



IN-SITU RESEARCH SYSTEMS

Product Catalogue

Joule heating | Catalyst evaluation
Spectroscopy | Battery research
Synchrotron reaction systems

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Explore the catalogue

Contact SSI for product selection, configuration and quotations. Dense technical sections are presented as enlarged landscape pages.

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Technical product data and photographs are retained from the supplied catalogue. Battery workflow captions describe the equipment functions in English. Availability and final quotations are confirmed on enquiry.

JOULE HEATING DEVICE SERIES

Continuous high-flux Joule heating platform

▶▶ Products Introduction

The continuous/high-throughput Joule heating material preparation platform combines the advantages of rapid temperature rise, precise temperature control and continuous production of Joule heat. It is suitable for material research and development and automated production, and can be used to process lithium battery materials, carbon materials, ceramics, metal compounds, two-dimensional materials, etc., especially some materials that require high-temperature treatment and have a large demand. Moreover, its unique heating mechanism and rapid temperature rise and fall characteristics make it more energy-efficient compared to traditional heat treatment equipment. At the same time, its unique operation mode (small batch, multi-channel, continuous) can quickly screen out the proportion required by customers to achieve the purpose of rapid experiments. It is widely applied in the energy industry, materials and engineering, aerospace, chemical engineering and other fields.



▶▶ Product parameter

	Single-station glove box(optional)
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Main components	Single-station glove box(optional)
	Automated heating processing module
	Electrical control system
	Chiller
	Bipolar rotary vane mechanical pump
	High-purity nitrogen source
Basic parameters(heating system)	Total power of the equipment: approximately 30KW(customizable)
	Heating method: Graphite heating
	Flash burning mode: Maximum temperature 2500°C
	Heat preservation mode: Maximum temperature 2300°C, heat preservation duration :≤10 seconds
	The fastest heating rate :≤1000°C/S
	Temperature measurement method: Infrared non-contact type, accuracy ±1%FS
	Single-tube processing capacity :2mL
	Single-group processing capacity :2 tubes *2mL=4mL
	Processing cycle :60 seconds per set (excluding heating)
	Cold vacuum degree :≤10Pa
	Vacuum acquisition : Two-stage rotary vane vacuum pump
	Cooling method: Water cooling
	Water and oxygen content :≤100PPm(water and oxygen purification system required)
	Equipment dimensions: Length * width * height =2400*1250*1900mm
	Total weight:1500 KG
Operation control system	With PLC as the core control, the heating system, vacuum system and automatic loading and unloading system are automatically executed and fed back, making the control system more coordinated, stable and reliable
	The system is integrated on the touch screen, allowing for operation and display of various working conditions. Various information parameters (such as heating parameters, vacuum pressure, etc.) can be set through permissions
	The electrical control system is equipped with a visual inspection system and various reliable interlocking, interlocking and protection functions, as well as an alarm function
	Different parameter formulas can be set to facilitate heat treatment of different samples
	Data is automatically uploaded and saved

Hot-press Joule heating system

Products Introduction

Ultra-fast high temperature hot press sintering:

By combining rapid temperature rise ($\geq 2000^{\circ}\text{C}/\text{min}$) and high pressure ($\leq 10\text{T}$) technology, the sintering time can be significantly reduced to ensure a stronger bond between powder particles, resulting in the preparation of materials with extremely high density.



Model :CIS-JHP-1030



Model :CIS-JHP-2050

Product parameter

Model	CIS-JHP-1030	CIS-JHP-2050
Electrical specification	380V 60KW,50/60HZ (Customizable)	
Overall size (mm) Width*Height*Depth	1600×2000×750	Electrical control cabinet 800×1920×1600 Cavity mounting frame 1000×2100×1200
Sample diameter	10mm, 20mm, 30mm	20mm, 50mm (Customizable)
Sample thickness	5-20mm	
Cavity size (mm) Width*Height*Depth	310×360×300	340×440×370
Temperature range	The maximum temperature of the mold shall not be lower than 2300°C	
Pressure range	3T	10T
Temperature control accuracy	±3°C	

Product information - specifications and continuation

Temperature control accuracy	$\pm 3^{\circ}\text{C}$	
Pressure control accuracy	$\pm 5\text{kg}$	$\pm 20\text{kg}$
The fastest controllable heating rate	$\leq 5000^{\circ}\text{C}/\text{min}$	$\leq 1200^{\circ}\text{C}/\text{min}$
System leakage rate	$\leq 5\text{E}-9$ (He)	
Ultimate positive pressure of the cavity	0.02Mpa	
Electrode insulation resistance (with water)	$\geq 1\text{M}\Omega$	
Vacuum pump	VRD-24	VRD-30
Operating ambient temperature	$\leq 45^{\circ}\text{C}$	
Cooling method of the sample stage	Air-cooled (optional for normal-temperature inert gas/cold argon purging circulation)	
Chamber cooling method	Water cooling (requires a chiller)	
Chiller	Standard configuration	
Temperature measurement probe	The temperature measurement range is 600-3200°C, with an accuracy of $\pm 1\%$ FS	
Materials of vacuum chambers and structural components	SUS304	
Mold material	Graphite	
Observation window	Quartz window (sapphire and other lenses are optional)	
Safety function	It features multiple alarm functions such as over-temperature, over-pressure, over-limit and leakage alarm, as well as multiple protection functions including no water protection and load discharge protection, to ensure the safety of equipment and personnel	
Real-time monitoring	Multi-channel pressure detection achieves precise closed-loop control of mold pressure and temperature, improving the experimental effect	
Automated operation	One-click start, fully automated flow control throughout the process	
Operation mode	HMI touch screen operation, centralized data collection and processing	
Shell structure	Sheet metal type	
Gas line specification	2 intake channels, 1 exhaust channel, 1 vacuum channel, and 1 safety unloading channel (Other intake requirements can be customized)	

Joule heating system

Products Introduction

Joule heating device is a new type of rapid heat treatment/synthesis equipment, the equipment can make the material in a very short (millisecond | second) time to reach a very high temperature (1000~3000° C), the fastest heating rate can reach 10000k/s;

By increasing the temperature of the material at the highest speed, the physical properties of the material can be investigated under extreme environment and severe thermal shock, and nano-scale particles, single-atom catalysts, high-entropy alloys can be prepared by increasing and decreasing the temperature at the highest speed. At present, it is widely used in battery materials, catalysts, carbon materials, ceramic materials, metal materials, plastic degradation, biomass and other fields.



Product parameter

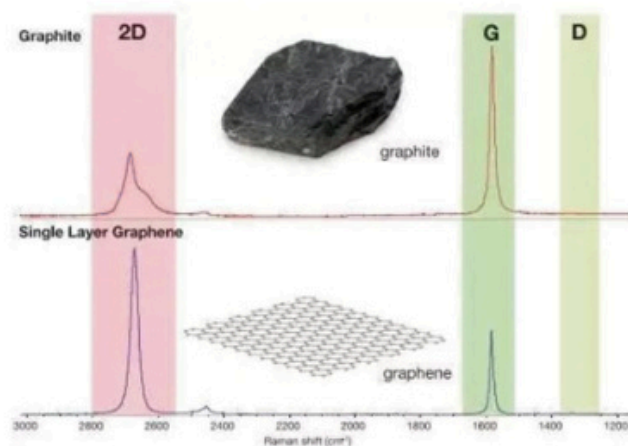
Version	Flagship model	Streamlined version
Model	CIS-JH-V4.0.0	CIS-JH-V4.0.0-TD
Power supply	3phase 380V/40A	AC220V/16A
Output voltage	0-40v	0-12V
Output current	0-500A	0-170A
Current ramping time	2ms	20ms
The minimum width of the pulse can be set	1ms	20ms
Counting pulses can be set	255	/

Product information - specifications and continuation

Counting pulses can be set	255	/
Data collection cycle	5ms	5ms
Data communication mode	RS485+Ethernet+USB	RS485+Ethernet+USB
Data collection method	Touch screen+PC	Touch screen+PC
Data control mode	Touch screen+Software	Touch screen+Software
Data collection content	Touch screen+Software	Real-time temperature, real-time voltage, real-time current
Clamping electrode	Fixed type	Adjustable spacing
Maximum temperature	3000°C	1800°C
Long-term heat preservation	Long-term within 2000°C	/
Control mode	Insulation, program control, slope, thermal shock, compatibility with S-curve, sine wave curve and other custom curves	Diversified control modes such as heat preservation, slope, and manual operation
Temperature measurement method	Infrared temperature measurement	Infrared temperature measuremen
Temperature measurement range	250-2000°C/700-3200°C/550-3000°C	100-1400°C/250-2000°C
Power supply cooling method	Water cooling	Air cooling
Vacuum chamber	304 stainless steel, square in shape, with a 16mm observation window, sapphire window panels, and a volume of approximately 400ml. The cavity is	Aluminum alloy, square, 16mm observation window, sapphire window panel, volume approximately 400ml
Gas line device	1 intake path, 1 vacuum path, 1 exhaust path	1 intake path, 1 vacuum path, 1 exhaust path
Vacuum pump	VRD-8,the vacuum pump is controlled through the touch screen	OPR-DV2,the vacuum pump is controlled through the touch screen
Standard sample stage material	Flexible graphite paper, graphite plate, graphite tube, graphite boat	Graphite paper, 50mm long graphite boat, 20mm long ink tube, 50mm long tungsten boat
Sample stage size	≤100mm×15mm×0.2mm	≤55mm×10mm×0.05mm
Sample test quantity	500mg	50mg
Overall size (Width*Height*Depth)	750mm×610mm×660mm	510mm×624mm×600mm

Graphene preparation by biomass flash heating

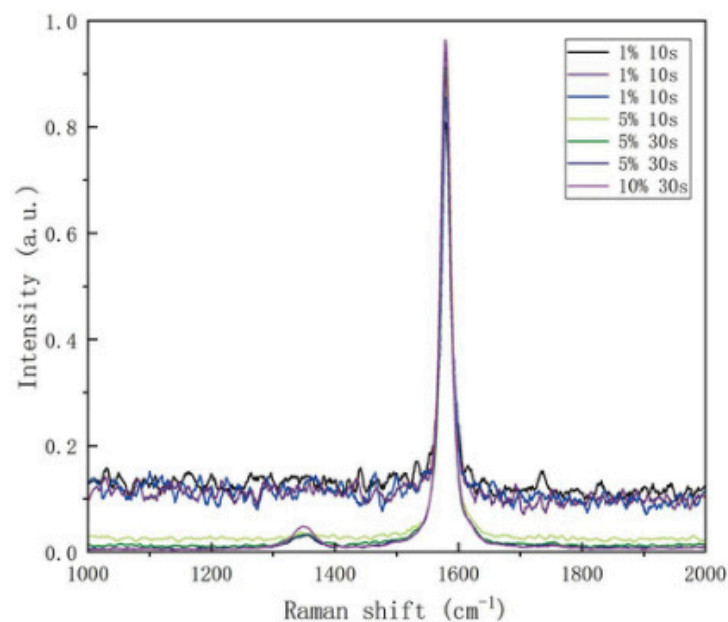
The following figure is the Raman diagram comparison of graphite and graphene, you can see that to determine whether it is graphene, the key is to look at the 2D peak.



和 D 峰相同的是，2D 峰也是共振峰^Q，具有明显的色散行为。所以 2D 峰的位置和峰形会随着激光频率变化。因此，在研究 2D 峰的时候，需要使用相同的激光频率。值得一提的是，单层石墨烯还可以透过 2D 峰和 G 峰的强度比例来鉴别。高质量（无缺陷）的单层石墨烯的 I_{2D}/I_G 为 2，随着比例的降低，说明石墨烯层数越来越厚。

No D peak means less impurity. The number of graphene layers is seen in 2D/G, less than 1 is multiple layers, equal to 1 is a double layer, and greater than 1 is a single layer.

Our experimental results are as follows (3000K preparation)



double layer, and greater than 1 is a single layer.

✓ External assisted Joule heating/Self propagating material preparation platform

▶▶ Products Introduction

External field assisted Joule heating material preparation platform can provide thermal field, electric field, magnetic field, quenching and atmosphere auxiliary environment for material heat treatment process. The auxiliary control of synthetic materials can be realized by controlling the external field strength. The heat treatment modes include joule heating, combustion synthesis and so on. Modular design, high degree of automatic control; It is composed of reaction chamber, electric control cabinet system, external magnetic field coil and water cooling mechanism.



Product parameter

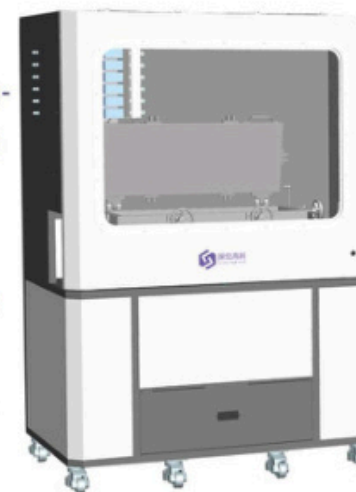
Equipment composition	Reaction chamber, external magnetic field diagram, electrical control system, water cooler	
Joule heating	Temperature heating range : $\leq 2500^{\circ}\text{C}$	
	Flash burning mode	The fastest heating rate : $\leq 500^{\circ}\text{C/S}$
	Temperature control mode	The holding time at 2500°C is ≤ 1 minute, and the holding temperature error is $\pm 1^{\circ}\text{C}$
		Temperature measurement method: Infrared non-contact type, accuracy $\pm 1\%\text{FS}$
		Cold vacuum degree : $\leq 10\text{Pa}$
		Sintering environment: Atmosphere, vacuum (automatic control for cleaning, evacuating, and air intake)
		Graphite crucible size : $48*20*10\text{mm}$; Volume: 2ml (There are differences among different batches and configurations. Please refer to the actual item.)
Combustion synthesis	Hot explosion mode	Working mode: The material is rapidly heated to the ignition temperature by Joule heat, and the sample undergoes an overall combustion reaction
		Sample properties: Solid-state pressed sheet
		Graphite crucible size : $48*20*20\text{mm}$ (with lid) Volume : 7.5ml
	Self-propagating mode	Working mode: The combustion agent is ignited by the heating of the tungsten wire and then self-spreads and burns out completely
		Sample properties: Solid-state pressed sheet
		Graphite crucible size : $48*20*20\text{mm}$ (uncovered) Volume : 7.5ml

		Graphite crucible size :48*20*20mm(covered) Volume :7.5ml
Quenching function	After sintering in various modes is completed, the graphite crucible can quickly and automatically fall into the water or oil in the collection basin for high-temperature quenching treatment	
Magnetic field test parameters	Magnetic field intensity: The central magnetic field intensity is better than 12.5Gs (1000A/M)	
Electric field test parameters	Electric field intensity: $\leq 55V/mm$ (theoretical value in cold state)	
Operation control system	With PLC as the core control system, the entire machine system automatically executes and feeds back the process flow according to the set parameters. The control system is simple to operate, stable and reliable	
	Standard configuration is optional. If there are special functions, they can be deeply customized	

✓ Rapid heating furnace/Joule heat pipe furnace

▶▶ Products Introduction

The Joule rapid heating furnace is a new type of efficient laboratory heat treatment equipment. This equipment can provide a considerable sample processing capacity and a large constant temperature processing area, and can also be expanded to specific atmosphere environments. It has the characteristics of cleanliness, energy conservation and stability of tube furnaces, but the heating rate can reach tens of thousands of times that of tube furnaces. Combined with the unique liquid nitrogen cooling system, it can achieve rapid cooling of the environment with high total heat. Rapid heating and cooling provide significant assistance for the investigation of the thermal shock resistance of samples, the reduction of the length of pyrolysis carbon chains, and the decrease of catalyst unit cell agglomeration, etc. Therefore, it is widely used in the preparation of new materials, plastic pyrolysis, biomass and other fields.



Product parameter

Model	CIS-JHTF-1220	CIS-JHTF-2005
Design temperature	1200°C	Quartz tube: 1200°C, corundum tube: 1700°C, boron nitride tube (or molybdenum tube) : 2000°C
Maximum heating rate	40C/s	Quartz tube: 150 ° C/s, boron high oxide tube (or molybdenum tube) : 60° C/s, corundum tube: 1C/s
Electrical specification	380V 60KW, compatible with 50/60Hz	380V 60KW, compatible with 50/60Hz
Material of the reaction tube	Quartz tube	Quartz tube Quartz/Corundum /Molybdenum /Boron nitride tube
Atmosphere environment inside the reaction tube	Vacuum or slightly positive pressure	Vacuum or slightly positive pressure
Maximum sample processing capacity	200ml	50ml
Temperature measurement method	Infrared non-contact type, accuracy $\pm 1\%$ FS	
Auxiliary cooling system	Rapid cooling can be achieved by using a liquid nitrogen cooling system	
Overall dimensions (length, width, height)	1300mm*800mm*1900mm (subject to actual conditions)	1000mm*800mm*1900 (subject to actual conditions)
Other	Standard configuration includes a chiller and a vacuum pump	

✓ Discharge plasma Joule heating device

▶▶ Products Introduction

The discharge plasma Joule heating device is an advanced rapid sintering equipment. It adopts a double-layer square cavity and has a water-cooling function. Vacuum, atmosphere and plasma sintering environments can be provided inside the reaction chamber. It has heating modes such as rapid, constant temperature and thermal shock. The adoption of a fully digital plasma experimental power supply can better control the plasma parameters during the sintering process.

▶▶ Product parameter

- Maximum operating temperature :3000°C;
- Long-term heat preservation: Yes;
- Temperature measurement range :250-2000°C/700-3200°C;
- Plasma output voltage :0-30KV;
- Plasma power supply power :0-500W;
- Center frequency: Approximately 10KHz;
- The adjustable frequency range is 5KHz to 20KHz ;
- It can conduct arc discharge and glow discharge tests in various atmosphere environments under normal and low pressure, and is equipped with input power measurement, high-voltage output voltage and current detection interfaces.



Long-duration Joule heating system

▶▶ Products Introduction

The insulated Joule heating device is a device that features rapid temperature rise, energy conservation and environmental protection. It has the advantages of long heat preservation time, precise temperature control and large single processing capacity. This device has a complete and sealed stainless steel heating chamber. The chamber adopts a double-layer integrated structure design and contains a hollow water-cooling structure. At the same time, a water-cooled power supply is configured to ensure the good operation of the heater. The device supports the test requirements of various working conditions such as vacuum atmosphere, inert gas protected atmosphere and low oxygen concentration atmosphere.

According to customer requirements, this device supports the following functional upgrades and expansions :1、 It supports the addition of a Joule heating device heating chamber (with dual chambers sharing power supply, water cooling, vacuum pump and other components); 2、 It is equipped with a standard gas float flowmeter, supporting the upgrade of the gas mass flow controller & flowmeter. 3、 The standard temperature measurement is equipped with an infrared thermometer, and it supports the addition of an infrared thermal imaging thermometer.

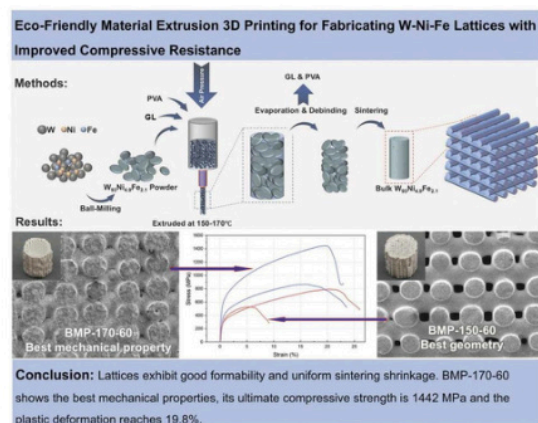
and it supports the addition of an infrared thermal imaging thermometer.

Product parameter

- Serrated sample stage (graphite) Maximum temperature :2500 ° C(vacuum environment, held for approximately 30 minutes; Argon atmosphere, with heat preservation for ≥ 50 h; Heating temperature: 2400°C(vacuum environment, holding for about 5 h);
- Total power of the equipment :64KW(including 54KW for heating equipment, 1.1KW for vacuum pump, and 8.9KW for water cooler);
- Power supply :AC380V 50Hz;
- Sample stage volume :50ml;
- Heating rate : $\leq 40^{\circ}\text{C/S}$;
- Temperature measurement method: Infrared thermometer;
- Temperature control accuracy : $\pm 2^{\circ}\text{C}$;
- Cavity air interface: Two air inlets, one air outlet, and one vacuum air extraction port;
- Cooling method: The cavity and power supply are cooled by water, and the heater dissipates heat naturally;
- Overall dimensions (Width, depth and height) 1200mm*1110mm*1850mm(subject to the actual product).



Application Cases - Eco-friendly material extrusion 3D printing for fabricating W-Ni-Fe lattices with improved compressive resistance



Advanced metastable Metal Materials Research Center of Northeastern University designed and prepared porous tungsten alloy materials using ink-direct-writing technology. By adjusting the parameters of 3D printing and optimizing the sintering industry, a tungsten alloy porous skeleton with excellent mechanical properties was obtained. The relevant article was published in the international TOP journal in the field of Additive manufacturing under the title of “Eco-friendly material extrusion 3D printing for fabricating W-Ni-Fe lattices with improved compressive resistance” .

CATALYST EVALUATION DEVICE

✓ Miniature Fixed bed

▶▶ Products Introduction

This (desktop) micro fixed bed reactor is suitable for laboratory work surface, with small size and compact structure, modular design for easy assembly and improvement. According to the reaction system, the reaction channel, the number of gas and liquid paths, the type & size of the separation device and the sampling analysis method can be customized to perfectly meet the actual needs of customers.

▶▶ Product parameter

- Modular: Small modular desktop, free assembly, expansion and improvement according to the experimental system;
- Accuracy: pressure soil 0.25%F.S, flow rate $\pm 1\%$ FS, temperature difference in constant temperature zone $\pm 1^{\circ}\text{C}$, temperature control accuracy $\pm 1^{\circ}\text{C}$
- Applicability: It can realize multi-gas phase, gas-liquid two-phase and gas-liquid-solid three-phase reaction, and can be combined with GC/MS/IR to achieve online detection.
- Convenience: The temperature is controlled by PID to ensure that the reaction temperature is stable, and the output can be constant to examine the reaction heat change. Data acquisition and control are integrated on the touch screen, the operation interface is simple and friendly, easy to use. It can realize automatic sampling and analysis of products, and realize all-weather continuous operation without manual intervention;



continuous operation without manual intervention;

- Safety: Electrical safety chain, the use of hardware and software combined safety design, overpressure, overtemperature alarm, outdated processing automatically stop working; Misoperation protection; Power outage, gas shutdown treatment, etc.

Modules	Function	Parameter
Number of reaction channels	/	1-2
Reaction conditions	maximum operating temperature	800°C
	Maximum operating pressure	9.8MPa
Feed module	Feed composition	Single atmosphere, multi-component, gas-liquid, gas-liquid-solid
	Feed pretreatment method	Filtration, premixing, preheating, vaporization and remixing, vaporization after melting, etc.
	Gas/liquid feeding method	Mass flow meter/bubble generator, syringe pump, plunger pump
	Gas isolation flow rate	2-6
	Liquid flow rate	1-2
	Feed distribution error	1%
Reaction module	Catalyst loading(ml)	0.1-10
		10mm or Customized
	Reaction tube inner diameter	
	Catalytic bed shape/height	cylinder/10-200 mm
	Catalyst form	Powder, granules, molding and overall structure
	Reaction tube materials	Quartz,316L,310S,Hastelloy,GH high temperature synthetic gold
	Temperature control method	Electric heating
	Heating method	Joule heating or electric heating
Product separation module	separation mode	Gas-solid separation, gas-liquid separation
	separation device	Cyclone separator, temperature controlled condenser
Product analysis module	/	Offline sampling, online GC/MS/IR sampling
Electronic control method	/	Digital display instrument control/touch screen control/computer software control
System & auxiliary parameters	Supply power	20A,AC220v,50Hz, Ground resistance <4Ω
	Exhaust gas	customized
	size	1.2*0.7*1.0M
	Safety features	Adopting a safety design that combines software and hardware, it provides alarms for overpressure and overtemperature, and will automatically stop working if it expires and is not processed. Misoperation protection, power outage, gas outage processing

Multichannel fixed-bed reactor

Products Introduction

This multi-channel fixed bed reactor, the high temperature and high pressure multi-position reaction device designed to maximize the efficiency of the experimental personnel can realize the rapid, efficient and parallel screening of catalytic materials, reaction evaluation and process optimization. Each channel reactor can choose the integrated, independent and fast switching mode.

Product parameter

- Highly customized: process flow, process parameter confirmation and standard part selection are fully customized according to customer needs;
- Accurate calculation and design: According to customer data, accurate material and heat balance, including reactor, separation device, heat exchange device and other non-standard parts of the size and parameters of the calculation design;
- High precision control: pressure $\pm 0.25\%$ F.S, flow $\pm 1\%$ F.S, high precision control of constant temperature zone temperature;
- Highly automated: pressure, temperature, flow and other data acquisition and control integrated on the touch screen, the operation interface is simple and friendly, easy to use. Automatic product sampling analysis can be achieved, all-weather continuous operation. It can realize arbitrary switching of evaluation stages such as pretreatment, purging and reaction among different channels, and improve the working efficiency of experimental personnel to the greatest extent;
- Excellent parallelism: independent setting of reaction parameters of each channel, real-time monitoring of status and product analysis, independent flow meter injection, temperature control, separate configuration of product separation, sampling analysis



analysis, independent flow meter injection, temperature control, separate configuration of product separation, sampling analysis module, control of parameter errors between channels.

Modules	Function	Parameter
Number of reaction channels	/	2-12
Reaction conditions	maximum operating temperature	800°C
	Maximum operating pressure	9.8MPa
Feed module	Feed composition	Single atmosphere, multi-component, gas-liquid, gas-liquid-solid
	Feed pretreatment method	Filtration, premixing, preheating, vaporization and remixing, vaporization after melting, etc.
	Gas/liquid feeding method	Mass flow meter/bubble generator, syringe pump, plunger pump
	Gas isolation flow rate	2-10
	Liquid flow rate	1-2
	Feed distribution error	1%
Reaction module	Catalyst loading(ml)	0.5-200
	Reaction tube inner diameter	10-60mm
	Catalytic bed shape/height	cylinder/Irregular module after wrapping 10-500mm
	Catalyst form	Powder, granules, molding and overall structure
	Reaction tube materials	Quartz,316L,310S,Hastelloy,GH high temperature synthetic gold
	Temperature control method	Electric heating,Light heating, thermal oil, molten salt circulation
	Heating method	Joule heating or electric heating
Product separation module	separation mode	Gas-solid separation, gas-liquid separation
	separation device	Cyclone separator, temperature controlled condenser
Product analysis module	/	Offline sampling, online GC/MS/IR sampling
System & auxiliary parameters	Supply power	20A,AC220v,50Hz, Ground resistance <4Ω
	Exhaust air	customized
	size	customized
	Safety features	Adopting a safety design that combines software and hardware, it provides alarms for overpressure and overtemperature, and will automatically stop working if it expires and is not processed. Misoperation protection, power outage, gas outage processing

Joule-heated fixed-bed reactor

Products Introduction

Joule heat fixed bed reactor rapidly and controllably reaches the set reaction temperature by controlling the output pulse or stable/controllable direct current of the Joule heating power supply. Through the Joule effect of the catalyst bed or its conductive carrier itself, it is assisted by the multi-channel gas mixing device, liquid pumping vaporization device (optional) and pre-heating, heating and pressure increase conditions at the front end of this device. Meet the conditions required for the reaction. Compared with traditional heating methods, the Joule heat fixed bed can significantly accelerate the heating rate ($\geq 100^{\circ}\text{C/S}$), reduce the preparation time, improve the evaluation efficiency, and lower the operating cost. At the same time, the traditional electrically heated reactor can be retained for researchers to use as a reference for comparison or in series/coupled reactions. This device can be optionally equipped with multi-component gas feed and liquid feed, and is suitable for various reaction modes such as gas phase, gas-solid two-phase or gas-liquid-solid three-phase. By installing a condenser + cold trap or hot trap/pipeline heating at the rear end of the reactor, it can achieve gas-liquid separation or gas-liquid-solid separation of the reaction tail gas materials or full-component analysis. It can evaluate various reaction systems such as synthesis, cracking and reforming.

New features

In addition to the structure and functions of a conventional fixed bed, this device also has the following functions:

- Remote control: The electric heating furnace, temperature control and pressure sensors are connected to the control system, enabling remote real-time control when abnormal temperature or pressure occurs Stop heating and close the gas line valve to ensure the safety of the experiment.
- Real-time power and energy consumption recording: Output of real-time power and reaction energy consumption records for different reactors, temperature curve recording function (customized as needed).



Items	Function	Parameter
Number of reaction channels	/	Customized

Number of reaction channels	/	Customized
Reaction conditions	maximum operating temperature	1200°C
	Maximum operating pressure	10MPa
Feed module	Feed composition	Single atmosphere, multi-component, gas-liquid, gas-liquid-solid
	Feed pretreatment method	Filter ,vaporization, preheat, mixing
	Gas/liquid feeding method	Mass flow meter/Plunger pump
	Gas isolation flow rate	Customized
	Liquid flow rate	Customized
	Feed distribution error	1%
Reaction module	Catalyst requirement	Custom particle (conductive), powder (conductive carrier)
	Catalyst loading(ml)	Customized
	Reaction tube material	Quartz tube (inner tube), stainless steel tube (outer tube)
	Stainless steel material	310,316,304
	Heating method	Joule heating
Heating module	Composition	Carbon rods, carbon cloth, silicon carbide particles, quartz inner tube, stainless steel outer tube, cooling system
	Power	4 KW
	separation mode	gas-liquid separation
	separation device	Condenser, gas-liquid separator
Product separation module	/	Offline sampling, online GC/MS/IR sampling
Product analysis module	/	Touch screen
Control system	Supply power	32A, AC220V,50Hz
System & auxiliary parameters	size	<120*70*180CM
	Safety features	Adopting a safety design that combines software and hardware, it provides alarms for overpressure and overtemperature, and will automatically stop working if it expires and is not processed. Misoperation protection, power outage, gas outage processing

In-situ differential mass spectrometry

✓ In-situ differential mass spectrometry system

▶▶ Products Introduction

In-situ differential mass spectrometry system, through the online combination of the electrochemical cell and the mass spectrometry system, realizes the dynamic monitoring and real-time tracking of electrochemical reactions, and can capture, identify and dynamically track reaction products and intermediates in real time.

▶▶ Product Features

① Fully enclosed structure design

Protect internal components from contamination, ensure a clean measurement environment, avoid external interference, and enhance the sensitivity and stability of the equipment.

② Multi-instrument coupling capability

It can be used in online conjunction with infrared, Raman, adsorption instruments, thermobalances, reactors and other equipment to achieve real-time and dynamic monitoring and analysis of chemical reactions.

③ High-performance vacuum pump set

The German Pfeiffer pure oil-free dry molecular pump set (split molecular pump + diaphragm pump) is adopted to ensure a stable vacuum environment and extend the service life of the equipment.

④ Ultra-fast scanning speed

The scanning speed reaches 1ms/amu, which is at the leading level in the industry and can capture transient intermediates in rapid response processes.

⑤ Networked control

Supports IP address setting and network cable control, with a communication speed of up to 100Mbit/s, enabling remote operation and data transmission.

⑥ The mass spectrometer is seamlessly coupled with the workstation

The synchronous control design ensures seamless connection between mass spectrometry detection and workstation operation, enhancing experimental efficiency and data accuracy.



Electrochemical mass spectrometry cell

- Cell body material :PMMA+PEEK;
- Sealing ring :FKM;
- Design temperature: Room temperature;
- Design pressure: Atmospheric pressure;
- The device is equipped with a circulating liquid inlet, through which liquid can be passed to conduct static/dynamic gas production research of the electrolyte. ;
- WE: Catalyst-supported carbon paper RE: Solid silver chloride electrode CE: Platinum column + platinum mesh.

Infrared - Mass spectrometry tandem cell

- Cell body material :PMMA+PEEK;
- Sealing ring :FKM;
- Design temperature: Room temperature;
- Design pressure: Atmospheric pressure;
- The device is equipped with a circulating liquid inlet, through which liquid can be passed to conduct static/dynamic gas production research of the electrolyte.;
- WE: Catalyst-supported carbon paper/nickel foam RE: Silver chloride electrode/silver ion electrode/mercurous sulfate electrode/mercuric oxide electrode/calomel electrode CE: Platinum wire ring electrode/Graphite rod electrode It is applicable to the research of supported catalysts.

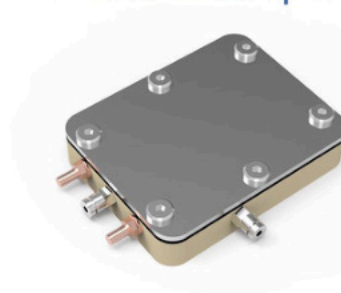


Raman - Mass spectrometry tandem cell

- Cell material :PEEK
- Test conditions: Normal temperature and normal pressure;
- Observation window: High-purity quartz, light window diameter 37mm;
- Counter electrode: Platinum wire electrode/graphite rod electrode;
- Reference electrode: Silver-silver chloride electrode/m
- Working electrode: Catalyst-loaded carbon paper, nickel foam, etc. Focal length: minimum 6mm;
- Anode and cathode chambers: Proton exchange membranes (provided by the user) can be used to separate them, effectively preventing side reactions from occurring.
- Gas chamber: A gas chamber is provided below the cathode chamber, separated by a hydrophobic and breathable membrane and porous ceramics.



In-situ mass spectrometry cell for pouch cells



- It can be assembled in the glove box and the process is simple ;
- The pressure applied to the pouch battery can be manually adjusted ;
- The space for placing electrodes is adjustable and suitable for electrode sheets of different thicknesses;
- The mold is processed with PEEK and 316 stainless steel, which is corrosion-resistant;
- It can be combined with chromatography or mass spectrometry for online gas detection;
- Suitable cell size for testing :MAX70x56mm, customizable;
- Thickness :MAX12mm and adjustable thickness;
- Customizable other thicknesses: Reaction tank dimensions: length * width * height :110*86*20mm.

In-situ mass spectrometry cell for button cells

- It can be assembled in the glove box and the process is simple;
- The space for placing electrodes is adjustable and suitable for electrode sheets of different thicknesses;
- The mold is processed with PEEK and 316 stainless steel, which is corrosion-resistant;
- It can be combined with chromatography or mass spectrometry for online gas detection;
- Suggested electrode sheet size: 16mm in the separator, 12mm in the positive electrode, 14mm in the negative electrode. Customization is available. Material: Stainless steel +peek;
- Reaction cell size: 34.6*13.5mm(excluding the electrode part).



Multi-environment in-situ infrared reaction system

✓ In-situ infrared electrochemical ATR system

▶▶ Products Introduction

In situ infrared electrochemical ATR can obtain the orientation, arrangement, coverage and other state information of adsorbed species on the electrode surface, which is an effective means to study the electrode process at the molecular level. The attenuated total reflection mode of the surface enhancement spectrum has the advantages of simple surface selection law, strong surface signal, easy mass transfer and small interference by bulk solution. It is especially suitable for real-time detection of dynamic electrode surface processes.

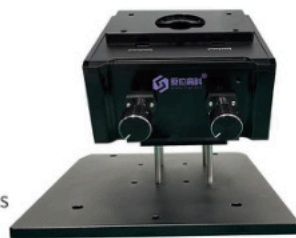
The in-situ reaction system introduces three electrodes and a gas interface, which can pass reaction gases such as CO₂ and N₂ into the solution under the condition of external bias pressure, and realize the photocatalytic in-situ infrared spectroscopy characterization. On this basis, surface plasmon resonance wave is introduced to achieve surface enhancement effect by evaporating (or sputtering, etc.) gold layer on the surface of monocrystalline silicon to enhance the signal characterized in situ.



Product parameter

In situ technology composite ATR accessories

Universally compatible with both domestic and imported Fourier transform infrared spectrometers. This composite ATR accessory is a multifunctional optical accessory that can be used to analyze solids, liquids, pastes, gels, and difficult-to-handle materials, etc. It can also be matched with various in-situ reaction cells, capable of qualitatively analyzing the changing trends of products or intermediate products on the electrode surface over time (potential) during electrocatalytic reactions (such as CO, electroreduction, etc.) and the charging and discharging processes of various types of batteries (such as lithium-ion, lithium-sulfur batteries, etc.). This attachment provides multiple ATR detection modes.



ATR heats the crystal plate

- Temperature: Room temperature -200°C;
- Pressure: Atmospheric pressure, open system;
- Sample: Drop coating sample (sample viscous/pasty/with poor fluidity);
- Product body: Optional (Ge Si crystals are suitable for temperatures below 135 °C, and ZnSe crystals are suitable for 135-200°C);
- Drop coating sample area: Crystal bare leakage area 10mm.



High-temperature stirring H-type ATR

- Temperature: Room temperature -200°C
- Heating method: Oil bath heating (for heating the electrolyte);
- Pressure: Atmospheric pressure, open system;
- Sample: Drop coating sample;
- Crystals: Optional (Ge Si crystals are suitable for temperatures below 135°C, and ZnSe crystals are suitable for 135-200°C);



In situ infrared internal Reflection (H type)

- Material :PTFE and quartz body, resistant to chemical corrosion;
- Angle range :30~80 degrees continuously adjustable to ensure that different electrocatalysts are in the maximum luminous flux state;
- Sealing: The sealing performance of the reaction tank is good, and the reaction gas can be passed into it;
- Crystal selection :Si/znSe/Ge/znS and other crystals are optional, easy to disassemble;
- Features: 5-port design to meet various application requirements.

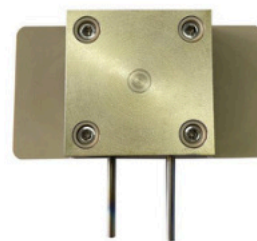


In situ infrared external reflection

- Material :PEEK;
- Target temperature: room temperature;
- Sample treatment: drip coating sample;
- Pressure in the reaction cell: normal pressure;
- Window: calcium fluoride (18*2)/ crystal;
- Electrodes (optional) : working electrode (glass carbon electrode), reference electrode (silver chloride electrode), opposite electrode (platinum wire ring electrode).

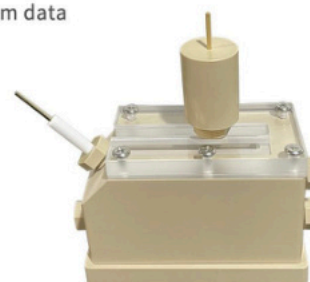
Lithium batteries in situ infrared ATR test cell

- Material: The metal part of the pool body is made of high purity titanium material to ensure the corrosion resistance and strength of the external material;
- Diameter : $\leq 16\text{mm}$;
- Diaphragm diameter : $\leq 20\text{mm}$;
- Sealing: The fluorine rubber ring is used for sealing to ensure the overall sealing of the system;
- Compatibility: It should be used with in-situ Technology or PIKE's ATR optical path system.
- Ease of use: easy to assemble, easy to disassemble, easy to clean each component;
- Application: Suitable for infrared spectrum test of secondary batteries (reusable);
- Functional characteristics: During the normal charging and discharging process, the infrared spectrum data can be collected online (matching the attenuated full reflection light path).



In situ infrared multiple reflections

- Material : PEEK, quartz cell body, corrosion resistance;
- Angle range : 40° - 50° adjustable;
- Tightness: non-sealed system;
- Crystal : Si/Ge crystal optional;
- Features: With an inlet and an outlet, can be inlet gas & liquid.



✓ In-situ infrared diffuse reflectance system

▶▶ Products Introduction



In situ infrared reaction system is used to evaluate the performance of catalyst or material in multiple environments by Fourier transform infrared spectrometer. The intermediate states and products of the reaction can be easily tracked and identified, thus providing direct evidence for the investigation of the reaction mechanism of the catalytic reaction system. In situ infrared diffuse reflection is mainly used for the characterization of gas-solid catalysis and catalytic reactions, such as the identification of hydroxyl groups on the catalyst surface, the study of adsorbed species on the catalyst surface, and the characterization of acid-base on the catalyst surface.

The reaction system can be applied in vacuum to high pressure environments, with temperatures up to 500°C (under vacuum), and is ideal for studying heterogeneous catalysis, gas-solid interactions, photochemical reactions and oxidation mechanisms. At present, it has been applied to the infrared spectroscopy study of gas-solid interface reaction in the fields of photocatalytic degradation of gaseous organic matter and thermal catalysis ($\text{CO} + \text{H}_2$, $\text{CO}_2 + \text{H}_2$).

▶▶ Product parameter

High temperature and high pressure diffuse reflection cell



- The cell body is mainly made of 316L stainless steel, with maximum temperature resistance of 500°C and pressure resistance of 3MPa; / Hastelloy material, maximum temperature 800°C , corrosion resistance;
- The reaction pool can be equipped with a high precision touch screen temperature controller for precise control and gentle heating, and a cooling cycle device can be used to cool the outside of the reaction pool.
- The cap of the reaction chamber has three Windows, two of which are infrared Windows and the other is quartz window, which are used for introducing external light sources (photocatalytic excitation light sources) or as observation Windows;
- Provide three inlet/outlet, for the evacuation of the tank body and the introduction of gas, can be formed in the reaction tank, such as vocs, CO_2 reaction gas, reaction tail gas first into the safety bottle and then absorbed by a specific solution to outdoor, each gas through the mass flow meter to control the flow, reaction gas path operation interface is convenient and friendly, easy to operate;
- All kinds of optical window can be customized, optional high temperature Raman pool cover.

High and low temperature diffuse reflection cell

- Design temperature : -150° C ~300°C;
- Design pressure: negative pressure (-150° C ~RT), 3MPa (RT~300° C);
- Cell material: cell cover 316L;
- Window material: quartz;
- Temperature control device: program temperature control, touch screen operation (including supporting software); The device is provided with an air inlet and outlet, which can pass gas;
- The water cooling interface is reserved and the water cooler is equipped to protect the temperature outside the pool body. Equipped with liquid nitrogen tank liquid nitrogen pump, control liquid nitrogen flow rate;
- Need to be equipped with mechanical pump/molecular pump and corresponding pipeline accessories, vacuum (reduce the frost of the window and protect the low temperature area).



Electric field cell diffuse reflection cell



- A back pressure valve can be optionally equipped as needed ;
- Product parameters ;
- Design temperature: Room temperature to 400°C ;
- Design pressure :3MPa ;
- Product material: Hastelloy + ceramic;
- Light window sheet: Quartz ;
- Infrared window piece :ZnSe*2 ;
- Electrode: Copper wire electrode ;
- The device is equipped with air inlet and outlet ports, through which atmosphere can be introduced.

High-temperature plasma diffuse reflection cell



- Design temperature :500°C or room temperature is optional;
- Design pressure: Atmospheric pressure;
- Product material: Stainless steel 316+ ceramic;
- Light window sheet: Quartz;
- Infrared window panel: CaF₂*2;
- Electrodes: Central high-voltage electrode, annular electrode;
- The device is equipped with air inlet and outlet ports, through which atmosphere can be introduced.

✓ In-situ infrared transmission system

▶▶ Products Introduction



In situ infrared transmission cell reaction system is mainly used to study the infrared spectral characteristics of samples under different temperature and gas environment. The product is mainly composed of three parts: reaction tank, gas mixing control system and temperature control system. The main body of the reaction tank is made of 316L stainless steel and equipped with infrared window. The gas mixing control system accurately controls the gas flow through the mass flow meter and realizes the mixing. The temperature control system realizes the temperature control of the gas path, the gas mixing tank and the reaction tank through various sensors.

Product parameter

Infrared high temperature transmission cell

- Hd 800+480 resolution true-color touch screen flow control, easy to operate, easy to use;
- This product has three stages of heating and four channels of temperature display, real-time understanding of each position temperature, temperature control accuracy of $\pm 0.1^{\circ}\text{C}$;
- The standard provides 2~4 gas distribution routes, and the number of gas routes can be customized;
- The maximum temperature of the reaction cell can be 500°C ;
- The main body of the reactor is designed with double jacket to ensure the thermal insulation and safety of the experiment.

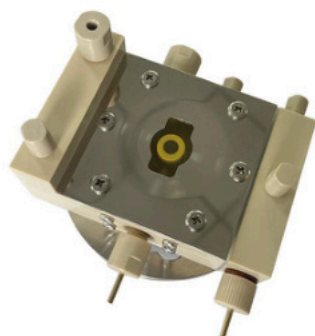


In-situ XRD REACTION DEVICE SERIES

✓ In-situ XRD electrochemical reaction cell

Products Introduction

In-situ XRD electrochemical reaction cell is mainly used to study the phase structure changes of electrode materials in liquid phase three or two electrode environment.



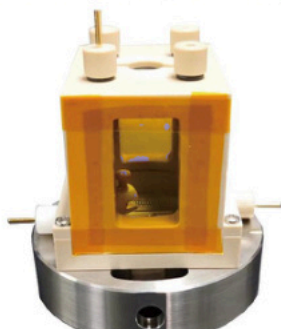
Product parameter

- Liquid phase three electrode (or two electrode) electrochemical reaction, sample size 5-10 mm electrode sample (need to be loaded on carbon paper);
- Equipped with gas inlet and outlet to ensure the flow of gas during the reaction process;
- Equipped with Ag/AgCl electrode, glass carbon electrode and platinum wire electrode, of which the working electrode is glass carbon electrode;
- Good sealing;
- Diffraction Angle range : $10^{\circ} < 2\theta < 100^{\circ}$;
- PEEK or PTFE material (optional);
- Can match different brands of diffractometer models.

✓ Photoelectrocatalytic XRD reaction cell

Products Introduction

The reaction cell is used for in-situ XRD characterization of photoelectrocatalytic reactions. There is a quartz light window on the top of the cell body, and polyimide windows on the left and right sides of the cell body. It is equipped with a reference electrode, a counter electrode and a working electrode, which can operate at different wavelengths. In-situ XRD testing can be carried out under illumination and different electrical conditions to obtain the structural changes of the material; the reaction cell can realize ventilation operation in the solution in the reaction cell, and the product can be equipped with an optional temperature control system to accurately control the test temperature of the reaction cell.



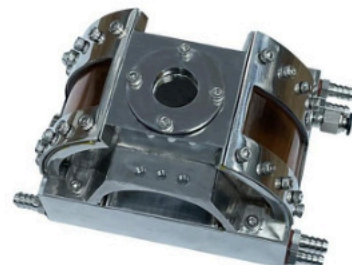
Product parameter

- Cell body material: PEEK;
- Light window: quartz;
- X-ray window: polyimide film;
- Detection angle: $10^{\circ} < 2\theta < 100^{\circ}$;
- Sealing ring: PTFE/FFKM, etc.;
- Temperature test range: normal temperature;
- Working electrode: glassy carbon. platinum electrode clip.

✓ High temperature photocatalytic XRD reaction cell

▷▷ Product parameter

- Cell body material :GH2747;
- Temperature range: Room temperature -900°C;
- Separable sample stage: Aluminum nitride;
- Window: Optical sapphire/polyimide film;
- Temperature control accuracy: $\pm 0.1^{\circ}\text{C}$;
- Temperature uniformity: $\pm 1^{\circ}\text{C}$;
- Outer surface temperature of the cell : $\leq 40^{\circ}\text{C}$;
- Atmosphere: Compatible atmosphere;
- Water-cooling configuration :1200W circulating water-cooled machine;
- Temperature control configuration: Customized temperature controller, programmed temperature control, touch screen operation (including supporting software).



✓ In-situ XRD lowtemperature reaction cell

▷▷ Products Introduction

In situ low temperature XRD reaction cell is mainly used to study the structural evolution of materials in variable temperature (low temperature) environment.

▷▷ Product parameter

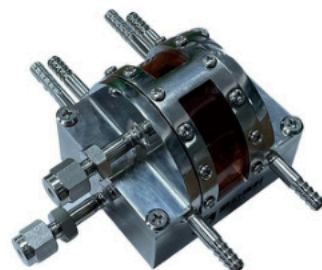


- Modular design: there is no need for liquid nitrogen in the process of temperature change, the whole sample pool is small, and the sample pool can be integrated with the laboratory light source and used on the synchrotron radiation diffraction line station;
- Polyimide film: a protective film that insulates the air to prevent the sample from freezing during the test;
- Refrigeration: The use of liquid nitrogen free five-level ceramic Parr patch refrigeration;
- Temperature range : -53°C ~ room temperature;
- Cold end size: $\phi 15\text{ mm}$.

✓ In-situ XRD high-temperature reaction cell

▷▷ Product parameter

- Cell material :SUS316L;
- Window: Polyimide;
- Sealing ring: Silicone;
- Test conditions: Room temperature~600°C;
- Pressure range :0-0.3MPa;
- Temperature control accuracy : 0.1°C ;
- Temperature uniformity: $\pm 1^{\circ}\text{C}$;
- Atmosphere: Corrosive atmospheres can be passed, such as ammonia, sulfur dioxide, etc.;
- Water-cooling configuration :270W circulating chiller;
- Temperature control: Customized temperature controller, programmed temperature control, touch screen operation.



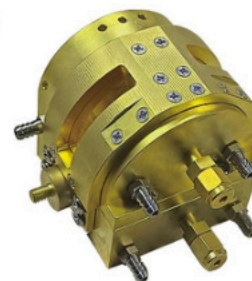
Product parameter

- Cell material :GH2747;
- Separable sample stage: Aluminum nitride;
- Window: Polyimide film;
- Test temperature: Room temperature to 1000°C(in an air or oxygen environment);
- Temperature control accuracy : $\pm 0.1^{\circ}\text{C}$;
- Temperature uniformity : $\pm 1^{\circ}\text{C}$;
- Outer surface temperature of the cell: $<40^{\circ}\text{C}$;
- Atmosphere: Compatible atmosphere;
- Water cooling configuration :1400W water cooler;
- Temperature control configuration: Customized temperature controller, programmed temperature control, touch screen operation (including supporting software).



Product parameter

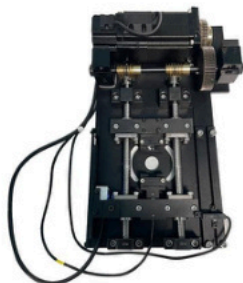
- Cell material: Hastelloy C276(embedded ceramics)/SUS316 electroplating (embedded ceramics);
- Window: imported PI film/beryllium window;
- Temperature test range: room temperature ~1200°C;
- Temperature control accuracy : $\pm 0.1^{\circ}\text{C}$;
- Temperature uniformity: $\pm 1^{\circ}\text{C}$;
- Outside the pool surface temperature : $\leq 40^{\circ}\text{C}$;
- Atmosphere: accessible atmosphere;
- Water cooling configuration :1200W circulating water cooler;
- Humidity control configuration: Joule heating power supply system, programmed temperature control, touch screen operation (including supporting software).



✓ Stretch/shorten the XRD sample stage

Products Introduction

The stretching /shorten XRD sample stage can be used in conjunction with the Rigo smart-lab diffractometer to achieve the stretching and shortening of samples.



Product parameter

- It adopts a biaxially oriented structure, and the adjustment range of the stretching rate is 1-100um/s;
- The sensor adopts both tensile and compressive directions, with a maximum load capacity of 2500N, and the deformation exceeds 50% of the sample.

IN-SITU RAMAN REACTION DEVICE SERIES

✓ In-situ Raman high temperature reaction device cell

▷▷ Products Introduction

In situ Raman high-temperature reaction chamber is mainly used to observe the Raman spectrum changes of samples under high temperature conditions, so as to explore the influence of high temperature on the phase structure of samples. The device mainly includes a pool body (high temperature furnace body), heating system, water cooling system, temperature control system, sample table and other parts. The ambient heating method can adjust the temperature of the reaction tank in real time to ensure that the sample is at a constant temperature point.

▷▷ Product parameter

- Design temperature :1000°C;
- Main material :310S/GH2747(If there is corrosive gas, the material can be replaced with Hastelloy C276, and the temperature can be reduced to 900°C);
- Temperature control device: Program temperature control, touch screen operation (including supporting software);
- Temperature control accuracy: $\pm 0.1^{\circ}\text{C}$;
- Window material: Optical sapphire;
- Separable sample stage. The material of the sample stage is aluminum nitride ceramic.;
- Others: It can be filled with atmosphere and vacuumed;
- Water cooling configuration :1400W circulating water cooler.



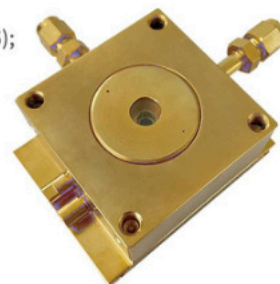
▷▷ Product parameter



- Design temperature :600°C(If pressure is required, two pool covers can be made, and the pressure of the high-pressure cell cover can be 2MPa);
- Main material :SUS316(If there is corrosive gas, the material can be replaced with Hastelloy C276);
- Temperature control device: Program temperature control, touch screen operation (including supporting software);
- Temperature control accuracy: $\pm 0.1^{\circ}\text{C}$;
- Window material: Optical sapphire;
- Three sets of separated sample stages are made of aluminum nitride ceramic;
- Others: It can be filled with atmosphere and vacuumed;
- Water cooling configuration :300W circulating water cooler.

▷▷ Product parameter

- Design temperature :600°C(If pressure is required, two cell covers can be made, and the pressure of the high-pressure cell cover can be 2MPa);
- Main material :SUS316(If there is corrosive gas, the material can be replaced with Hastelloy C276);
- Temperature control device: Program temperature control, touch screen operation (including supporting software);
- Temperature control accuracy: $\pm 0.1^{\circ}\text{C}$;
- Window material: Optical sapphire;
- Three sets of separated sample stages are made of aluminum nitride ceramic;
- Others: It can be filled with atmosphere and vacuumed;
- Water cooling configuration :300W circulating water cooler.



✓ In-situ Raman electrochemical reaction cell

▶▶ Products Introduction

In-situ Raman electrochemical cell is mainly used to observe the in-situ spectral changes of electrode materials in electrochemical experiments, so as to explore the changes in the chemical structure of electrode materials during electrochemical reactions. The device is equipped with a reference electrode and a counterelectrode to provide electrochemical experiments with a three-electrode system and reserve a gas-liquid interface to be used for in-situ Raman optical advances at various high temperatures and gas/liquid cycles. The electrochemical cell can be quickly assembled and disassembled for easy cleaning.

I.U series in-situ Raman electrochemical cell (suitable for self-supported samples)



Model : CIS-Raman-EC-U1

▶▶ Product parameter

- The main cell body material is PEEK/PMMA/PTFE/PI;
- The working electrode can be selected as a flat electrode such as catalyst supported wallpaper and nickel foam;
- The size and thickness of the planar electrode can be adjusted, and the disassembly is convenient and quick;
- The reference electrode can be silver/silver chloride electrode, mercury sulfate electrode, mercury/mercury oxide electrode and saturated calomel electrode;
- Platinum wire ring electrode and graphite rod electrode are available for electrode;
- The study of the static and dynamic atmosphere and electrolyte, and the whole tank body is well sealed;
- Optional optical window quartz, sapphire and nitride window, window diameter 37mm;
- the distance between the working electrode surface and the light window is less than 6mm.

▶▶ Product parameter

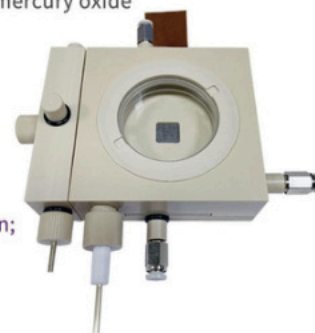
- The main cell body material is PEEK/PMMA/PTFE/PI;
- The working electrode can choose the plane electrode such as negative Spanish baby carbon paper and foam town;
- The size and thickness of the planar electrode can be adjusted, and the disassembly is convenient and quick;
- The reference electrode can be made of silver/silver oxide plate, mercury sulfate electrode, mercury/mercury oxide electrode and saturated calomel electrode;
- Platinum wire ring electrode and graphite rod electrode can be selected for the electrode;
- The study of the static and dynamic atmosphere and electrolyte, and the whole body is well sealed;
- The narrow cathode and the anode chamber are separated by an ionic membrane (user's own) to effectively avoid possible chemical reactions in the polar regions;
- Optical window can be stacked quartz, gem and nitride window, window diameter 37mm;
- Working electrode surface distance from the light quotient distance 6mm



Model : CIS-Raman-EC-U1-H

Product parameter

- The main cell body material is PEEK/PMMA/PTFE/PI ;
- Working electrode optional gas diffusion electrode and catalyst negative type hydrophobic acid paper ;
- The size and thickness of the planar electrode can be adjusted, and the disassembly is convenient and quick ;
- The reference electrode can be silver/silver chloride electrode, mercury sulfate electrode, mercury/mercury oxide electrode and saturated calomel electrode;
- Platinum wire ring electrode and graphite rod electrode are available for electrode ;
- Can carry out gas, wave flow opposite skin research, the whole tank body sealing is good ;
- The cathode chamber and the anode chamber are separated by an ionic membrane (user's own) to effectively avoid possible chemical reactions in the polar regions;
- A gas diffusion chamber is added under the cathode chamber, which has the function of gas diffusion;
- Optical window optional quartz, sapphire and nitride window, window diameter 37mm;
- The distance between the electrode surface and the light window is less than 6mm.



Model :CIS-Raman-EC-U2-H

(Gas diffusion)

2.P series in situ Raman electrochemical cell (suitable for powder samples)



Model :CIS-Raman-EC-P1

Product parameter

- The main cell body material is PEEK/PMMA/PTFE/PI;
- The working electrode is glass carbon electrode and other disc electrodes;
- The reference electrode can be silver/silver chloride electrode, mercurous acid electrode, mercury/mercury oxide electrode and saturated calomel electrode;
- The electrode can be platinum wire ring electrode and stone rod electrode;
- The static and dynamic study of the permeable atmosphere and electrolytic ling, and the whole tank body is well sealed;
- Optical window quartz, sapphire and nitride window, window diameter 36mm;
- The distance between the working electrode surface and the light window is less than 6mm.

Product parameter

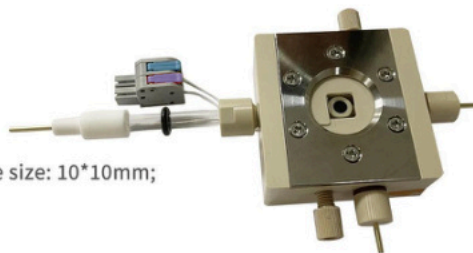


Model :CIS-Raman-EC-P1-H

- The main cell body material is PEEK/PMMA/PTFE/PI;
- working electrode such as glass carbon electrode disc electrode;
- The reference electrode can be silver/silver chloride electrode, sulfite electrode, / oxidized fruit electrode and saturated calomel electrode:
- Platinum wire ring electrode and graphite rod electrode are optional for the electrode:
- Stong atmosphere and electrolyte static and dynamic research, the whole tank body seal is good;
- The cathode chamber and the anode chamber are separated by an ionic membrane (user's own) to effectively avoid possible chemical reactions in the polar regions:
- Optional optical window quartz, sapphire and nitride window, window diameter 36mm;
- The distance between the electrode surface and the light window is less than 6mm

Product parameter

- Design temperature: Room temperature -80°C;
- Design pressure/volume: Atmospheric pressure /5ml;
- Product material :PEEK+316 stainless steel + purple steel;
- Window panel: Quartz window panel 1mm;
- The diameter of the light window is 24mm; Sample thickness: 0-1.5mm, sample size: 10*10mm;
- Electrode: Counter electrode: Platinum wire ring electrode;
- Reference electrode: Silver-silver chloride electrode;
- Working electrode: Glassy carbon electrode.



Model :CIS-Raman-EC-P1-T80

IN-SITU CHARACTERIZATION OF BATTERIES

✓ Lithium battery in-situ XRD cell

Products Introduction

The lithium battery in-situ XRD test cell is mainly used for online collection of XRD spectral data of electrode materials in lithium ion reaction systems. It can conduct real-time and online observation of phase changes during the chemical reaction of lithium battery electrode materials.



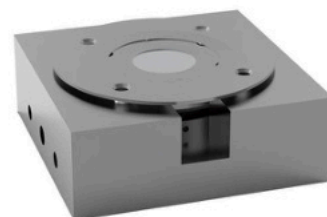
Product parameter

- Cell body material: 316L stainless steel;
- Temperature: normal temperature;
- Pressure: normal pressure; Sample type:
- all samples that can be used as lithium battery materials, positive and negative electrodes ≤ 16 mm in diameter;
- Diaphragm diameter: medium < 20 mm;
- Detection angle: $10^\circ < 2\theta < 100^\circ$.

✓ High and low temperature lithium battery XRD testing cell

Product parameter

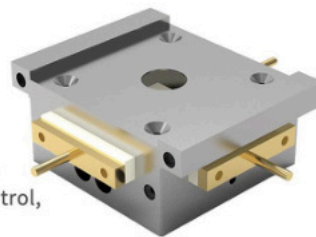
- Design temperature: -150°C~100°C/-30°C~100°C, temperature control accuracy: $\pm 1^\circ\text{C}$, using program control;
- Design pressure: normal pressure;
- Cell body material: 316 stainless steel;
- Sample type: All samples that can be used as lithium battery materials, the diameter of the positive and negative electrodes $\Phi \leq 16$ mm;
- Diaphragm diameter: $\Phi \leq 19$ mm;
- Focal length: < 8 mm;
- Refrigeration method: Liquid nitrogen refrigeration technology is used for refrigeration, and heat conduction is used to surround and heat the sample to ensure uniform temperature at the sample;
- Test window: single-layer quilt window;
- Device overall dimensions: $\approx 80 \times 80 \times 30$ mm;
- Vacuuming: Yes, the vacuum pump is connected through the KF25 (other specifications can be customized) flange; including: a temperature-adjustable vacuum chamber, a temperature controller, a set of in-situ XRD lithium-ion in-situ cells and other components.



✓ In-situ Raman testing cell for fuel cell

Product parameter

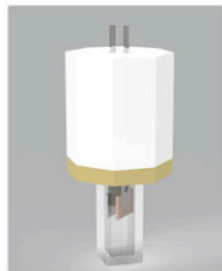
- Design temperature: Room temperature -600° C;
- Design pressure: Atmospheric pressure -1MPa;
- Cell material: SUS316 electroplated pool;
- Window panel material: Sapphire window panel, diameter 28mm, thickness 1mm(3 pieces);
- Temperature control device: Customized temperature controller, program temperature control, touch screen operation (including supporting software);
- The device is equipped with a gas phase inlet and outlet, allowing for the introduction of atmosphere to meet the requirements of negative pressure injection (the gas path inlet is adjustable and can be added);
- Gas line terminal :SUS316 ferrule joint 1/8in;
- Water cooling device :270W circulating water cooler.



✓ Li/Na Battery UV electrolyte test cell

Product parameter

- Operating Temp.: Ambient (RT);
- Operating Pressure: Atmospheric;
- Materials: PEEK + Fused Silica + PTFE;
- Cell Dimensions: 26×26×66 mm;
- Sample Size: ≤10×8 mm (rectangular);
- Function: Enables in-situ surface morphology characterization under bias during optical microscopy observation.



✓ High and lowtemperature lithium Raman testing cell

Product parameter

- Cell material :316 stainless steel;
- Design temperature :-150~100° C, temperature control accuracy: $\pm 1^{\circ}\text{C}$, using program control;
- Design pressure: normal pressure;
- Sample type: All samples that can be used as lithium battery materials, positive and negative diameter <16mm;
- Diaphragm diameter: $\Phi \leq 19\text{mm}$;
- Focal length :<10mm;
- Refrigeration method: liquid nitrogen refrigeration technology is used for refrigeration, and heat conduction method is used to surround the sample for heating to ensure uniform temperature at the sample;
- Test window: double quartz window, diameter 6mm;
- Dimensions :130mmx90mmx35mm;
- Vacuum pumping: Yes, the vacuum pump is connected through the KF25(other specifications can be customized) flange;
- It includes: a vacuum chamber with adjustable temperature, a temperature controller, a set of in-situ Raman lithium ion in-situ cell and other components.



✓ Lithium battery in-situ Raman test cell

▷▷ Products Introduction

The in-situ Raman test cell of lithium-air battery is mainly used for online collection of Raman spectrum data of air electrode during the charging and discharging process of lithium-air battery, which can monitor the phase transition of air electrode materials in real time and online.

▷▷ Product parameter

- Cell material :316L stainless steel /TA2/3003A1;
- Temperature: The reaction tank is not equipped with heating and cooling system, it is recommended to use at room temperature;
- Pressure: normal pressure;
- Sample type: All samples that can be used as lithium battery materials, positive and negative electrode diameters <16mm;
- Diaphragm diameter: $\Phi < 20$ mm;
- Focal length :<8mm, meet the test requirements of the mainstream Raman spectrometer on the market, and canCustomize according to demand;
- Window: Quartz window, diameter more than 6mm, can be customized according to customer needs.



✓ Lithium air-battery in-situ Raman test cell

▷▷ Products Introduction

The in-situ Raman test cell of lithium battery is mainly used for the acquisition of Raman spectrum data of materials in lithium ion reaction system, which can study the electrode structure during the chemical reaction of lithium battery electrode materials.

▷▷ Product parameter

- Cell material :316L stainless steel;
- Temperature: The reactor is not equipped with heating and cooling system, it is recommended to use at room temperature;
- Pressure: normal pressure;
- Application: lithium air battery test system, can ensure the normal application of lithium air battery;
- Gas intersection design: Gas intersections are set up on both sides of the pool to facilitate atmosphere control during the experiment;
- Focal length :<8mm, meet the test requirements of the mainstream Raman spectrometer on the market;
- Window: Quartz window, diameter >6mm, can be customized according to customer needs.



✓ Solid-state battery in-situ AFM cell

▷▷ Products Introduction

Solid-state battery in-situ AFM cell is mainly used for in situ AFM characterization of electrode materials in solid lithium battery system. After argon ion bombards the cross section of solid lithium electrode materials, in-situ AFM test and performance test can be performed without disassembly of the cell body.

▷▷ Product parameter

- Cell material :PEEK;
- Design temperature: room temperature;
- Design pressure: normal pressure (customizable pressure);
- Fluid collection material: titanium alloy, copper (customizable material);
- Sample type: All samples that can be used as solid state lithium battery materials;
- Size parameters: Internal PEEK tank body design size 10*9*3mm, positive and negative electrode size 5.5-6.5mm.



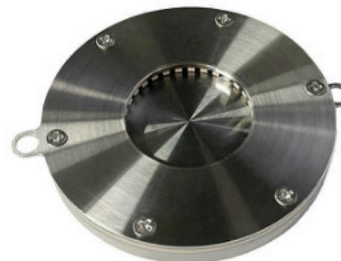
✓ Water-based battery in-situ AFM cell

▶▶ Products Introduction

Water-based battery in-situ AFM cell is mainly used for the in situ AFM characterization of electrode materials in the water battery system, which can be used for online visualization of the interface morphology evolution. The AFM probe needs to go deep into the liquid to measure the surface morphology of the electrode.

▶▶ Product parameter

- Cell material :PEEK;
- Design temperature: room temperature;
- Design pressure: normal pressure;
- Cell body height :8mm;
- Electrode material diameter: $\Phi \leq 22\text{mm}$.



✓ Lithium battery in-situ XAFS test cell

▶▶ Products Introduction

There is an X-ray penetration window at the top and bottom of the in-situ XAFS test cell for lithium batteries. During charging and discharging, X-rays can be driven into the product in the vertical direction through the window to monitor the phase changes of battery materials in real time, so as to better understand and analyze experimental phenomena and experimental influencing factors.



▶▶ Product parameter

- Cell material :316 stainless steel (other materials can be customized);
- Temperature: normal temperature;
- Pressure: normal pressure;
- Sample size: pole plate $\leq \Phi 16\text{mm}$, diaphragm $\leq \Phi 19\text{mm}$;
- Application model: all samples of lithium battery materials;
- Cell size : $\approx 46 \times 16\text{mm}$.

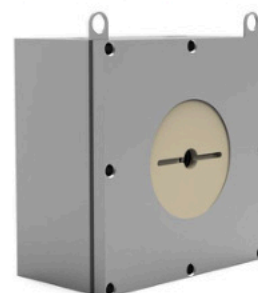
✓ High/Low-temperature lithium battery in-situ XAFS transmission test cell

▶▶ Products Introduction

This reaction cell mimics the coin cell structure design. It is used for in-situ synchrotron radiation testing and characterization of lithium (sodium) electrode materials during charge/discharge cycling under atmospheric pressure and temperatures ranging from -180°C to 80°C .

▶▶ Product parameter

- Design Temperature: -180°C to 80°C ;
- Design Pressure: Atmospheric;
- Cell Body Material: SUS316;
- Separator Diameter: $\leq \Phi 19\text{mm}$;
- Model: CIS-XAFS-LB($-180-80^{\circ}\text{C}$);
- Cell Dimensions: $80 \times 43 \times 80\text{mm}$;
- Sample Type: Compatible with conventional lithium battery material samples; Electrode diameter $< \Phi 16\text{mm}$.



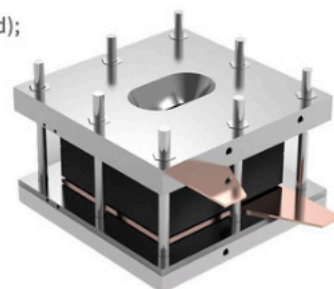
✓ In-situ XAFS testing cell for fuel cell

Product Introduction

There is an X-ray penetration window (graphite) at the top and bottom of the in-situ XAFS test cell. During charging and discharging, X-rays can be driven into the product in the vertical direction through the window to monitor the phase change of the battery material in real time, so as to better understand and analyze the experimental phenomena and experimental influencing factors.

Product parameter

- Cell material :316 stainless steel + copper + stone quantity (other materials can be customized);
- Temperature: normal temperature ~80°C(temperature can be customized);
- Pressure: normal pressure (pressure can be customized);
- Air chamber: two into two out, double air chamber;
- Electrode: double electrode, can be customized three electrodes, four electrodes, etc.
- Cell size: Size customization.



✓ Zinc-Air in-situ three-electrode XAFS cell



Product parameter

- Operating temperature: Ambient;
- Internal pressure: Ambient;
- Material: PEEK;
- X-ray Window: Kapton® polyimide film;
- Sample Loading: Carbon paper-supported electrodes;
- Electrode System: 3-electrode configuration.

✓ Transmission electron microscope in-situ liquid system

Product Introduction

Utilizes two high-strength titanium alloy plates as sealing covers, combined with perfluoroelastomer O-rings for enhanced sealing. Features dual silicon nitride chips forming a liquid cell, where samples are encapsulated between silicon nitride membranes for real-time liquid-phase observations in TEM.

Product parameter

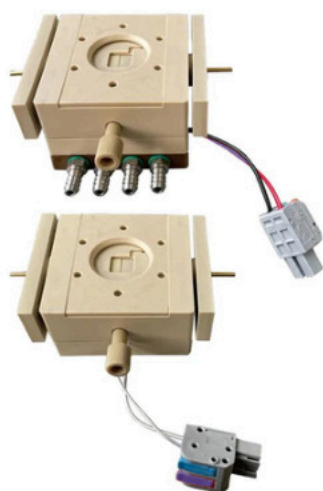
- Vacuum Compatibility: Maintains TEM-grade vacuum integrity;
- Liquid Cell Thickness: Adjustable spacer, down to 100 nm;
- Sample Capacity: Compatible with liquid-phase specimens;
- Pressure Tolerance: Withstands internal pressures up to 1 atm;
- Vacuum Adaptation: External sealing meets TEM vacuum requirements.



✓ In-situ lithium dendrite observation system

In situ microscopic observation cell series

▶▶ Product parameter



CIS-0M-004
In-situ Observation Cell

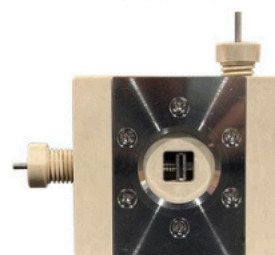
- Material: PEEK;
- Electrodes: Standard glassy carbon (GC) electrode (customizable);
- Window Material: Fused silica (quartz);
- Key Features:
 - ✓ Dendrite growth observation capability;
 - ✓ Inert gas purging & in-situ electrolyte injection;
 - ✓ Helium-leak tested sealing;
- Optical Window: Ø24 mm;
- Working Distance: ≥ 1 mm;
- Sample Chamber: 10×10 mm rectangular area;
- Thickness Range: 0.6–2 mm;
- Overall Thickness: ≤ 35 mm;
- Range: -30°C to +150°C;
- Accuracy: $\pm 1^\circ\text{C}$;
- Compatibility: All rechargeable battery systems;
- Control System: Programmable PID controller;
- Thermal Design:
 - ✓ Modular cooling/heating stages (swappable without breaking cell seal);
 - ✓ Independent base plates for subzero/HT operation;
- Optional Solid-State Accessory:
 - Pressurization Module:
 - ✓ Max. pressure: 60 kgf (equivalent to 6 MPa);
 - ✓ Higher pressures customizable.

▶▶ Product parameter

- Material: PEEK;
- Electrodes: High-purity titanium (custom materials optional);
- Window Material: Fused silica;
- Key Features:
 - ✓ Dendrite growth observation capability;
 - ✓ Gas-purge function & in-situ liquid injection;
- Sample Chamber: 10×10 mm rectangular area;
- Thickness Range: 0.6–2 mm;
- Applications: All rechargeable battery systems:
 - ✓ Helium-leak tested sealing;
- Optical Window: Ø24 mm;
- Minimum Working Distance: 1 mm;
- Special Configurations:
 - ✓ Horizontal/side-mountable orientation (minimizes bubble formation);
 - ✓ Compatible with Li-air battery testing;
- Optional Solid-State Module(CIS-0M-003):
 - ✓ Pressurization up to 60 kg (6 MPa);
 - ✓ Higher pressure customization available;



CIS-0M-003



CIS-0M-003-1



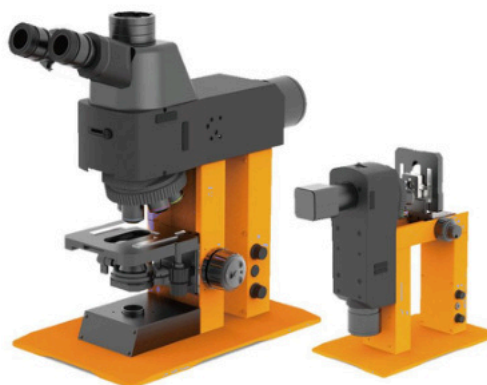
CIS-0M-002

Product parameter

- Material: quartz;
- Volume: about 5ml;
- Electrode material: pure titanium;
- Electrode spacing :3mm;
- Enclosure: tetrafluoroidal, sealed with sealing ring;
- Application: symmetrical zinc battery.

Dendrite observation optical system

The standard is equipped with a special stage for dendrite observation, as well as a number of special fixtures with different functions, which can be applied to a variety of different specifications of electrolytic cells.



Optical system	Dendrite observation optical system
Viewing tube	As the three-eye observation tube, 20° tilt, pupil distance 45-79mm, eye point adjustable, spectral ratio 100:0, 50:50
Eyepiece	Ultra-wide field of view Eyepiece 10X(field of view 25mm), high limit, adjustable diopter
	Dendrite observation special objective 5X dendrite observation special objective 10X
	Objective lens dendrite observation special objective 20X
	dendrite observation special objective 50X
	dendrite observation special objective 100X
Objective converter	Manual five-hole objective converter
Drop lighting system	6.6W full spectrum LED lighting, preset center, continuous brightness adjustable
Transmissive lighting system	The pendulum condenser has a numerical aperture of 1.25 with a variable stop
Focusing system	Coarse tuning coaxial, coarse tuning with locking device (to prevent collision lens), can be set tightness, fine tuning grid value 1μm
microscope stage	Double mechanical stage, including bracket frame, glass plate and in situ battery clamp
Camera interface	1X Standard C interface 1X

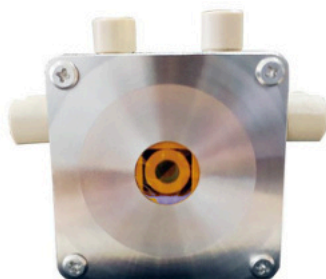
SYNCHROTRON RADIATION IN-SITU DEVICE SERIES

✓ Heterogeneous photocatalytic in situ XAFS reaction cell

▶▶ Products Introduction

It is mainly used for in situ XAFS data acquisition in the process of photocatalysis, electrocatalysis and photocatalysis. The reaction tank integrates multiple external field conditions such as light and electricity, and can carry out liquid phase, gas phase and solid equal heterogeneous catalytic reactions, including typical photocatalytic degradation of VOCs, water decomposition, CO₂ reduction, nitrogen fixation, etc.

▶▶ Product parameter



- The device is equipped with an electrode interface, a gas inlet and outlet and a control component, which can introduce a variety of related experimental conditions;
- According to customer needs, different reaction volumes, electrodes and gas interfaces can be customized;
- Provide gas path control device for photocatalytic degradation of VOCs reaction;
- For liquid phase reaction such as decomposition water, the liquid layer thickness can be adjusted (the liquid layer has X-ray absorption);
- For the reaction of degradation of VOCs, decomposition of water, reduction of CO₂, nitrogen fixation, etc., miniaturized chromatography can be provided at the same time, while XAFS analysis, Detection of various gas phase products;
- The reaction pool is small, easy to couple synchrotron radiation station, and easy to operate.

✓ High temperature and high pressure XAFS reaction cell

▶▶ Products Introduction

High temperature and high pressure XAFS reaction cell can be used with Beijing Synchrotron Radiation (BSRF)/ Shanghai Light Source (SSRF)/ Singapore Synchrotron Radiation (SSLS) and other stations, which can realize in-situ XAFS online test of samples under high temperature and high pressure environment. The test modes were transmission mode and fluorescence mode.

▶▶ Product parameter

- During the test, gas intake and temperature control can be achieved;
- Gas flow is controlled by mass flowmeter, heating rod is heated, high precision touch screen temperature controller temperature control;
- Maximum operating temperature 500°C;
- Maximum pressure 3MPa.



✓ High-temperature Dual-Mode XAFS cell (Transmission/Fluorescence)

▷▷ Products Introduction

For in-situ XAFS online testing at $\leq 1000^{\circ}\text{C}$ (ambient pressure) at BSRF/SSRF/SSLS beamlines. Dual detection modes.

▷▷ Product parameter

- Multi-gas compatibility with helium-leak tested seals ;
- Heating block + precision touchscreen controller;
- Max. temperature: 1000°C ;
- Integrated water-cooling system;
- Observation viewport.



✓ Air mixing system

▷▷ Products Introduction

The gas mixing device is mainly used to provide atmosphere environment, and can be used in tube furnace, in-situ reaction pond, etc.

▷▷ Product parameter

- Support 1~6 air inlet mixing, each air inlet supports up to 5 kinds of gas composite, input and output pressure 0 ~10 MPa(optional);
- Touch screen control, can quickly set each gas type and flow, and directly output the real flow after mixing:
- Can process the data, form reports and curves, support data download;
- Save the time and energy of research workers, the equipment is simple and fast to use.



✓ Molecular pump set / Vacuum system

▷▷ Products Introduction

The Molecular Pump Set/Vacuum System is a high-vacuum generation device. It primarily consists of a molecular pump, mechanical pump, vacuum measurement system, and electrical control system. Featuring stainless steel KF flange connections and touchscreen operation, this system delivers high vacuum levels, rapid response times, and user-friendly operation.

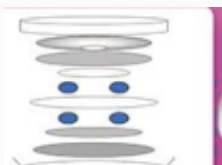
▷▷ Product parameter

- Power Supply: AC 220V 50/60 Hz;
- Power Consumption: 1 KW;
- Ultimate Vacuum: 9×10^{-5} Pa (unloaded);
- Pumping Speed: 85 L/s;
- Connection Port: KF25;
- Operating Temperature: $5-32^{\circ}\text{C}$;
- One-touch start/stop control via touchscreen;
- Multiple operational modes for diverse vacuum requirements;
- Achieves ultimate vacuum of 9×10^{-5} Pa, meeting most application needs;
- Model: CIS-JZ-80G;



Coin-cell fabrication

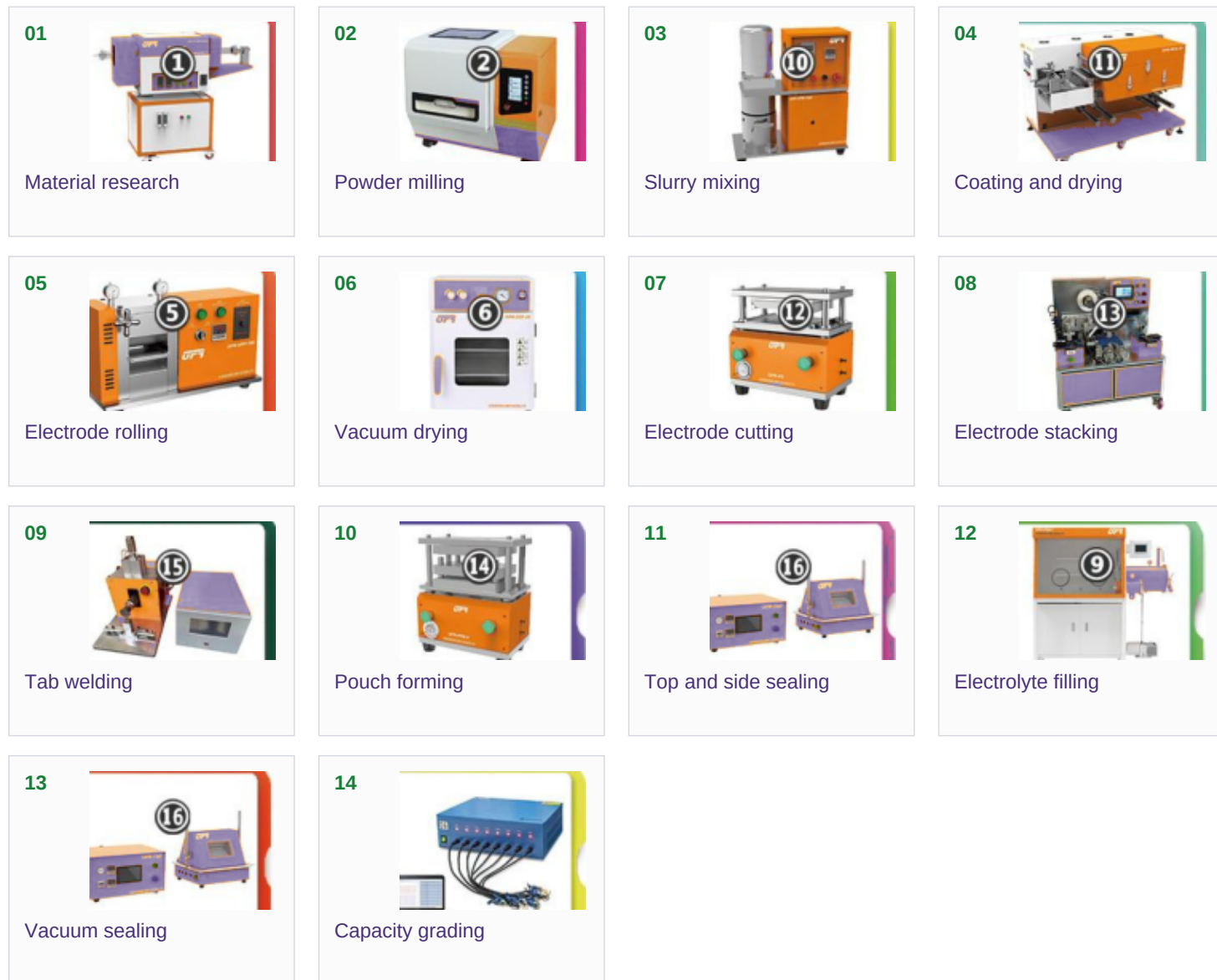
Laboratory equipment for electrode preparation, cell assembly and testing.

01  Material research	02  Powder milling	03  Slurry mixing	04  Film coating
05  Slurry deaeration	06  Coating and drying	07  Electrode rolling	08  Vacuum drying
09  Disc punching	10  Ultrasonic cleaning	11  Electrolyte filling	12  Cell assembly
13  Cell crimping	14  Capacity grading		

Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.

Pouch-cell fabrication

Laboratory workflow for electrodes, pouch assembly, sealing and testing.



Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.

Cylindrical-cell fabrication

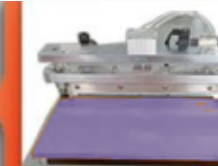
Laboratory workflow for cylindrical cell preparation, assembly and testing.



Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.

Pilot-scale pouch-cell line

Equipment sequence for pilot-scale soft-pack battery production.

01  Vacuum mixing	02  Electrode coating	03  Electrode rolling	04  Continuous slitting
05  Vacuum drying	06  Die cutting	07  Tab welding	08  Pouch forming
09  Top and side sealing	10  Electrolyte filling	11  Pre-sealing	12  Formation
13  Degassing	14  Final sealing	15  Trimming	16  Vacuum resting
17  Formation and grading	18  Capacity grading		

Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.

Pilot-scale prismatic-cell line

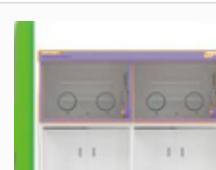
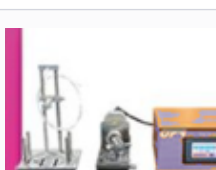
Equipment sequence for aluminium-case prismatic battery production.

01  Vacuum mixing	02  Electrode coating	03  Electrode rolling	04  Continuous slitting
05  Vacuum drying	06  Die cutting	07  Tab welding	08  Stacking
09  Stack assembly	10  Current-collector welding	11  Leak testing	12  Housing assembly
13  Electrolyte filling	14  Vacuum drying	15  Laser welding	16  Cell cleaning
17  Formation and grading	18  Capacity grading		

Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.

Pilot-scale cylindrical-cell line

Equipment sequence for pilot-scale cylindrical battery production.

01  Vacuum mixing	02  Electrode coating	03  Electrode rolling	04  Continuous slitting
05  Vacuum drying	06  Electrode slitting	07  Cell winding	08  Tab welding
09  Bottom spot welding	10  Groove rolling	11  Cap spot welding	12  Leak testing
13  Electrolyte filling	14  Cell crimping	15  Vacuum sealing	16  Formation and grading
17  Capacity grading			

Typical equipment sequence. Final configuration depends on cell chemistry, capacity and process requirements.