and more frequent temperature variations produce greater peak numbers. Specifically, peaks with upward-facing tops represent exothermic peaks, while those with downward-facing tops indicate endothermic peaks.

The figure below shows a typical DSC curve, demonstrating four distinct types of transitions.



Ⅰ represents a secondary transformation, which is a change in the horizontal baseline

Pea

k II, the endothermic peak, is caused by the melting or fusion transition of the sample.

III represents the endothermic peak, which is caused by the decomposition or pyrolysis reaction of the sample.

The peak labeled as Ⅳ represents the exothermic peak, which is the result of the crystalline phase transition in the sample.

2. Main technical indicators

product name	differential scanning calorimeter			
model	DSC-100	DSC101	DSC-500	DSC103
DSC range	0 ~ ±600mW	0 ~ ±800mW	0 ~ ±1000mW	
temperature range	Room temperature-600 ℃	Room temperature-800 ℃	Room temperature-1200 ℃	Room temperature-1500 ℃
heating rate	0.1~100℃/min			
temperature sensitivity	0.001℃			
working power supply	AC220V/50Hz or custom			
Temperature control method	Intelligent PID temperature control with automatic scanning for heating and constant temperature			
Atmosphere control	Dual-channel automatic switching (instrument automatic switching)			
gas-flow rate	0-200 mL/min (customizable for other ranges)			
gas pressure	≤0.5MPa			
display mode	7-inch LCD touch screen with 24-bit color display			
Parameter Standards	Equipped with standard materials (indium, tin), users can adjust temperature and enthalpy independently			
remarks	All technical indicators can be adjusted according to user needs			

3. Instrumentation

1. Melting point (phase transition temperature) measurement

operating steps ：

1. Turn on the computer, plug in the instrument power, turn on the switch on the back of the instrument, and connect the instrument data cable to the computer.

2. Open the software and configure the flow chart. (The set temperature is the final temperature reached by the instrument, and the heating rate is the temperature increase per minute.)

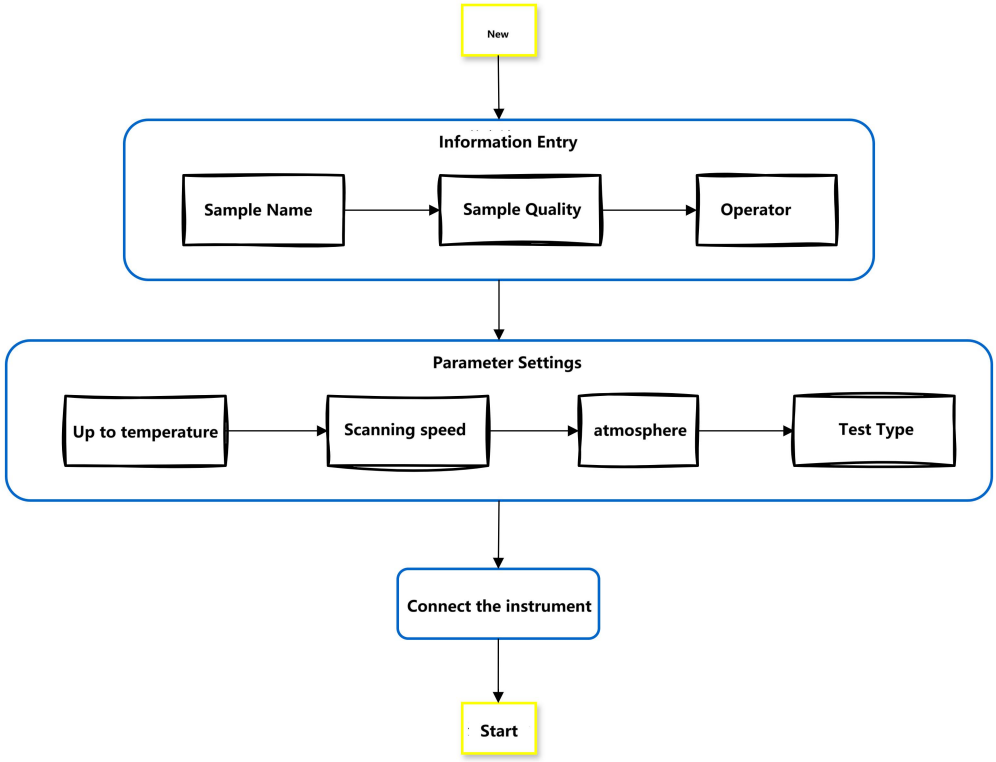


Figure 7-2 Experimental setup flowchart

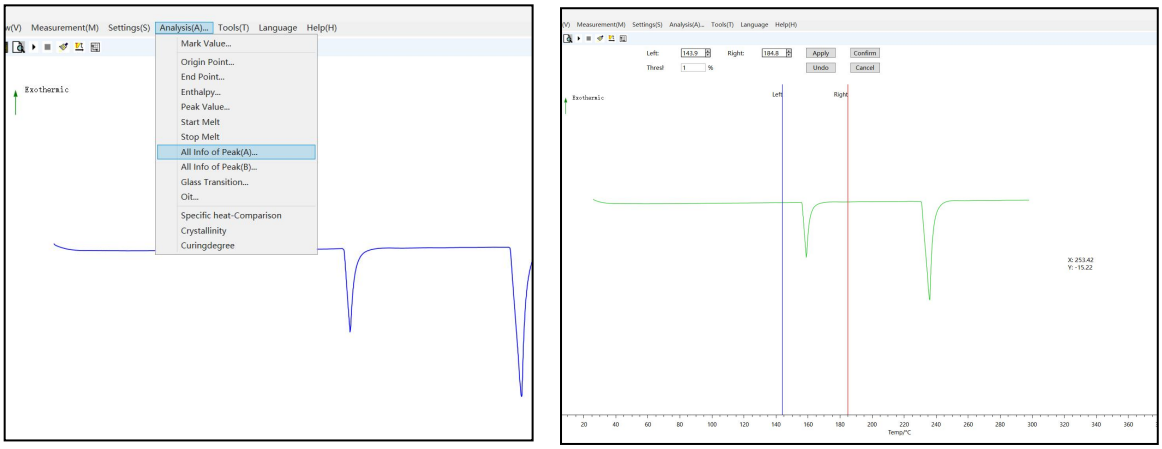
3. Set the initial temperature and termination temperature. The initial temperature should be at least 30℃ lower than the temperature point of the first data.

4. Click the "Start" button in the shortcut menu to initiate the experiment. The device will heat up according to the preset program, while the software records relevant data in real time. When the set temperature is reached, the instrument will automatically stop running.

5. Click the spectrum to turn it green, completing the selection. Then, click [Analysis] → [Peak Comprehensive Analysis] in the taskbar, where two black lines will appear. Drag the left analysis line to the front end of the variation and the right analysis line to the

back end. After selecting, click [Apply] and [OK] in sequence. Finally, click the curve again to turn it blue, completing the analysis.

6. Figure 7-3 shows the DSC curve of pure tin. The theoretical melting point of pure tin is 231.9℃, while the instrument-measured melting point Teo = 232.5℃, with the measured fusion enthalpy H = 44.2272J/g.



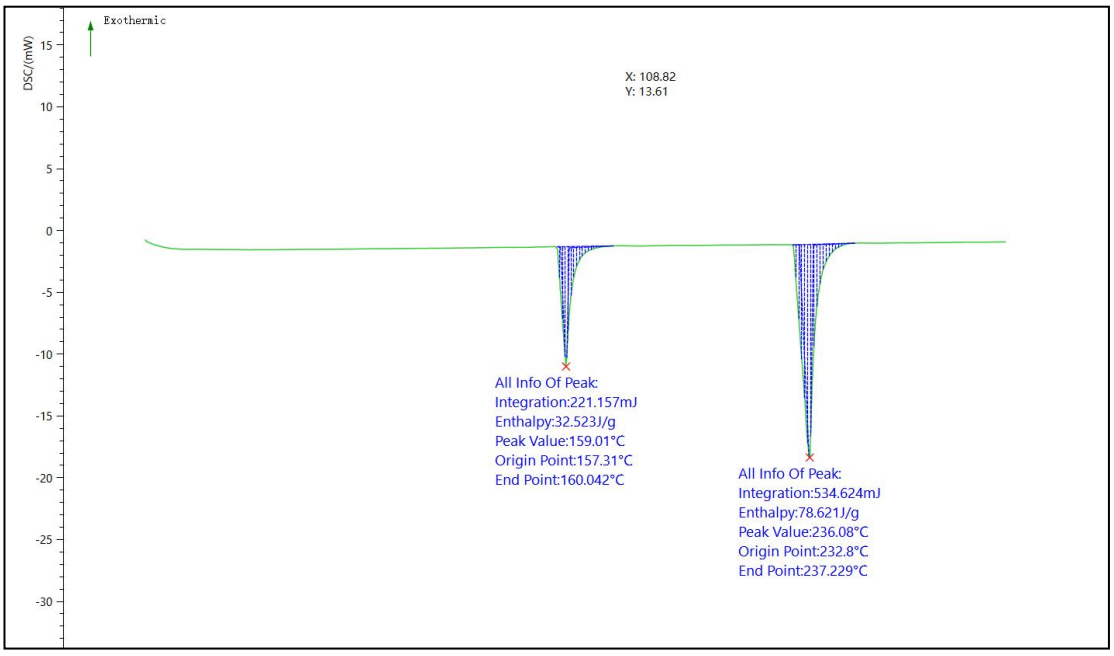


Figure 7-3 DSC profile of tin particles

2. Instrument coefficient determination (heat enthalpy calculation)

Instrument coefficients may vary due to environmental factors such as temperature and humidity. To ensure accurate experimental results, regular calibration of instrument coefficients is required. Tin, zinc, and indium are commonly used as calibration materials for measuring instrument coefficients.

The measurement method of instrument coefficient: on the basis of temperature

calibration without error, the heat enthalpy of the test standard is measured, and then the instrument coefficient is calculated according to the theoretical heat enthalpy of the test standard and the corresponding calculation formula.

Procedure: Select [Instrumental Coefficient] from the [Tools] menu to display Figure 7-4. Enter the theoretical and measured melting enthalpy values, then click [Calculate] to obtain the instrumental coefficient. This coefficient is essential for crystallinity analysis. If continuous experiments are not feasible, record it for future use.

Taking the experiment of pure tin sample as an example, the theoretical heat enthalpy 60.5J/g of tin and the measured heat enthalpy 25.353J/g are input, and the instrument coefficient K is automatically calculated as 2.3863.

Instrument coefficients are typically determined after calibration. During calibration, the mass of the standard material is weighed and entered into the mass column of the real-time data section. If the phase change temperature measured during calibration closely matches the actual temperature of the sample, the enthalpy value is recorded and the instrument coefficient is calculated. The resulting value serves as the instrument's coefficient.

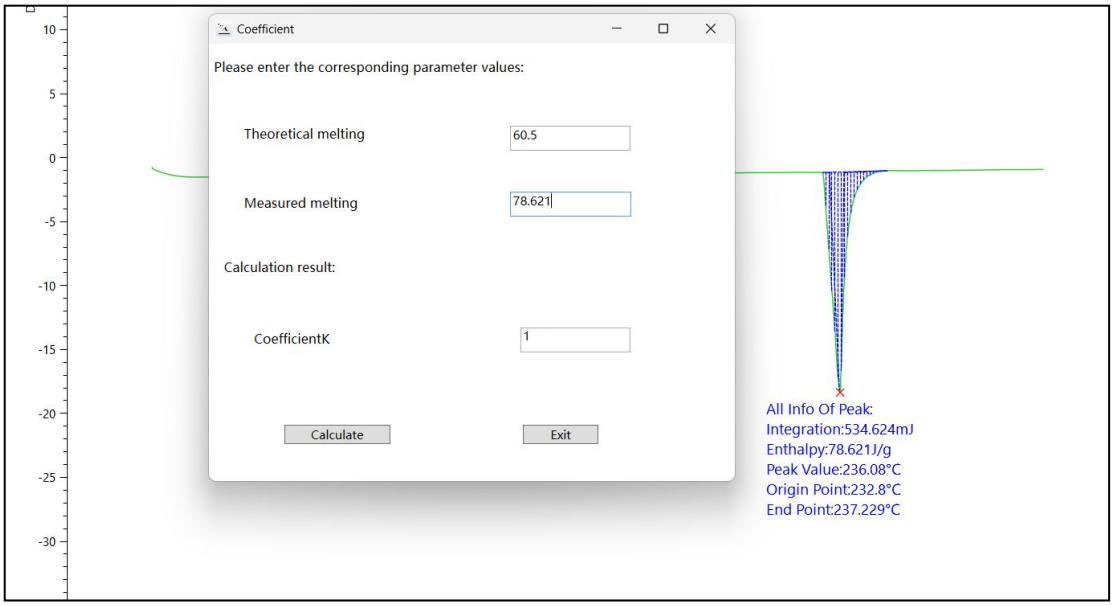


Figure 7-4 Instrument Coefficient Calibration Interface

3. Measurement of glass transition temperature

Glassification refers to the process of transforming a substance into a glassy amorphous state (glassy phase), which exists in a transitional state between liquid and solid with no crystalline structure. The DSC measurement of glass transition temperature (Tg) is based on the property of polymers showing increased heat capacity during glass transition. On the DSC curve, this manifests as a shift of the baseline toward the endothermic direction when passing through the glass transition temperature. As shown in

Figure 7-5, point A marks the initial deviation from the baseline. Extending the baseline before and after the transition, the vertical distance ΔJ between the two lines is termed the step difference. Point C is located at ΔJ/2. Drawing a tangent from point C intersects the extended baseline at point B. The International Council on Thin Film Analysis (ICTA) recommends using point B as the glass transition temperature (Tg). The glass transition temperature does not have a fixed value and varies depending on measurement methods and conditions. Therefore, when labeling the glass transition temperature of a polymer, the specific measurement method and conditions should be clearly indicated.

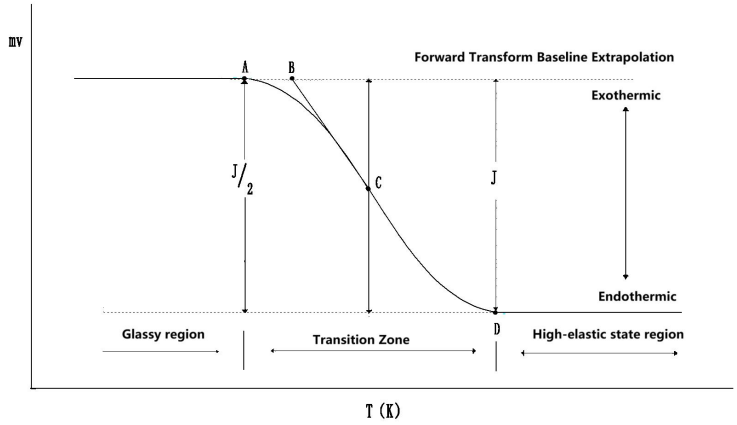


Figure 7-5 Glassification transition process

Other phase transition temperatures, such as curing temperature, crystallization temperature, etc., can be analyzed in the same way as the melting point.

operating steps ：

1. First, turn on the computer, plug the power plug of the instrument into the socket, turn on the power switch on the back of the instrument, and then connect the instrument to the computer with the data cable.

2. Connect the gas supply unit and select the nitrogen or oxygen option on the instrument's display. Adjust the flow meter to maintain a stable gas flow rate of approximately 50 ml/min. Typically, inert gases such as nitrogen, helium, or argon are used as the experimental atmosphere, with the gas connected to the nitrogen port. However, some samples may also be processed under air atmosphere conditions.

3. Start the software, create a new experiment file, and set the parameters according

to the experiment flow chart.

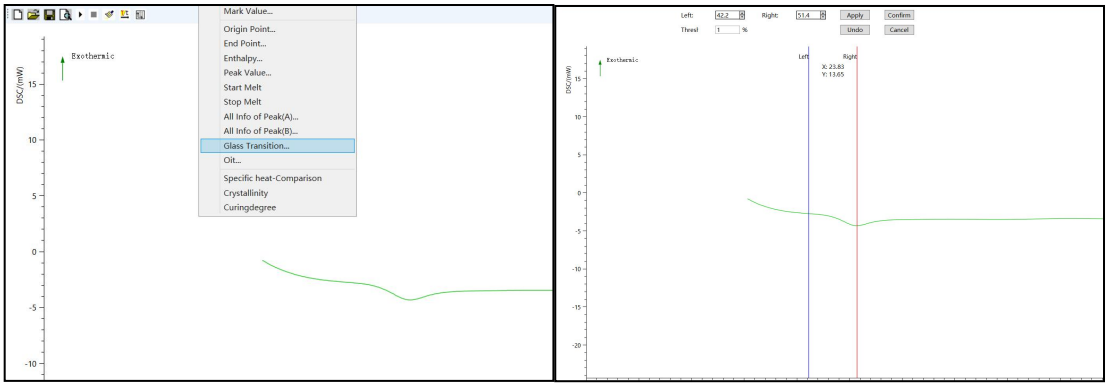
4. Prepare reference samples according to experimental requirements. Usually, an empty crucible can be used as a reference, or inert substances can be selected.

5. Accurately weigh 10-20mg of the sample with a balance and put it into the crucible.

6. Click the "Start" button in the shortcut menu to initiate the experiment. The device will gradually heat up according to the preset program, while the software records experimental data in real time. When the set temperature is reached, the instrument will automatically stop running.

7. Click the spectrum to turn it green, completing the selection. Then, select [Analysis] → [Glass Transition] from the taskbar. Two black lines will appear on the interface. Move the left analysis line to the start of the transition and the right one to the end. After selecting the region, click [Apply] and [OK] sequentially. Finally, click the curve again to turn it blue, completing the analysis process.

8. Figure 7-7 shows the processed data of a sample. The glass transition temperature (Tg) of the sample is 103.17℃, with T1 representing the onset temperature and T2 the termination temperature of the glass transition.



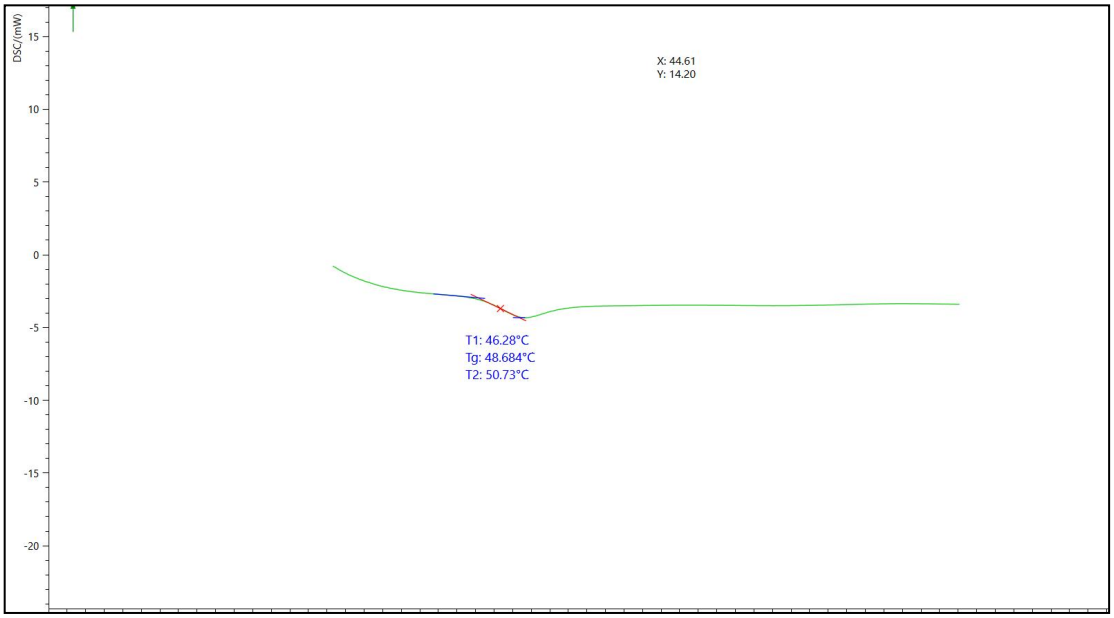


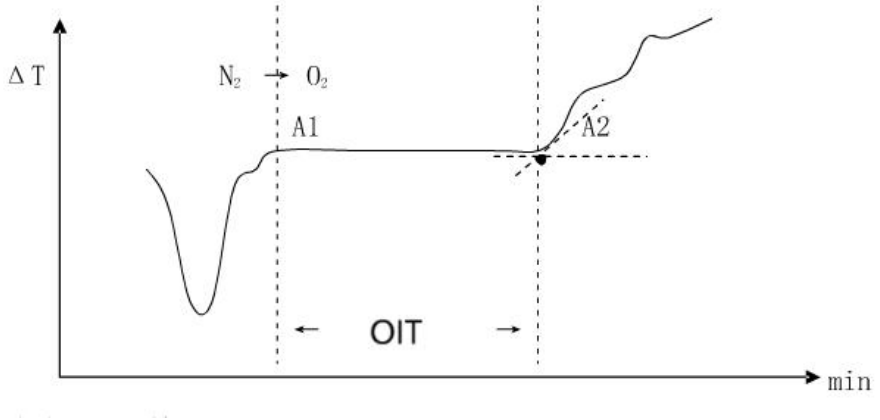
Figure 7-7 Analysis of glass transition temperature of a sample

4. Oxidation induction period measurement

Oxidation Induction Time (OIT) measures the duration required for a sample to initiate an autocatalytic oxidation reaction under high-temperature oxygen conditions (200 °C), serving as a key indicator of a material's heat resistance during processing, storage, welding, and application. The OIT method utilizes Differential Scanning Calorimetry (DSC) to assess accelerated aging in plastics by monitoring exothermic reactions during molecular chain scission. The procedure involves placing a plastic sample and an inert reference material (e.g., alumina) in a DSC chamber, where oxygen rapidly replaces inert gases (e.g., nitrogen) at a controlled temperature. By analyzing DSC curve variations caused by oxidation, the OIT (in minutes) is determined to evaluate the plastic's resistance to thermal aging.

The oxidative induction period method is a sensitive accelerated testing technique. When the antioxidant in polymers is completely consumed by oxygen at high temperatures, the oxidation reaction rapidly occurs with significant heat release. Using a differential scanning calorimeter (DSC), the onset point of the exothermic peak can be easily determined, allowing quantitative characterization of oxidative degradation through time measurements. As shown in the figure below, at point A1, the instrument automatically switches from nitrogen to oxygen, marking the start of oxygen exposure and initiating the calculation of the sample's oxidative induction time. During the temperature-controlled phase, the intersection point between the horizontally extended

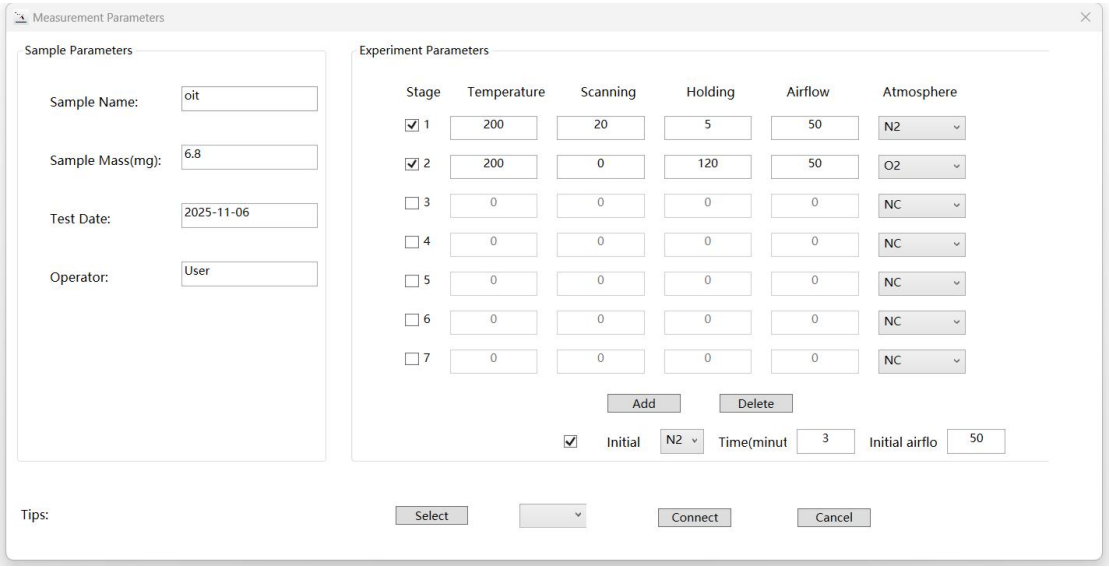
DSC curve and the tangent line at the maximum slope of the exothermic peak's rising edge is designated as point A2. The interval between A1 and A2 represents the oxidative induction period.



graph 7-8

operating steps ：

1. First, turn on the computer, plug in the instrument power, turn on the switch on the back of the instrument, and connect the instrument data cable to the computer.
2. Connect the gas and select nitrogen or oxygen on the instrument display. Adjust the flow meter to maintain a gas flow rate of approximately 50 ml/min. Inert gases such as nitrogen, helium, or argon are typically used as atmosphere, with the nitrogen port connected.
3. Launch the software, create a new file, and enter the following parameters: [Sample Name], [Sample Weight], [Operator], [Experimental Parameters], [Atmosphere], etc. Then click [Connect Instrument]. (For Stage 1: Set the constant temperature duration to 5-10 minutes, scan rate to 20, and cutoff temperature to 190-210°C (commonly 200°C). For Stage 2: Set scan rate to 0, maintain the same cutoff temperature as Stage 1, and extend the duration by at least 10 minutes beyond the sample's OIT time. If the sample duration is unknown, set it to 150 or 200 minutes. Select OIT as the test type.) The instrument will connect to the computer. The device will follow the programmed temperature rise while the software records data in real time. Upon reaching the preset temperature, the instrument will automatically stop, as shown in Figure 7-9.



5. Specific heat capacity measurement

The specific heat capacity (specific heat) of a substance is defined as the ratio of the heat absorbed by a given mass of the substance to the product of its mass and temperature increase, denoted by the symbol c. In the International System of Units (SI), it is expressed in joules per kilogram per kelvin (J/(kg·K)) or joules per kilogram per degree Celsius (J/(kg · ℃)). Here, J represents joules, and K denotes the thermodynamic temperature scale, which indicates the energy required to raise (or lower) the temperature of 1 kilogram of the substance by 1 kelvin.

Specific heat capacity refers to the heat absorbed or released by a unit mass of a substance when its temperature rises or falls by one unit. In the International System of Units (SI), it is measured in joules per kilogram per kelvin (J/(kg·K)), representing the energy required to raise the temperature of one kilogram of a substance by one kelvin.

operating steps ：

1. Turn on the computer, plug in the instrument power, turn on the switch on the back of the instrument, and connect the instrument data cable to the computer.

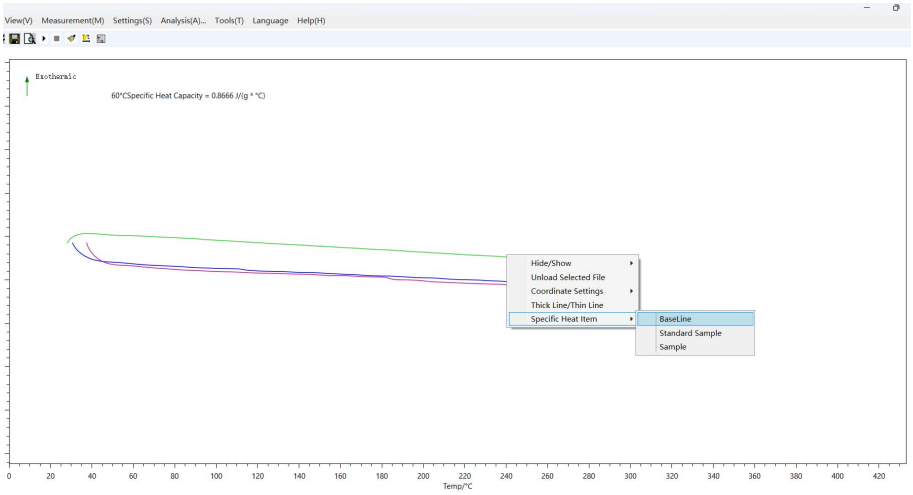
2. Open the software, create a new file, and set parameters according to the experiment flow chart.

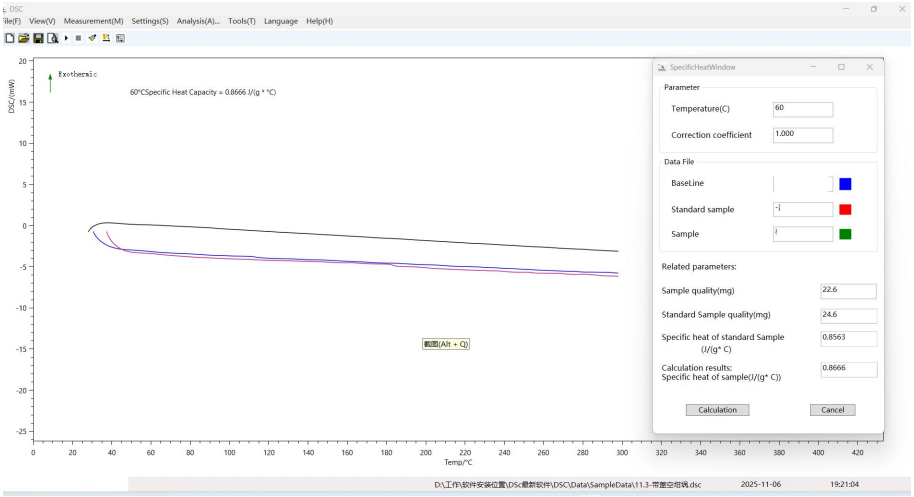
3. The specific heat capacity experiment requires three test groups. For the first group, place a blank crucible on both sides as a baseline experiment, with the cutoff temperature set 10 ° C higher than the specific heat capacity measured at the target

temperature. For the second group, insert a sapphire standard sample on the right side, weigh it using a 1/10,000 precision balance, and input the mass into the sample mass column. Maintain the same temperature range as the first group. For the third group, place the sample on the right side with a mass as close as possible to that of the sapphire standard. Collect data from all three groups and store them separately.

4. When processing data, double-click [Sample Data] on the left side of the software to open the chromatogram, or click the open button in the shortcut menu to access the target curve. Select the curve to highlight it in green, then click [Analysis] in the menu bar and choose [Specific Heat-Specific Heat Method].

5. Open the three test spectra, click the one to turn green (selected), right-click it, and select the corresponding items (baseline, standard, sample). Then click [Analysis]—[Specific Heat—Comparison Method] in the taskbar, enter the temperature to compare, and click [Calculate].



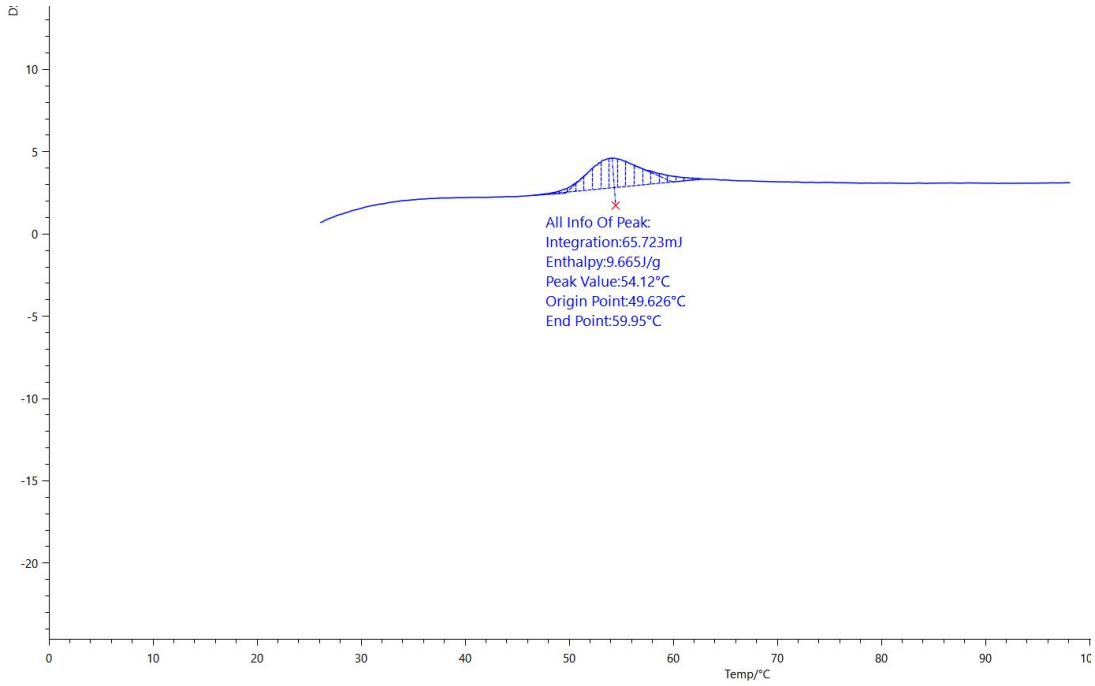


4、Hardness test procedure

operating steps ：

1. First, turn on the computer, plug in the instrument power, turn on the switch on the back of the instrument, and connect the instrument data cable to the computer.
2. Connect the gas and select nitrogen or oxygen on the instrument display. Adjust the flow meter to maintain a gas flow rate of approximately 50 ml/min. Inert gases such as nitrogen, helium, or argon are typically used as atmosphere, with the nitrogen port connected.

3. Open the software, create a new file, and enter the following details: [Sample Name], [Sample Weight], [Operator], [Experimental Parameters], [Atmosphere], etc. Then click [Connect Instrument].



4. Click the spectrum to turn it green, completing the selection. Next, select [Analysis] → [Peak Comprehensive Analysis] from the taskbar. The interface will display two black lines: move the left analysis line to the start of the variation and the right one to the end. After selecting the region, click [Apply] and [OK] sequentially. Finally, click the curve again to turn it blue, completing the analysis process.

5. Click [Analysis] - [Hardness] in the taskbar, enter the pre-curing and post-curing enthalpies, then click calculate.

5、Crystallinity test procedure

operating steps ：

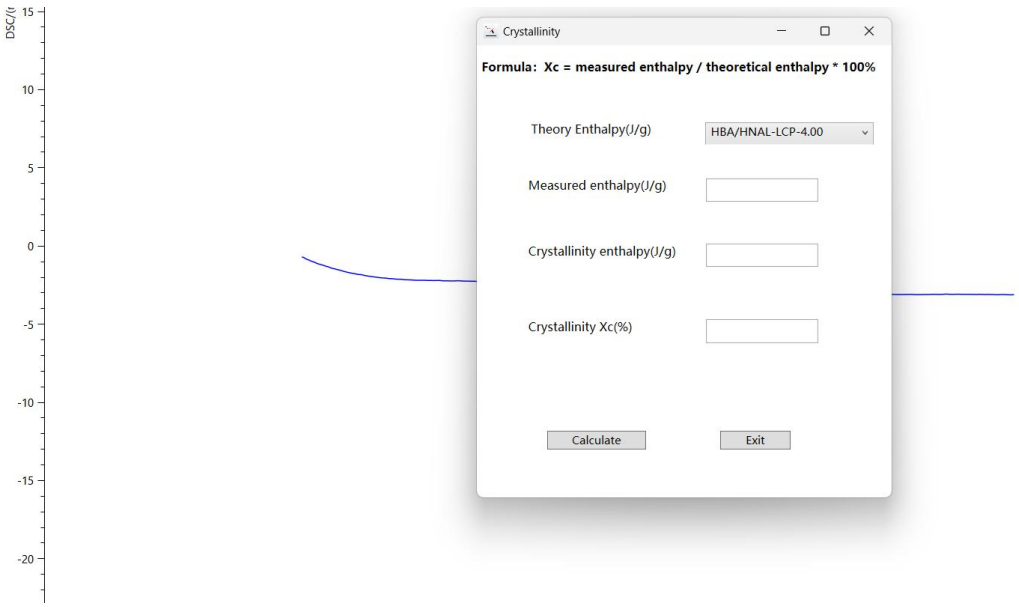
1. First, turn on the computer, plug in the instrument power, turn on the switch on the back of the instrument, and connect the instrument data cable to the computer.

2. Connect the gas and click the nitrogen and oxygen icons on the instrument display. Adjust the flow meter to maintain a gas flow rate of approximately 50 ml/min. Inert gases such as nitrogen, helium, or argon are typically used as atmosphere, and connect the nitrogen port.

3. Open the software, create a new file, and enter the following details: [Sample Name], [Sample Weight], [Operator], [Experimental Parameters], [Atmosphere], etc. Then click [Connect Instrument].

4. Click the spectrum to turn it green, completing the selection. Next, select [Analysis] → [Peak Comprehensive Analysis] from the taskbar. The interface will display two black lines: move the left analysis line to the start of the variation and the right one to the end. After selecting the region, click [Apply] and [OK] sequentially. Finally, click the curve again to turn it blue, completing the analysis process.

5. Click [Analysis] - [Crystallinity] in the task bar, select the theoretical heat of the sample, then enter the melting enthalpy and recrystallization enthalpy, and click calculate to get the corresponding value.


15
10
5
0
-5
-10
-15
-20
Crystallinity
Formula: Xc = measured enthalpy / theoretical enthalpy * 100%
Theory Enthalpy(J/g)
HBA/HNAL-LCP-4.00
Measured enthalpy(J/g)
Crystallinity enthalpy(J/g)
Crystallinity Xc(%)
Calculate
Exit

6. Selection of calibrator and temperature correction

1. Selection of reference material

Periodically perform temperature calibration to ensure test accuracy. Select calibrants based on the actual test temperature of the sample. The selection principle for calibrants: The extrapolated temperature of the calibrator should be close to the temperature of the sample to be tested to ensure test accuracy. Our company only provides tin calibrants.

The following table shows the melting point and theoretical enthalpy values of the common calibrators.

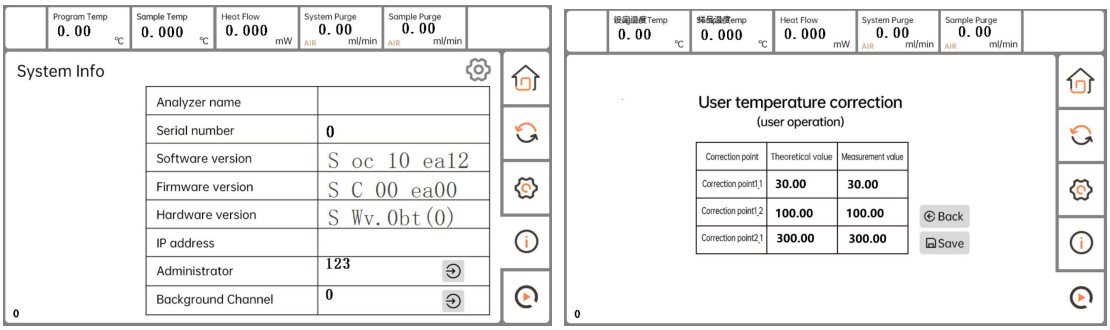
RM	Theoretical melting point ℃	Theoretical fusion enthalpy J/g
indium In	156.6	28.6
tin Sn	231.9	60.5
zinc Zn	419.5	107.5

2. Temperature calibration (refer to the melting point measurement for experimental steps)

1. Purpose: To ensure that the temperature indicated by the instrument is consistent with the true temperature of the sample.

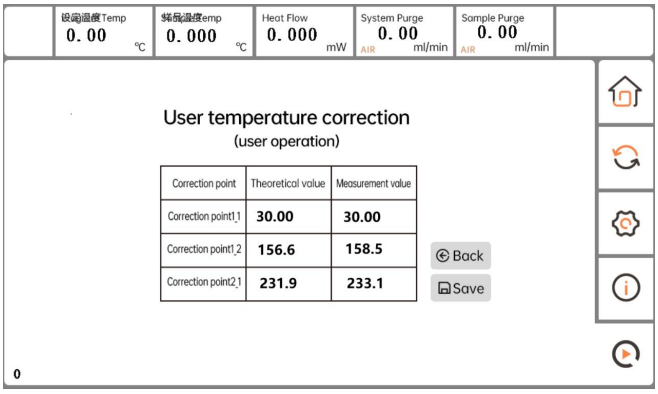
2. Procedure: Measure the phase transition temperature of the standard material using the same method as for the sample. Typically, standard materials such as tin, indium, and zinc are used for temperature calibration, though other materials may be selected based on specific requirements. This procedure follows the same method as the melting point determination. For this temperature calibration, we selected indium (In, melting point: 156.6°C) and tin (Sn, melting point: 231.9°C) as standard materials.

3. On the instrument display, enter 123 to access the admin interface and adjust correction point 3 to the melting point of our Sn standard. The measured value corresponds to the actual Sn melting point. (Correction point 1 <Correction point 2 <Correction point 3)



6-1 Calibrate to enter the interface

2. As shown in the figure above, correction points 2 and 3 are visible. We need to conduct an indium-tin melting point experiment and analyze the results. The theoretical values of 156.6 and 231.9 are input respectively, while the measured values are input and saved according to the actual measurement results, as shown in the figure below.



3. As shown in the figure above, we have entered the theoretical value and the measured value obtained from the experiment, and saved it for another test. (The temperature correction is completed before the factory.)

4. For subsequent temperature calibration, conduct the melting point tests for indium and tin again (or select tin alone). Compare the results with the theoretical melting points of 156.6°C for indium and 231.9°C for tin. If the temperature error is within ±1°C, no further calibration is required.

Assuming the test yields an indium melting point of 158.1℃ and a tin melting point of 233.56℃, apply the calibration method of "add a few degrees if higher, subtract a few degrees if lower":

The measured value of indium is 158.1℃, which is about 1℃ higher than the theoretical value of 156.6℃ (rounded here). Adjust the measured value to 159.1℃.

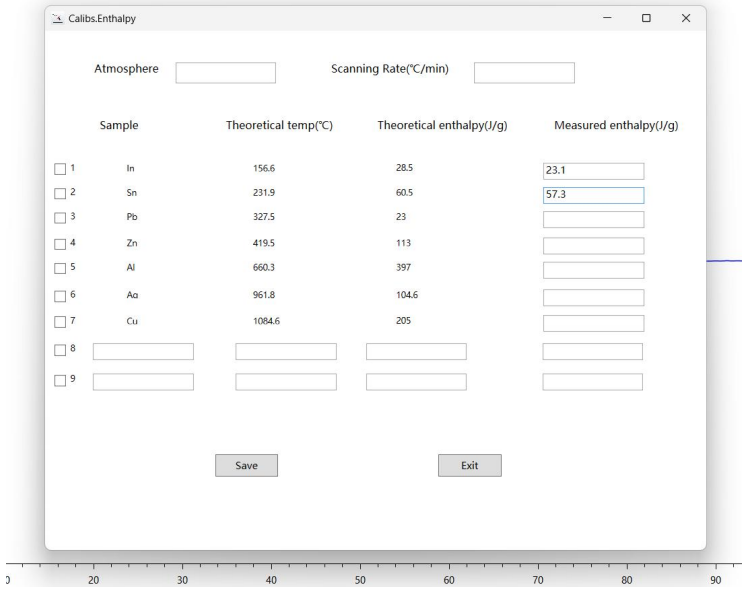
The measured value of tin is 233.56℃, which is about 1℃ higher than the

theoretical value of 231.9℃ (rounded here). Adjust the measured value to 234.56℃.

After completing the above calibration steps, click Save and restart the instrument.

3、Software temperature calibration process

1、In the [Tools] bar, select [Thermal Entropy Correction] and check the samples to correct. Enter the enthalpy data obtained from the test spectrum in the [Actual Thermal Entropy] column, then click Save.



2. In the [File] section, select [Import Thermal Entropy Correction File]. After clicking the option, choose the recently saved thermal entropy file for import.

7. Software Description

1. Software interface

The differential scanning calorimeter (DSC) is used to measure melting point (enthalpy), glass transition temperature, instrumental parameters, crystallinity, and oxidation induction period. Users can select any of these parameters for experiments based on their needs.

This is a general-purpose software. Create a new file, enter the [Sample Name], [Sample Quality], and [Operator], then set the [Cut-off Temperature], [Scan Rate], [Atmosphere], and [Test Type]. Click Connect Instrument as shown in Figure 5-1.

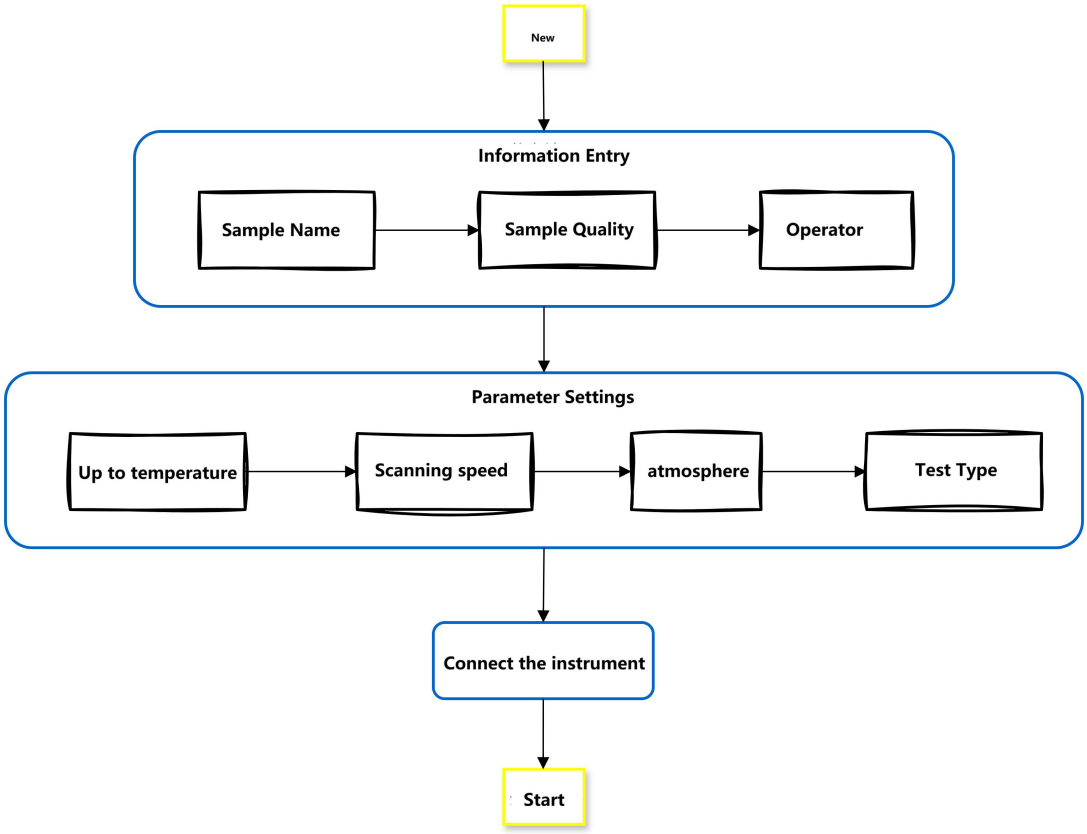


Figure 5-1 Parameter setting flowchart

2. Software Function Details

Create Open Save Print Start Stop Clear Screen Switch Interface Zoom In Zoom Out Restore Adjust Coordinates

Figure 5-8 Software shortcut keys

3. Software analysis function description.

The following is an introduction to the [Analysis] submenu in the software menu bar:

Analysis type	act on
Comprehensive Peak Analysis (A)	The temperature data and enthalpy data of the samples are mainly analyzed
glass transition	The glass transition temperature (tg) of the sample is primarily analyzed.
Oxidative induction period	Manually adjust oxidation time
Specific heat-comparison method	The specific heat value of the sample was measured by the indirect method
crystallinity	Sample crystallinity analysis mode
degree of cure	Sample curing pattern

8. Instrument Interface

1. Startup screen

This interface displays sample temperature, heat flux, gas flow, and other information.

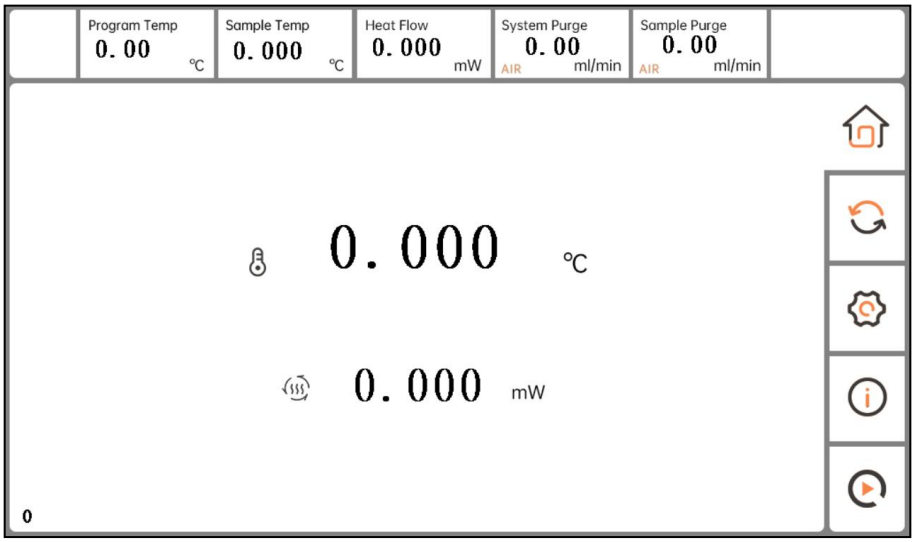


Figure 4-1 Initial state interface

Before the experiment, check the sample temperature, DSC values, and gas flow rate. To prevent the crucible from being blown out by excessive gas flow during the experiment, adjust the gas flow rate using a float flow meter before starting the equipment. 2. Parameter Settings

The "Parameter Settings" button is used to configure experimental parameters, typically through the software interface.

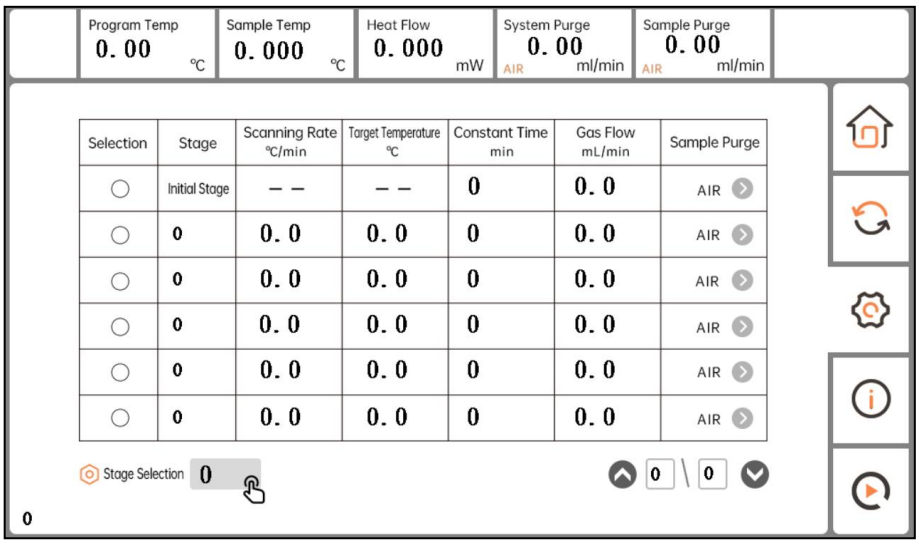


Figure 4-2 Parameter Settings

Both the host computer and instrument interface allow parameter settings, including preset sample heating rates, target temperatures, holding times, and atmosphere data. (It is recommended to configure the host computer to prevent sample name duplication, which could overwrite previous data.)

3. Device Information

The Device Information button displays device type, hardware version, software version, device ID, and other information.

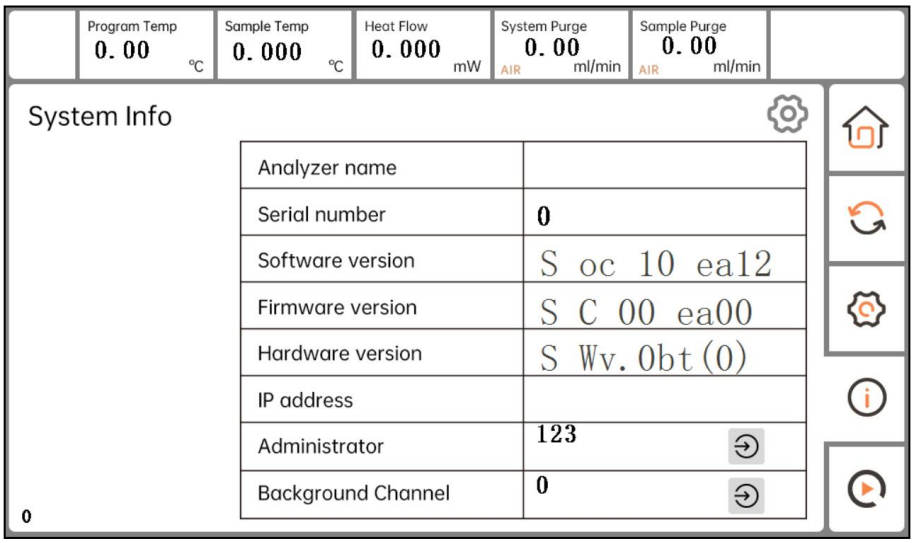


Figure 4-3 Device Information Interface

The administrator channel allows internal personnel to access the backend for temperature calibration (see P24 for detailed calibration steps).

4. Operation Interface

The "Start/Stop" button displays current data information after initiating operations in the computer software.

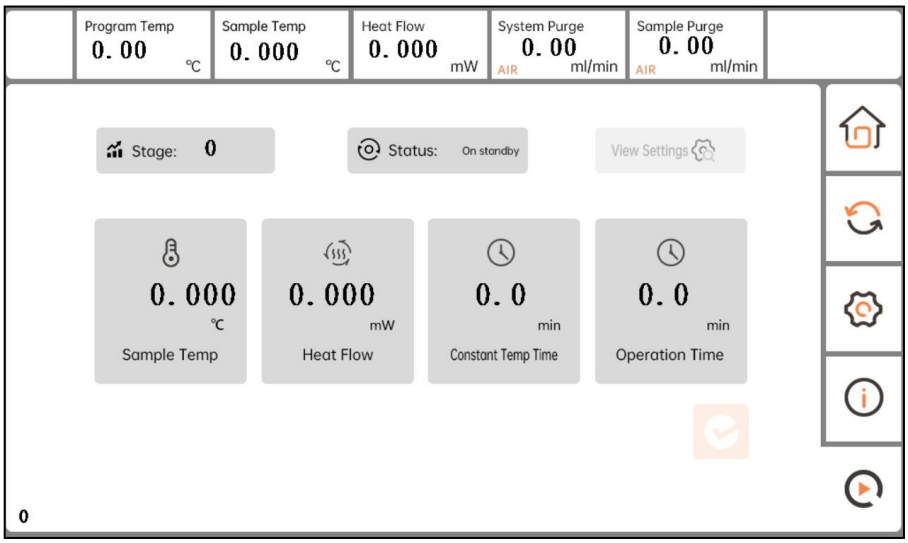


Figure 4-4 Running Interface

4.4.1 On the computer software, after setting the experimental parameters and other data, click Run in the software or click [Start Run] on the instrument screen.

4.4.2 Click [End Running System] to stop.

4.4.3 The instrument cannot be set during operation.

9. Instrument usage precautions

1. To ensure proper operation of the instrument, test samples must not undergo thermal decomposition within the specified temperature range, must not react with aluminum metal, and must be non-corrosive. If the sample under test generates significant gas emissions or poses explosion risks during heating, the instrument must not be used for testing. Therefore, prior to testing, a preliminary understanding of the sample's properties is required.

2. Before the experiment, check whether all the connections of the instrument are correct, and ensure that the gas used is sufficient and the tools are complete.

3. In the test, if the aluminum crucible is used as the sample dish, the maximum temperature of the test shall not exceed 550℃.

4. The laboratory temperature should be maintained between 20℃ and 30℃. Under relatively stable temperature conditions, the accuracy and repeatability of experimental results are higher. If the room temperature is higher, the air conditioner should be turned on to ensure short-term stability. After each experiment, wait until the instrument cools down below 40℃ before proceeding to the next one.

5. The bottom of the crucible should be flat, without sawtooth or bending phenomenon, otherwise it will affect the heat transfer effect.

6. When preparing DSC samples, avoid spilling them onto the crucible's edge to prevent sensor contamination and instrument damage. Ensure the crucible's base and outer surface remain free of sample residue or impurities to avoid compromising experimental results.

7. The sample quantity should be moderate, neither excessive nor insufficient. Solid samples are generally taken at about 10mg; the volume of liquid samples should not exceed one third of the crucible capacity. If there are special requirements for the sample quantity, the quantity shall be determined according to the requirements.

8. For inorganic samples, they can be ground and sieved in advance; for polymer samples, they should be as uniform as possible; fiber samples can be cut into the same length of 1-2mm; powder samples need to be compacted.

9. Position the crucible at the sensor's designated spot. For small sample sizes, spread it evenly across the crucible's base to prevent one-sided accumulation. If the sample is granular, place it precisely in the center of the crucible.

10. Generally, the heating rate should be set at 10℃/min. If the heating rate is too high, the curve will drift and the resolution will be reduced; if the heating rate is too low, the measurement time will be prolonged.

11. The use of hard objects to clean the sample tray and the experimental area is prohibited to avoid irreversible damage to the instrument.
12. If there is dust or other powder-like debris in the experimental area, blow it clean with a ear bulb. It is strictly prohibited to blow with your mouth to prevent accidents.
13. During data collection, avoid significant vibrations around the instrument and never open its lid. Even minor impacts on the front of the instrument will produce distinct peaks and valleys on the DSC curve.
14. During data collection, avoid adjusting the purified gas flow rate, as even minor fluctuations may affect the DSC curve.
15. After the experiment, handle the DSC furnace lid with care. Once the temperature drops below 100℃, handle it gently with tweezers to avoid burns or damage.
16. Power supply requirements: AC220V,50Hz, power consumption ≤ 1000W.
17. Before disconnecting the data cable, you must first shut down the software and then the instrument to prevent errors in online communication.

The solution is as follows:

If the connection is successful but no data is returned, restart the computer.
If the connection fails, uninstall the USB device with an exclamation mark in Device Manager, then reload it without restarting the computer.

Due to protective programs on computers and instruments, software may occasionally display a "Communication failure" prompt during startup. When encountering this issue, first disconnect both the instrument and computer by unplugging the instrument-side end of the data cable. Wait 3-5 minutes, then power on both devices. Start by turning on the computer, then launch the software and reconnect the data cable. After powering on the instrument, wait approximately 20 seconds. In the menu bar, click [Settings]> [Communication Connection]. Once connected, press [Run] to activate the instrument. Note that multiple attempts may be required to achieve successful connection. To prevent such issues, always follow this sequence during each startup (no need to manually disconnect or reconnect cables).

Product Warranty Card

Product Warranty Card

User Information

Name of organization or individual:_____

Full address:_____

_____

telephone Tel：_____Fax:_____Post Office Box (P.C.):_____

Service records

Repair Service Record

Product Name		Product Model		Product number	
Invoice Number		Purchase date		Free warranty period Period of Warranty	
date Date	take notes Description			Maintenance personnel Serviced by	

User Guide

In order to ensure the interests of users, I have established a quality assurance system, with free warranty service by card.

1. Please carefully fill in the user information in the product warranty card.

2. Fee structure: Free repairs during the warranty period. After the warranty expires, repair fees will be charged (covering only the cost of repairs). We provide lifetime maintenance for our products. For damages caused by improper use or human error, additional charges may apply.