驰 诚 真 空

Ion Coating Equipment

Using Instruction

CCZK-HT-MODEL

Factory No.：

Production Date：

Preface

Dear User:

Thank you for purchasing and using the high-quality, high-performance vacuum coating equipment manufactured by Jiangsu Cicel Vacuum Technology Co., Ltd. This equipment is a special mechanical device for surface coating and surface modification of workpieces under a specific vacuum environment, involving professional knowledge of vacuum, machinery, electrical engineering, etc. To ensure safe, correct installation, operation and maintenance of this equipment, and to give full play to its performance, please read this manual carefully before use. Please strictly follow the requirements of this manual to prepare water, electricity and gas to ensure efficient and stable operation of the equipment and create greater economic benefits for you.

This manual covers equipment introduction, basic specifications, main structural components, basic manual operation procedures, automatic coating processes and pre-preparations, operation precautions, as well as identification and troubleshooting of common faults, enabling users to quickly get started and use the equipment in a standardized manner.

Due to technological advancements and continuous product updates, our company reserves the right to modify the content of this manual without prior notice. The content of this manual shall not constitute part of any sales contract or agreement.

⚠Safety Warnings:

- Operators of this equipment must receive professional training and understand the equipment structure, working principles and safe operation procedures.
- Equipment installation, commissioning and electrical maintenance must be performed by professional technicians.
- Do not insert any part of your body into the vacuum chamber while the equipment is running.
- The equipment must be reliably grounded with a grounding resistance of less than 4Ω.

- In an emergency, immediately press the **[Emergency Stop]** button to terminate equipment operation.

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Chapter 1 Introduction

1.1 Equipment Overview

CCZK-HT is an ultra-hard coating machine that employs multi-arc ion plating technology, which introduces gas discharge into the vapor deposition process so that the entire coating process takes place in a plasma environment, thereby achieving high-performance film layers. It features PLC intelligent control and an HMI full-color touch interface for fully automatic logic control. The system includes abnormal alarm and protection functions, a 550°C PID - adjustable temperature control heating system, multi-channel mass flow control for process gases, and an ultimate vacuum level of 5.0×10^{-4} Pa.

It is primarily used for depositing ultra-hard functional coatings on materials such as metals, glass, and ceramics. Its core value lies in applying high-hardness, wear-resistant coatings to various tools and components through multi-arc ion plating technology, significantly extending their service life.

Equipment Advantages：

1. Long-life corrosion-resistant vacuum chamber

The vacuum chamber is constructed entirely from SUS304 stainless steel, offering excellent corrosion resistance and contamination resistance to ensure long-term stable operation. The built-in double-layer cooling water jacket design provides high cooling efficiency and effectively reduces the thermal radiation impact on workpieces.

2. High-density and uniform film layers

Equipped with multiple arc ion sources and a filtration system, the unit effectively filters out large molten droplets, resulting in denser and more uniform coatings, significantly improving coating quality.

3. Superior film adhesion strength

Fitted with a high-power pulsed bias power supply, the system delivers high ion energy and remarkable ion bombardment cleaning effects, ensuring strong film adhesion and a smooth surface finish.

4. High-efficiency and stable vacuum system

The vacuum system comprises a high-performance pumping unit including a molecular pump, a Roots pump, an imported direct-drive pump, a holding pump, and an optional cryogenic pump. It achieves an ultimate vacuum level of 5.0×10^{-4} Pa, with fast pump-down speed and high vacuum stability.

5. Precise temperature control for versatile processes

The 550° C PID-adjustable heating system enables precise temperature control, meeting the process requirements for a wide range of super-hard coating systems such as TiN, ZrN, TiAlN, and CrN.

6. Coating hardness far exceeding conventional steels and cemented carbide substrates

For example, TiN coatings reach approximately 2000 HV, and AlTiN coatings can achieve up to 3500 HV. The wear-resistant protective coatings applied to tool surfaces,

with thicknesses ranging from 5 to 10 μm, greatly enhance wear resistance and anti-abrasion performance..

1.2 Main Technical Parameters

No.	Item	Specification
1	Vacuum Chamber Dimensions	（Subject to actual conditions）
2	Effective Coating Space	（Subject to actual conditions）
3	Vacuum Evacuation Time	<10-15 min (evacuating an empty, clean chamber at room temperature from atmospheric pressure to 8.0×10^{-3} Pa; varies with process parameters)
4	Bias Power Supply (PBP Series Pulse Inverter Bias Power Supply, Xinda Shenzhen)	
	Input Voltage	380VAC ±10% (3-phase, N)
	Input Frequency	50/60 Hz
	Maximum Output Power	30 KW
	Maximum Output Voltage	0 - 500V / 0 - 1000V
5	Arc Ionization Source and Power Supply	
	Cathode Arc Ionization Source (HB-100)	Φ100 × H40mm
	DC Inverter Power Supply (CCZK-HT)	MAX250A
6	Gas Supply System	4-channel gas mass flow control system (D07-19B series, Omron Japan/Qixing Huachuang)
7	Workpiece Electric Heater	Tubular high-power stainless steel heater; power supply designed to support normal operation of all heating tubes
8	Workpiece Rotating Rack	Equally divided planetary rotation; suitable for coating small or tubular substrates; basic equal division distance: equally divided rotation diameter
9	Coating Cycle	4－6 hours (cooling time: 3－5 hours; the furnace door can be opened when the temperature reaches 50－80° C).

10	Operating temperature	Approximately 450° C (may vary depending on product requirements).
11	Ultimate Vacuum	5.0×10^{-4} Pa (empty, clean chamber at room temperature)
12	Total Power	KW (varies by model)/380V/50Hz
13	Total Weight	Approx. 10-30 ton

1.3 User Installation Preparation

(1) Power Distribution System

- Maximum total power requirement: 200-400 kW (consult CICEL staff for actual installed power)
- Power system: 3-phase AC 380V 50Hz
- Air switches must be suitable for motors and withstand higher starting currents
- Distribution cabinets must comply with national and local safety codes, provided by the end user
- Install near the main equipment in the workshop

(2) Cooling Water System

- Use soft water, preferably deionized or distilled water
- Cooling water temperature: ≤25℃
- Take anti-freezing measures if ambient temperature drops below 0℃ in winter
- Use an ice water machine or cooling tower for constant temperature control
- Circulating pump must provide sufficient flow and pressure; standard pressure range: 0.2~0.3 MPa

(3) Compressed Air and Process Gas

- Compressed air flow: ≥0.1 m^3/min
- Pressure: 0.4~0.8 MPa
- Compressed air must be oil-free and dust-free
- Inlet pressure to equipment: 0.5-0.6 MPa
- Process gas: High-purity N_2, Ar, O_2, C_2 H_2 (purity ≥99.99%)

(4) Foundation

Level site with maximum inclination ≤2° ; reserve anchor bolt holes per equipment foundation drawing

★ **Note:**

- 380VAC voltage fluctuation ≤±5%
- Cooling water inlet temperature: 18-25℃, temperature difference between inlet and outlet: 3-5℃; use soft water to reduce pipeline scaling
- Install oil-water separators on compressed air pipelines; pressure: 0.4-0.8MPa

Chapter 2 List of main components and maintenance instructions for main parts

2.1 Composition of Equipment Accessories

Vacuum Furnace Body	ID mm*IH MM
Anti-Fouling Liner	SUS304 1.0mm

Top Rotating Mechanism	SUS304/Q235
Multi-Arc Ionization Source	HB-100
Arc Power Supply	CCZK-IGBT-MAX250A
Bias Power Supply	PBP series
Multi-Arc Target	Titanium Target
Gas Flow Valve	D07-19B
Vacuum Gauge	ZDF-5227
Furnace Heating System	Stainless Steel Sheathed Heating
Vacuum Rotary Vane Pump	2X-70/Leibo
Roots Pump	ZJP-1200
Holding Pump	2X-30
Automatic Control Cabinet System	Supports manual, automatic and semi-automatic operation

2.2 Maintenance Instructions for Main Components

(1) Daily Vacuum Chamber Cleaning

- Wear a dust mask to avoid inhaling dust during cleaning
- Confirm workpiece electric heater is off and at room temperature
- Check for workpiece fixtures inside the chamber
- Blow the rotating rack, chamber liner and heater tubes with a high-pressure air gun
- Remove dust from the chamber with an industrial vacuum cleaner
- Clean the front door flange and rubber seal with alcohol
- Close the front door

Note: Clean the inner anti-fouling plates every 15 days of continuous use; polish with an abrasive wheel when removing.

(2) Roots Pump Maintenance

The Roots pump accelerates vacuum evacuation and effectively removes moisture in low vacuum stages (especially humid summer). It is controlled indirectly (logically) in automatic and manual modes. Refill the oil cup with vacuum pump oil regularly (consult the manufacturer for oil type).

Main maintenance and servicing items:

- Keep the pump clean with good ventilation and heat dissipation
- Check oil quality monthly; replace oil if discolored, diluted or emulsified
- Replace oil after running the pump for 1 hour to warm the oil; vent the pump before draining oil
- Do not mix other oils or water into lubricant to avoid impairing ultimate pressure

(3) 2X/H Series Rotary Vane/Slide Valve Mechanical Pump Maintenance

• Operates at atmospheric or vacuum pressure, only achieving low vacuum

• Contact experienced technicians for abnormal noise; do not disassemble the pump body

• Refill oil to the maximum level if below the minimum mark on the oil sight glass

• Keep the pump clean; do not place objects on it

• Adjust belt tension every six months

•Monitor pump, cooling water and oil temperature (max ≤80℃); cooling water inlet ≤30℃, outlet ≤40℃; keep water clean

• Drain cooling water if ambient temperature <5℃ to avoid freezing and pump damage

• Use SH0528-92 N100 vacuum pump oil (N68 if ambient temperature <15℃)

• Run the pump for 1 hour every 7-10 days if unused for long periods to prevent internal rust

• Check pipeline connections for leaks

• Replace oil after 150 hours of initial operation, then every three months; shorten intervals in humid/polluted environments

• Replace oil if blackened (dirty) or milky (water-contaminated)

(4) Workpiece Rotating Rack Maintenance

• Perform overall maintenance every ~50 coating cycles

• Disconnect bias cable; measure resistance between fixture and chamber body with a 1000V megohmmeter (≥100 MΩ during 1 minute rotation at atmospheric pressure)

• Replace bearings annually (vacuum environment shortens service life)

• Investigate abnormal scraping noise immediately

(5) Workpiece Fixtures

• Fixtures designed/manufactured by local professional manufacturers per requirements

• Key Design Rules:

- Max loading diameter ≤ design rotation diameter of hanging rods
- Uniform balanced loading to ensure bearing capacity
- No sharp edges to avoid operator injury

(6) Troubleshooting Abnormal Discharge of HB-100 Ionization Source

Negative voltage on auxiliary anode plate/ignition pin is caused by absorbing electrons from plasma. Common causes and solutions:

• Auxiliary anode plate too close to plasma: adjust position

• Ignition pin tip too close to target or coated with metal: remove buildup, adjust gap

• Target edge damage: machine edge for smoothness

• Faulty ignition system resistor or tripped air switch: replace/reset

• Excessive magnetic field strength: move permanent magnets backward

• Auxiliary anode plate touching target: adjust for uniform gap

• Burned parts under anode plate: inspect and repair

• Poor chamber conductivity (black coating): normal; voltage stabilizes over time

• Misaligned magnets causing deep target grooves: adjust magnet position

(7) Daily Maintenance of HB-100 Ionization Source

Perform daily maintenance for each cathode arc ionization source:

• Wear a dust mask

• Confirm heater is off and at room temperature

• Blow gaps between ionization source, target, auxiliary anode plate, ignition pin and flange with high-pressure air gun

• Measure resistance between cathode and flange (auxiliary anode plate): ~28 Ω (connected), >100 MΩ (disconnected); clean if abnormal

• Adjust ignition pin gap to target surface: ~8 mm

(8) HB-100 Evaporation Source Target Materials and Replacement

As the discharge evaporation process consumes the target material, the target will gradually become thinner. At this point, the auxiliary anode (ring) plate should be adjusted downward accordingly. The target materials installed on the cathode arc evaporation source and the magnetron sputtering source are consumable materials, and the amount of target material consumption varies depending on the actual coating application. Pure Ti, pure Zr, pure Cr, pure Ni, pure Al, pure gold, and their alloys can all be used as target material. CICEL Company can promptly provide various different target materials according to the final user's requirements.

Chapter 3 Safety Requirements

Due to safety reasons and the requirements of the CE standard, the manufacturer strongly recommends that the equipment should be installed according to the layout shown in the equipment layout diagram, and the equipment should be placed separately in two separate rooms (some large top-opening equipment requires double layers, with the upper layer providing operation space and the lower layer being the equipment placement area): The operation room and the equipment room should be isolated by walls, steel plates or fences and locked. (The upper and lower layers of equipment should be designed with stairs and an emergency exit on the lower layer.)

To avoid any unforeseen risks to maintenance personnel, operators and people around other equipment during the operation of the CCZK-HT equipment, the following suggestions and requirements are provided:

1. We always insist that only personnel with equipment maintenance skills can carry out the maintenance guidance work for the equipment.

2. Always close and lock all power cabinets, central control cabinets, ear cabinets, vacuum chamber bases, and service cabinets. Close and secure all covers on them.

3. Equipment operators and other personnel are not allowed to open and disassemble all power supplies, central control cabinets, vacuum chamber ear cabinets, vacuum chamber base covers, cable junction boxes, as well as the covers of the motor drive units and all motor junction boxes.

4. Operators and other personnel are not permitted to perform the following operations:

• Disconnect the cooling water pipes, compressed gas pipes or reaction gas input pipes;

• Adjust the cooling water flow of all pipelines;

• Adjust the pressure of the compressed gas in the equipment;

• Adjust the pressure of the reaction gas input of all pipelines.

5. In order to enter the vacuum chamber for any purpose, the following must be ensured beforehand:

• Put on a complete dust-proof suit and wear protective gloves;

• Wear a dust-proof mask over the mouth and nose;

• Confirm that there are no workpieces or fixtures in the vacuum chamber;

• Confirm that the electric heater tube is at room temperature (not heated and has cooled down);

• Ensure that there are other staff members present to watch over when entering the vacuum chamber, and do not allow any form of closing operation of the equipment.

6. To ensure the health of the staff in the workshop, the gas discharged from the primary extraction pump and the pre-stage pump should be discharged outside the workshop.

7. For experienced maintenance personnel:

•First, turn off the air switch on the central control cabinet, then you can open its front/back door or remove its guard plate;

• No matter which power cabinet's front door or cover plate you want to open, you must first turn off the air switch on the front panel of it.

• There are warning signs on the front/back doors and side panels of the central control cabinet, all pump motor cable junction boxes, the ear cabinet door of the vacuum chamber, and the side panels of the vacuum chamber base frame: high voltage, 380V AC or 220V AC. First, turn off the air switches on the central control cabinet and the related power cabinets before opening their front doors or covers.

• Before performing any operation to cut off the water cooling pipeline, first check whether the related cooling components have been turned off, and manually close the corresponding branch valves in sequence.

• Before performing any operation to cut off the compressed air pipeline, first

check whether all pneumatic drive valves are in the closed state.

• Before performing any operation to cut off the process gas input pipeline, first check whether the related mass flow meters are closed and close the connected reaction gas cylinders.

• The pressure setting of each process gas should be constant at 0.1 MPa, and should not exceed 0.15 MPa.

• The cooling water pressure setting of the CCZK-HT series is between 0.2 and 0.25 MPa, and should not exceed 0.3 MPa. High water pressure will damage the water jacket of the vacuum chamber.

• The compressed air of the CCZK-HT series should be set between 0.5 and 0.6 MPa, and should not exceed 0.8 MPa. High pressure is likely to cause leakage at the connection point of the air pipe.

• During each overall maintenance of the equipment, check that all large-sized metal bodies (pump plates or supports, service cabinets) have been connected to the vacuum chamber base frame with a 6 mm^2 yellow-green PE wire, and the resistance between them and the ground should be less than 5 Ω during each overall maintenance of the equipment.

Things to note during operation:

• When the HB-100 arc evaporation source is in operation, there is a high negative voltage on its negative electrode. Operators and any other personnel are not allowed to move the electrode wire plug, cooling water pipe, or compressed air pipe from the HB-100 arc evaporation source. Before starting any HB-100 arc evaporation source, the ear cabinet doors on both sides of the vacuum chamber must be closed and locked.

• Although the maximum rotation speed of the turntable has been set to a very low rpm value before shipment of the equipment, it is still necessary to be vigilant of the potential harm to the operator during the rotation of the turntable. When the front door of the vacuum chamber is opened, the turntable will rotate at a low speed by itself only if the foot switch beside the front door of the vacuum chamber is held down; otherwise, it will stop.

• The internal temperature of the vacuum chamber can reach 550℃! When the temperature is higher than 200℃, the operator should not release the atmosphere in the vacuum chamber. Nitrogen (HB-100 off state) can be filled into the vacuum chamber to accelerate the cooling process.

• As the temperature inside the vacuum chamber remains elevated, operators are required to don heat- resistant gloves prior to handling the racks and workpieces.

• The heater tubes of the workpieces in the vacuum chamber may be at high temperatures. To prevent or reduce the adsorption of water vapor from the atmosphere on the inner walls of the vacuum chamber, the heater in the vacuum chamber can be activated when the front door is opened. Operators must always be vigilant to prevent being burned.

• The vacuum chamber is highly contaminated with dust! When cleaning the interior of the vacuum chamber, use vacuum chamber cleaner or high-pressure air gun. Operators need to do the following: wear a dust mask on the mouth and nose; put on a complete set of dust-proof suit and heat-resistant gloves; confirm that there are no workpieces and fixtures in the vacuum chamber; avoid direct contact with any part of the vacuum chamber, as they may still be at high temperature.

Chapter 4 Overall Equipment Operation Procedure

4.1 Main Control Touchscreen Panel

Vacuum Gauge

The vacuum gauge unit is used to control and display the composite vacuum gauge.

• In manual control mode (without pressing the AUTOMATIC button): The vacuum gauge [ON] button is used to start and stop the vacuum gauge.

• In automatic control mode, the vacuum gauge is automatically controlled by the coating machine system.

Rotation

• Manual/automatic control of rotating rack start/stop

Heating System

The HEAT unit is used for heating the vacuum chamber and temperature control.

In the "MANU" mode, after setting the heating temperature in the green window, the workpiece transfer frame will automatically rotate. Then, by pressing the "ON" button, the heating power can be turned on or off.

4.2 Bias Power Supply Control Panel

On its control panel, there is an "ON" button, a low-high voltage conversion function, a green voltage window and a green duty cycle window for setting the power supply working status.

【ON】 Button:

In the "MANU" mode, when the current door is locked, pressing the 【ON】 button will activate the bias power supply; otherwise, it will have no effect.

Green Voltage Window:

In the "MANU" mode, the voltage value can be set in the green voltage window. You can also change the voltage setting value by holding down the up and down arrow buttons on the right side of the green setting area to adjust the negative bias voltage on the workpiece in the vacuum chamber.

Green Duty Cycle Window:

In the "MANU" mode, the duty cycle (0-90%) can be set in the green duty cycle window (R). You can also change the set duty cycle by holding down the up and down arrow buttons on the right side of the green setting area to adjust the pulse duty cycle (0-90%) on the workpiece in the vacuum chamber. In the "AUTO" mode, this green window does not function.

4.3 Cathode Arc Source Control Panel (HB100)

- MANU mode: ON start/stop; current 30-200A setting
- AUTO mode: automatic on/off; manual current adjustment; manual override triggers alarm

4.4 System Startup

- Press POWER ON for 2-3 seconds to energize; indicator lights up

• Log in: Username: 1, Password: 1879 (varies by equipment)

4.5 Pre-Start

• Check air compressor operation

• Verify cooling water circulation

• Confirm high vacuum valve V3 closed

• Start water pump

• Start holding pump

• Start Molecular pump heating

• Preheat ~70 minutes to reach ~200℃

4.6 Workpiece Loading

1. If the vacuum chamber is in a vacuum state, the air should be released first. After about five minutes, the front door will be opened.
2. Remove the already plated workpieces and then load the workpieces to be plated into the vacuum chamber.
3. Close and lock the front door of the vacuum chamber.

Note: The operator should wear heat-resistant gloves when loading and unloading the workpieces, as the workpieces may have high temperatures. When the front door of the vacuum chamber is opened, pay special attention to the heating tubes of the workpieces, as they may be in a heating state! Always be careful of the fixtures in the vacuum chamber. When the foot pedal switch in front of the vacuum chamber door is closed, the fixtures will rotate.

4.7 Furnace Heating Start

Activate heating system (Heating conditions can be selected as per requirements, including opening-door heating / closing-door heating)

4.8 Low Vacuum Pumping

1. Press the [ROUGH] coarse extraction button (the [ROUGH] indicator is on);
2. Adjust the potentiometer of the throttle valve to the fully open position (100);
3. Press the [V1] button (the "V1" indicator is on);

4. At this point, the roughing pump evacuates the vacuum chamber to achieve a low- vacuum pumping state.

If necessary, first start the rotation of the workpiece turntable, set the temperature on the temperature control panel, and then press the [HEAT] heating button to heat the workpiece inside the vacuum chamber.

4.9 High Vacuum Evacuation

- Close V1 at ~4 Pa
- Open V2
- Open V3
- Evacuate with molecular pump

4.10 Ar gas glow discharge

1. When the molecular pump or diffusion pump system reduces the vacuum to 1×10^{-2} Pa, adjust the throttle valve potentiometer to 15 or lower;

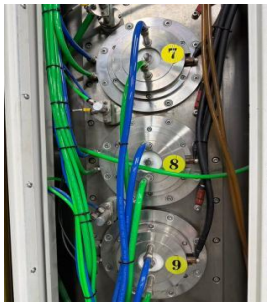
2. Adjust the gas intake volume of Ar to the set value, and the system will automatically adjust V4 to achieve a vacuum degree of approximately 1-2 Pa (Vacuum Control Mode 2);

3. Turn on the bias power supply, and gradually increase the negative bias voltage uniformly to -500V and then to -1000V within five minutes. At this time, there will be a blue-purple glow discharge phenomenon in the vacuum chamber.

4.11 Re-Evacuate High Vacuum Ion Bombardment Etching Process

A negative bias voltage is applied to the vacuum chamber, and argon gas is introduced to generate high- energy ion bombardment. This process leaves no chemical residues and is a standard pre- treatment step for PVD tool coating. It enhances coating adhesion and improves coating uniformity.

- Turn on etching and bias power.
- Adjust the bias voltage level according to process requirements.
- Etching Time: 30 min (actual duration varies depending on different processes); Current: 60–80 A



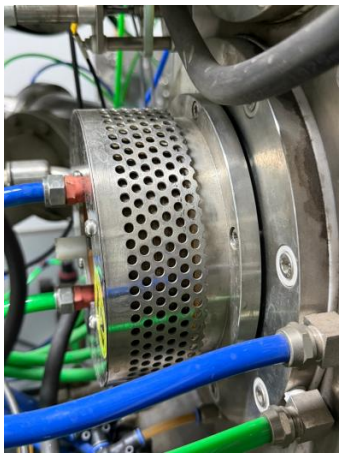
4.12 HB-100 Main Arc Bombardment

- Throttle valve to coating position (100)
- Set Ar/N_2 flow (30/100 sccm); start rotation
- Set bias to 300V
- Activate arc sources sequentially
- Hold for surface cleaning
- Adjust N_2 flow for stable discharge

4.13 Dynamic Dual Magnetic Arc Source (with Excitation Coil)

The controllable magnetic field confines the arc spot to prevent erratic movement, increases the arc spot rotation speed, reduces the splashing of large metal droplets, and simultaneously constricts the plasma beam. This achieves an optimal balance among coating smoothness, deposition rate, and coating adhesion.

Use during the coating process; switch it on or off according to product requirements.



4.14 HB-100 Arc Source Coating

1. Adjust the potentiometer of the throttle valve to the required position;
2. Reduce the bias voltage (BIAS) to a specific voltage (the bias power supply voltage can be lowered to the desired voltage in several steps);
3. Adjust the intake of I to IV circuits to maintain a specific vacuum degree;
4. Turn on or off each group of cathode arc ionization source (HB-100);
5. Set the coating time as required by the product specifications.

4.15 Workpiece Unloading

1. Once the coating process is completed, turn off all the cathode arc ionization sources.
2. Shut off the workpiece electric heater.
3. Turn off the workpiece bias voltage.
4. Adjust each gas supply to 0 and then shut down the gas supply system.
5. Raise the "V3" button (the "V3" indicator light goes out).
6. Raise the "V2" button (the "V2" indicator light goes out), and simultaneously turn off the Roots pump (the "Roots" indicator light goes out).
7. If the vacuum chamber needs to be shut down for more than 20 minutes, it is recommended to turn off the rough pumping pump (the "Rough" indicator light goes out) to avoid the pump running for a long time and wearing out.
8. When the temperature drops to approximately 60-80℃ of the preheating temperature, press the "VENT" button to release the vacuum in the chamber.
9. Open the front door of the vacuum chamber.
10. Remove all the coated workpieces

4.16 Shutdown (Power Off)

If all tasks have been completed, Approximately 2 hours later, the system will automatically shut down all parts of the equipment and power off (the equipment shutdown time can be adjusted. Please follow the training and operation guidance provided by our engineers).

Chapter 5 Manual Coating Operation

5.1 Standard Manual Coating Process

Step 1: Turn on the main control cabinet power

Close the air switch of the main control cabinet and turn on the power of the main control cabinet

Step 2: Power On the System

Press the "Power On" button on the main control cabinet panel labeled "Total Power On" and hold it for 3 seconds. The system will power on.

Step 3: Log in to the touch screen system

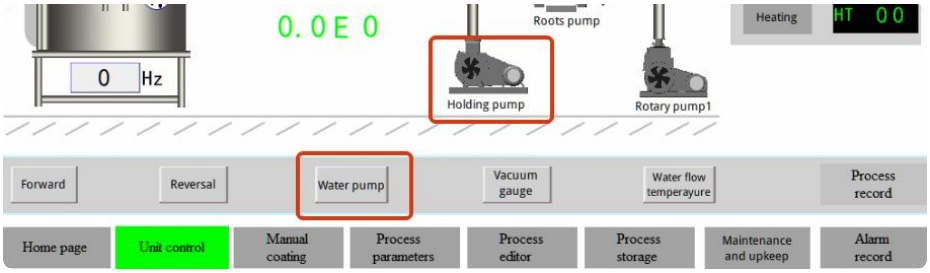
Log in to the touch screen system.

Username: 1 Password: 1879 / Username: 2 Password: 188

Step 4: Start the Molecular pump

Press the "Molecular Pump" image button. Once the molecular pump reaches its operating speed, wait for 15 to 20 minutes.

Note: Before pressing the [Maintain Pump] button, make sure the compressed air system has been started and the working pressure is normal. After pressing the [Pump] button, confirm that the pressure and flow of the circulating cooling water are normal before proceeding to the next step.

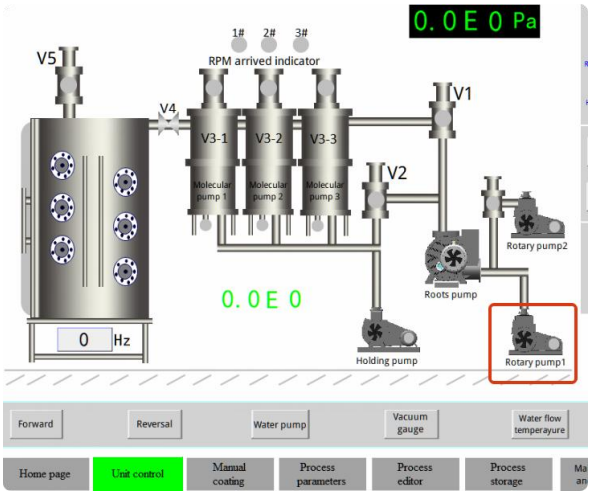


Step 5: Start preheating of the diffusion pump

Press the "Diffusion Pump" image button, and the diffusion pump begins to preheat. Wait for 1 hour until the temperature reaches around 200℃.

Step 6: Start the coarse suction pump

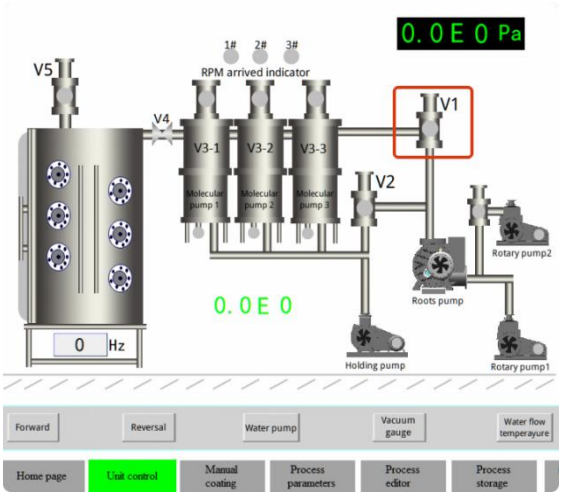
Press the 【Coarse Suction Pump】 button on the touch screen, and the coarse suction pump will start.



Step 7: Close and lock the front door of the vacuum chamber

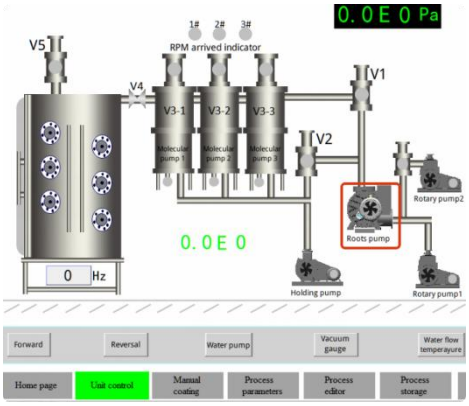
Step 8: Activate the upper valve V1

Press the [V1] button to activate the upper valve;



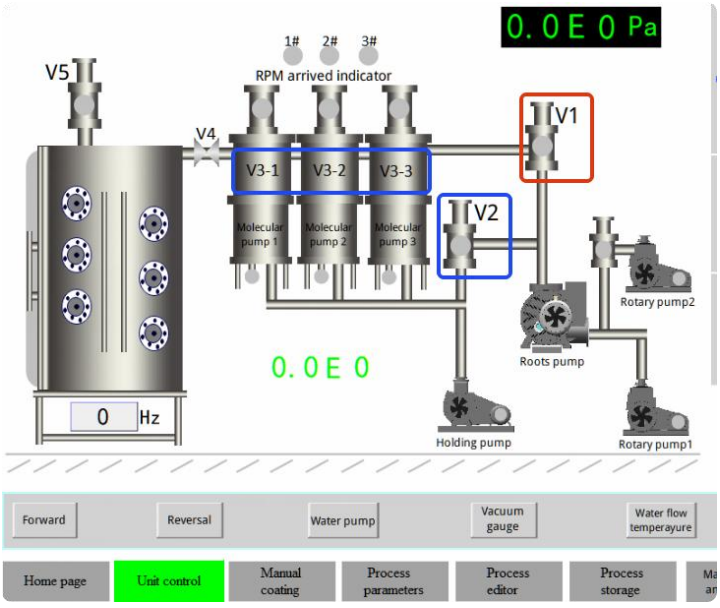
Step 9: Start the Roots pump

Observe that the vacuum gauge shows a vacuum degree of $7.0*10^{2}$ pa. Press the [Roots pump] button to start the Roots pump;



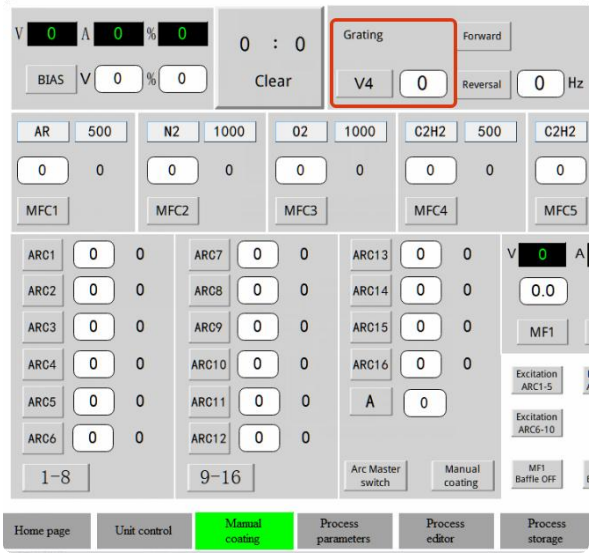
Step 10: Switch to high vacuum pumping

When the vacuum level reaches 3.0 * 10⁰ Pa, turn off the [V1] button; press the [V2] button to open the lower valve; wait for 3 seconds, then press the [V3] button to open the main valve;



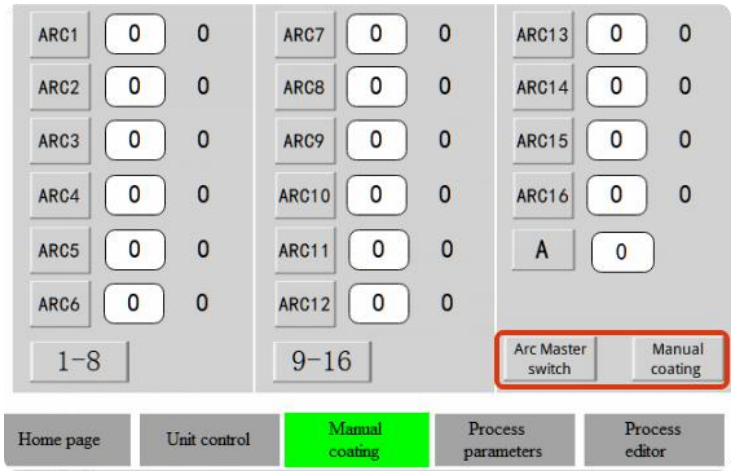
Step 11: Adjust the throttle valve

When the vacuum level reaches 7.5 x 10⁻ ³ Pa, adjust the throttle valve [V4] to 50%.



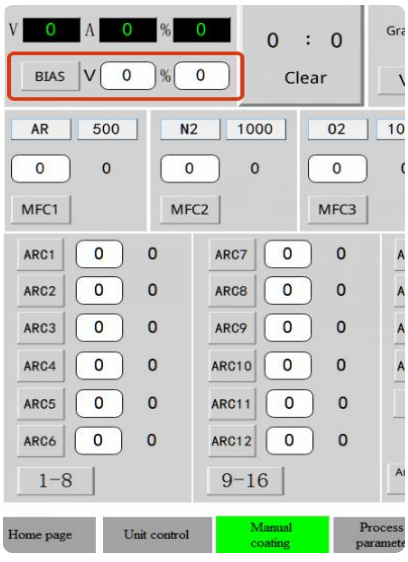
Step 12: Start the arc main switch and manual coating mode

Turn on the [Arc Main Switch] and [Manual Coating], and the turntable will automatically run

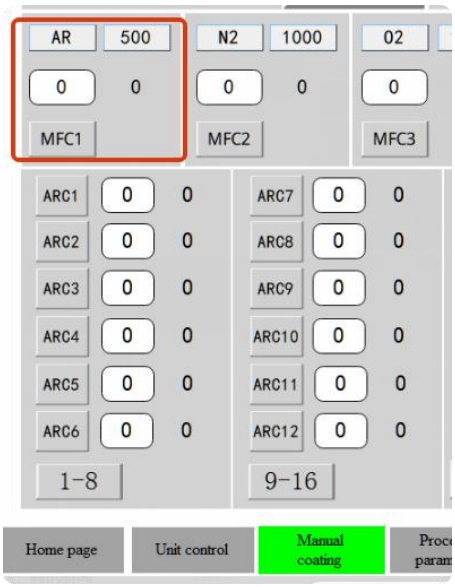


Step 13:Etching Process: Set bias voltage and perform cleaning via Ar ion glow discharge.

Configure the BIAS power supply; adjust the voltage to 500 – 800 V with a duty cycle of 50%.

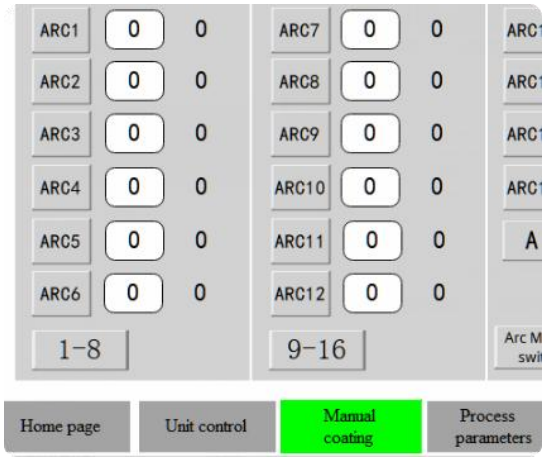


Then adjust the Ar gas flow via MFC and set the flow rate to 100 – 200. Once the vacuum pressure reaches 1.0 Pa, switch on the bias power supply. Ignite the arc source with current set to 60 A. This process step is defined as etching, which normally lasts 20 to 30 minutes.



Step 14: Main Arc Bombardment (Surface Activation)

Change the AR gas to 40-60, adjust the voltage to 300V, 50%. When the vacuum degree reaches around $1.0*10^{-1}$ Pa, turn on the arc head. Start 3-5 arc heads simultaneously, turn on for 20 seconds and then turn off. Then start the next group, continue in sequence until all are completed. This step utilizes high-energy particles to bombard and activate the surface of the workpiece, increasing adhesion.



Step 15: Product base layer and coating

Set the BIAS bias voltage to 100V, 50%, change the AR gas to 60, and when the vacuum degree reaches $2.0*10^{-1}$ Pa, fully open the arc head. After about 1 minute, turn off the AR gas and turn on the N2 gas. When the vacuum degree is $5.0*10^{-1}$ Pa,

the gold coating is completed after 3 minutes of coating.

Note: Different target materials and gases can be selected according to the product requirements for coating.

5.2 Equipment Shutdown

1. After the coating process is completed, turn off all the CCZK-HT arc power supplies;
2. Shut off all MFC, BIAS bias voltage, all V3, V2, [Roots pump] roto pump, wait for 5 seconds, then turn off all coarse pumping pumps [Rotary pump];
3. Turn off the vacuum gauge on the touch screen;
4. Press the [V5] button to release the vacuum chamber;
5. The entire manual coating test process is completed.

Chapter 6 Automatic Coating Operation

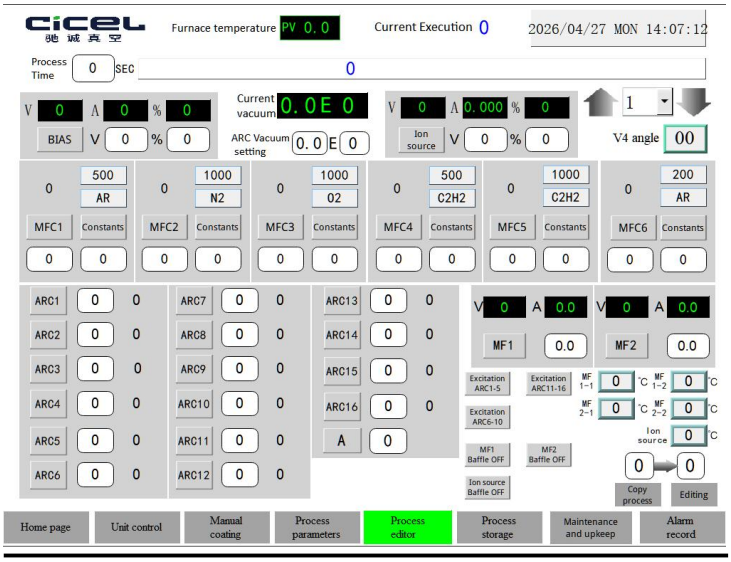
1. Turn on the touch screen (The prerequisite is that water, electricity and gas are available, and the rotational speed of the molecular pump reaches this level within 10 to 20 minutes.);
2. Enter the [Process Management Interface - Process Storage], select to call a pre-stored process [Process Call];
3. Return to the main interface and press the [Automatic] button on the touch screen;
4. Close the equipment door (for side-opening equipment);
5. Carefully observe the operation of the equipment and confirm that it is working properly.

Chapter 7 Process Editing, Setting and Recording

7.1 Process Parameter Editing

This interface is the parameter editing page for the coating machine, used to create

and set up a complete automated coating process program. Operators can define the entire process conditions here, including process flow, gas flow rate, power parameters, target position control, etc. This enables the solidification of mature coating processes into standardized formulas, achieving repeatable, traceable and automated operation in the production process.



Parameter Area Descriptions:

• BIAS Bias Power Supply: Voltage, current, duty cycle settings / display for the workpiece bias voltage/current, used to control the ion bombardment energy and affect the adhesion and density of the film layer.

• Ion Source Power Supply: Voltage, current, duty cycle settings / display for the ion source, providing a stable ion beam current for ion cleaning and ion deposition.

• MF1/MF2 Intermediate Frequency Power Supply: Voltage and current settings / display for the intermediate frequency power supply of magnetron sputtering, corresponding to different target positions for power control, enabling the deposition of metal/compound film layers.

Gas Flow Control (MFC)

Channel	Gas	Purpose
MFC1	（Ar）	Used to generate plasma, maintain the sputtering environment, and provide the basic

Channel	Gas	Purpose
		working gas for coating fabrication
MFC2	（N_2 ）	Used for preparing nitride film layers, adjusting the flow rate can control the composition and color of the film layer
MFC3	（O_2 ）	Used for preparing oxide film layers
MFC4	（C_2 H_2 ）	Used for preparing carbide film layers, adjusting the flow rate can control the hardness and friction coefficient of the film layer
MFC5	（C_2 H_2 ）	Backup acetylene channel, which can be combined with MFC4 to achieve the flow ratio control of carbide film layers
MFC6	（Ar）	Backup argon gas channel, which can be used for process purging, auxiliary sputtering, and other scenarios

Process Examples

	Model	**Color**	**Target**
	Small machine(1416/1618)	**Rose Gold**	**Ti-Al Target**
Process	Cleaning: Start evacuating to 1.2×10^{-2} Pa and then inject AR gas for 30 seconds to reduce the vacuum to 5.0×10^{-2} Pa for arc head ion cleaning. Turn on the bias voltage, set the voltage at -300, percentage at 50. There are a total of 16 arc heads, and 4 arc heads are turned on each time for 4 cycles. The operation lasts for 30 seconds. Work all the arc heads in sequence.		
	Base layer: AR gas pressure 80, bias voltage: voltage -100%, percentage 50%, vacuum maintained at 2.0×10^{-1} Pa , all arc heads on for 120 seconds;		
	Coating: Bias voltage: voltage -80%, percentage 50%, turn off AR gas, turn on N_2 gas, range 200-500, reduce vacuum to range 2.0×10^{-1} Pa, coat for 180 seconds, release gas and remove product;		
	Large machine(2330/2040)	**Rose Gold**	**Ti-Al Target**
Process	Cleaning: Start pumping to 1.2×10^{-2} Pa, then inject AR gas for 30 seconds to reduce the vacuum to 5.0×10^{-2} Pa. Perform ion cleaning on the arc head, turn on the bias voltage, set the voltage at -300 and the percentage at 50. Start 4 arc heads simultaneously, operate for 30 seconds, then activate all arc heads in sequence;		
	Base coating: Inject AR gas at 100/120, bias voltage: voltage -100, percentage 50, maintain vacuum at 2.0×10^{-1} Pa. Turn on all arc heads		

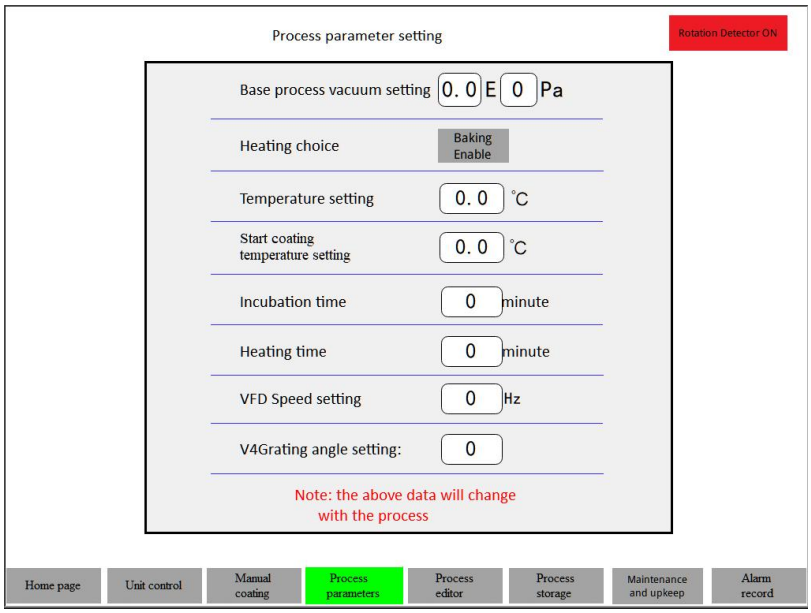
	for 120 seconds;		
	Coating: Bias voltage: voltage -80, percentage 50. Turn off AR gas and turn on N_2 gas, range 500-800. Reduce the vacuum to the range of $3.0\text{-}4.0\times10^{-2}$ Pa. Coating for 180 seconds; Release gas and remove the product;		
	Small machine(1416/1618)	**Black**	**Chrome target**
Process	Cleaning: Start pumping to 1.2×10^{-2} Pa and then inject AR gas for 30 seconds to reduce the vacuum to 5.0×10^{-2} Pa for arc head ion cleaning. Turn on the bias voltage, with a voltage of -300 percent at 50. There are a total of 16 arc heads. Open the opposite corners of the arc heads (half of the target material). Turn on one arc head at a time for 30 seconds, and do this 4 times.		
	Base coating: Inject AR gas for 80 seconds. Bias voltage: Voltage -100 percent at 50. Maintain vacuum at 2.0×10^{-1} Pa. Open the target material to half (more target material may affect the color). Turn on the arc heads for 120 seconds.		
	Coating: Bias voltage: Voltage -80, percentage 50. Turn off the AR gas and turn on C_2H_2 gas at 600-1600. (Gradually add it to reduce the vacuum to 5.0×10^{-2} Pa. After 7 minutes of coating, release the gas and remove the product;		
	Large machine(2330/2040)	**Black**	**Chrome target**
Process	Cleaning: Start pumping to 1.2×10^{-2} Pa and then inject AR gas for 30 seconds to reduce the vacuum to5.0×10^{-2} for arc head ion cleaning. Turn on the bias voltage, with a voltage of -300 percent at 50%. If there are 40 arc heads, open the opposite diagonal arc heads (half of the target material) 5 at a time. Work for 30 seconds, repeat 4 times.		
	Base coating: Inject AR gas for 80 seconds, bias voltage: voltage -100 percent at 50%, maintain vacuum at 2.0×10^{-1} Pa, open the target material to half (more target material may affect the color), open the arc heads for 120 seconds;		
	Coating: Bias voltage: voltage -80, percentage 50. Turn off the AR gas and turn on C_2H_2 gas at 1000-4000 (add it slowly to reduce the vacuum to 5.0×10^{-2} Pa. After 7 minutes of coating, release the gas and take out the product;		

7.2 Process Parameter Setting

This page is the interface for setting the process parameters of the coating machine, used to configure the key conditions such as vacuum, heating, speed, and gas path during the coating process. It is the core configuration module for achieving a stable

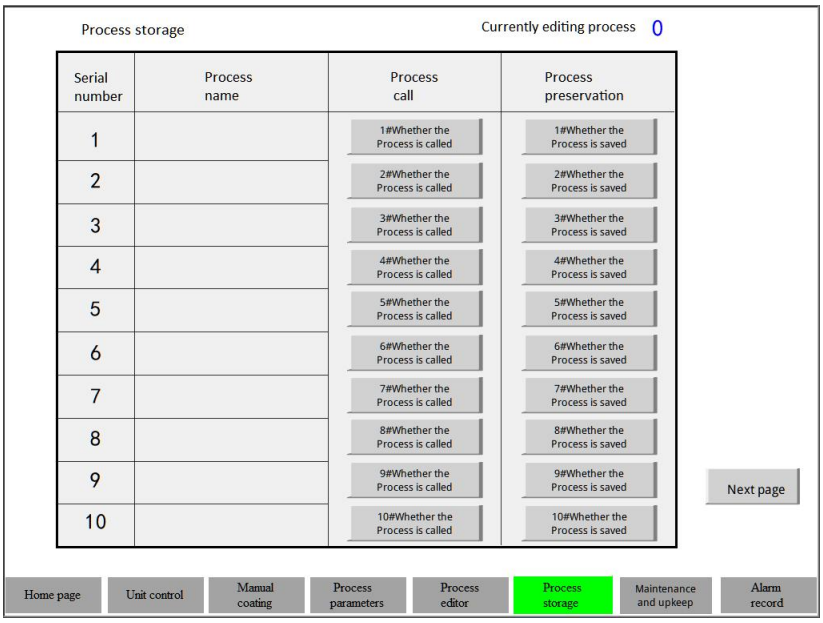
coating process.

Parameter	Description
Rotation Detection Switch	The red indicator shows the equipment status indication, indicating that the rotation detection function of the workpiece turntable has been enabled. The equipment will monitor the operation status of the turntable in real time. In case of any abnormalities, an alarm will be triggered to stop the machine, ensuring process safety.
Fine Vacuum	Displays the current pressure of the high vacuum chamber of the device, providing the basic vacuum environment for the coating process. High vacuum is a necessary condition for ion coating, which can prevent impurities from contaminating the coating layer and ensure the stability of ion bombardment.
Heating	Disable/Enable Switch. When disabled, the chamber heating function is turned off and no heating process is carried out; when enabled, the equipment will execute the chamber heating procedure according to the temperature parameters set below.
Temperature	The target temperature setting for the chamber heating should be determined based on the material of the workpiece and the requirements of the coating process. Generally, it is set at 450℃. If the temperature is too low, it may lead to insufficient adhesion of the coating layer. If it is too high, it may cause deformation of the workpiece.
Start Coating Temp	When the actual temperature of the chamber reaches the set value (generally between 400-500℃), the equipment will automatically unlock the coating process, which can prevent the membrane layer defects caused by the instability of ion bombardment at low temperatures.
Heating Time	The operating duration of the heating system is a read-only display item. It records the running time of the heating module in this process, usually ranging from 20 to 30 minutes.(If the constant temperature function is enabled, it will operate at the set temperature.)
VFD Speed	The speed setting value of the variable frequency drive (VFD) for the workpiece turntable is usually between 25-30 Hz. By adjusting the frequency, the speed of the turntable can be controlled, which directly affects the uniformity of the film layer.
V4 Throttle Angle	By adjusting the angle of the throttle valve, the flow rate of the process gas (such as argon or nitrogen) can be controlled to maintain a constant vacuum.



7.3 Process Management Interface

This interface is the process management interface for the coating machine, used for saving, calling up and managing the edited coating process formulas. It enables centralized archiving and rapid switching of process programs, ensuring the standardization and consistency of the production process.



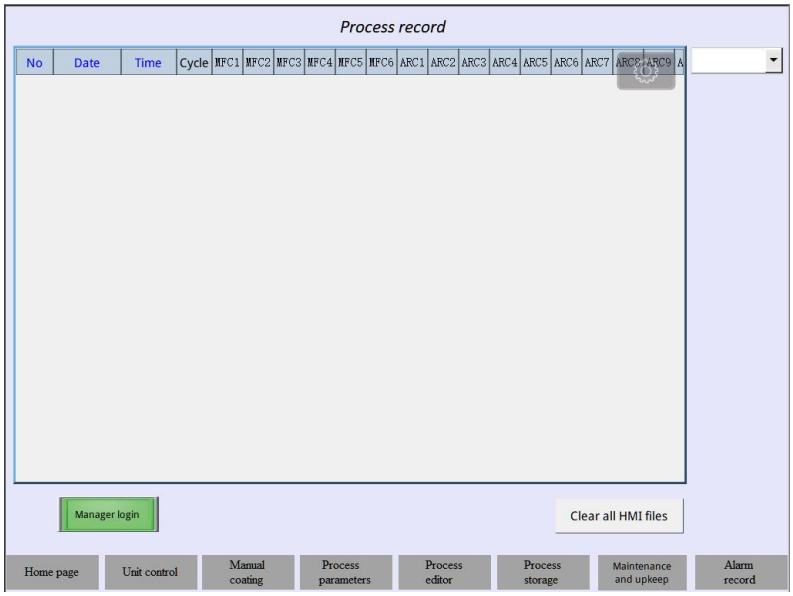
Process Name: The custom name column for the process formula allows for naming based on the type of workpiece, the material of the coating layer, and the purpose of the process, facilitating quick identification.

Call: Clicking on it will load and activate the process formula, allowing it to be directly used for production or editing.

Save: Clicking on it will store the currently completed process formula at this designated position.

7.4 Process Record

This interface is the process record interface for the film machine. It is used to record the key parameters of each coating production run, enabling data archiving, process traceability, and quality analysis during the production process. It serves as the core data source for production management and process optimization.



Enter the process record interface, use the header fields to filter the target production batch (such as by date or furnace number), and view the key parameters such as gas flow and arc source current for the corresponding furnace run, which can be used for process analysis or quality traceability.

Chapter 8 Equipment Maintenance

8.1 Daily Maintenance Steps

Operators should perform daily cleaning of the equipment every working day:

1. Use a high-pressure air gun and vacuum chamber cleaner to clean the interior of the vacuum chamber, all components installed inside the vacuum chamber, and the workpiece transfer frame. Clean the front door flange and sealing gasket with isopropyl alcohol.

• First, wear a dust mask over your nose and mouth to avoid inhaling dust during the cleaning process;

• Check that the vacuum chamber heater is turned off and at room temperature;

• Check that there are no workpiece fixtures in the vacuum chamber;

• Use the high-pressure air gun at the front door to blow off the workpiece transfer frame, the inner lining of the vacuum chamber, and the central heating tube;

• Use a powerful vacuum cleaner to remove dust from the vacuum chamber;

• Clean the door flange and sealing gasket with alcohol;

• Close the vacuum chamber door.

2. Check whether the resistance between the cathode and the HB-100 arc source flange is approximately 28 Ω . If the resistance is significantly lower than this value, use a high-pressure air gun to clean the HB-100 arc source again to solve the short-circuit problem. If this phenomenon still exists, remove the HB-100 for inspection and processing.

The shielding ring should be correctly installed on the insulating piece:

• Install the shielding ring and screw it all the way in (do not apply force);

• Install the target material and use the special clamp to tighten it. There should be no gap between the target material and the water-cooled base;

• Rotate the shielding ring counterclockwise to make the shielding ring directly

contact the bottom of the target material. Use a multimeter to measure the conduction between the shielding ring and the target material;

- Rotate the shielding ring clockwise by 90 degrees to make the shielding ring 0.5 mm away from the target material;
- Use a megohmmeter to measure and confirm that the insulation resistance between the shielding ring and the target material is higher than 100 MΩ.

The three auxiliary anode support rods will be firmly installed on the HB-100 flange using screws. To correctly adjust the auxiliary anode:

a) Use 3 adjustment rods to evenly adjust the gap around the HB-100 target material and the auxiliary anode;

b) The distance should be between 1 mm and 2 mm.

Finally, check the following insulation conditions, whose resistance should be higher than 100 MΩ:

a) Between the target material and the auxiliary anode;

b) Between the shielding ring and the target material.

Note: When a new HB-100 and a new target material are just installed in the vacuum chamber, manual vacuum pumping is required and the target material should be burned for a period of time to ensure its normal operation. Then, normal production can be carried out.

3.Check whether the target material is firmly installed on the water-cooled base, and ensure that the arc initiation needle and the burning surface of the target material maintain an appropriate distance (approximately 8 mm to 12 mm).

- The arc initiation needle piston should be evenly installed, and the arc initiation needle should be able to move flexibly up and down;
- A thermally sensitive material (carbon film) will be placed between the target material and the water-cooled base;

• The target material should be securely fastened to the water-cooled base using the special clamps provided randomly.

8.2 Overall Maintenance Steps for Equipment

After each coating stage (e.g. every one week), a comprehensive maintenance of the equipment should be carried out under the guidance and supervision of the maintenance personnel:

1. Close all circuit breakers on the front panel of the central control cabinet and in the central control cabinet itself, and also close all circuit breakers on the front and rear panels of the power supply.
2. Check all cooling water circulation pipelines and confirm that their flow rates are normal. If the flow rate of any pipeline is abnormally low, it may be due to foreign objects in the pipeline, especially at the water inlet.
3. Check the pump oil inside the vane mechanical pump (refer to Chapter 3 for pump maintenance). In operation, the level of the pump oil can be seen from its window. Regularly replace the mechanical pump oil as per the requirements of the relevant user manual. If the pump oil turns light yellow, the old oil should be drained and the cavity cleaned with some new oil, then refill the pump with new oil. Please refer to the user manual provided by the pump manufacturer for equipment maintenance.
4. Check the liquid level in the lubrication cup of the Roots pump and confirm that it can be filled to above the cup for more than one week each time.
5. Replace all inner linings in the vacuum chamber, clean the vacuum chamber and all components installed on it using a high-pressure air gun, vacuum chamber cleaner or alcohol (refer to Chapter 3 on how to clean the removed inner linings).
6. Follow the steps mentioned above to check the insulation condition of the HB-100.
7. Check the workpiece turntable system. Check if the turntable rotates flexibly; clean it with a high-pressure air gun; check the insulation condition of the workpiece

turntable:

a. Disconnect the output cable of the ionization source;

b. Use a 1000V megohmmeter to measure the resistance between any fixture and the vacuum chamber body. The value should be 10 MΩ or higher;

c. If the value is not as mentioned above, identify the cause and immediately eliminate any potential short-circuit problems.

8. Confirm whether the vacuum chamber is in a normal working state:

• Use the vacuum system to evacuate to 1.0×10^{-3} Pa;

• Close V3 and wait for 120 minutes to check if the vacuum level is 1 Pa or higher;

• If the above data is not correct, find the cause and immediately eliminate the air leakage problem.

9. Check the vacuum data on the combined vacuum thermocouple tube at the neck of the vacuum chamber and on the ionization tube. If the data of them are inconsistent, first calibrate them:

• When the vacuum indicated on the ZJ27 vacuum gauge reaches 1×10^{-2} Pa or higher, turn off the 【AUTO】 switch on the front control panel of it;

• Press the 【OFF】 button to turn off the ZJ27 vacuum gauge, and at the same time, the right window displays the vacuum level (thermocouple tube) on the combined ZJ-52T;

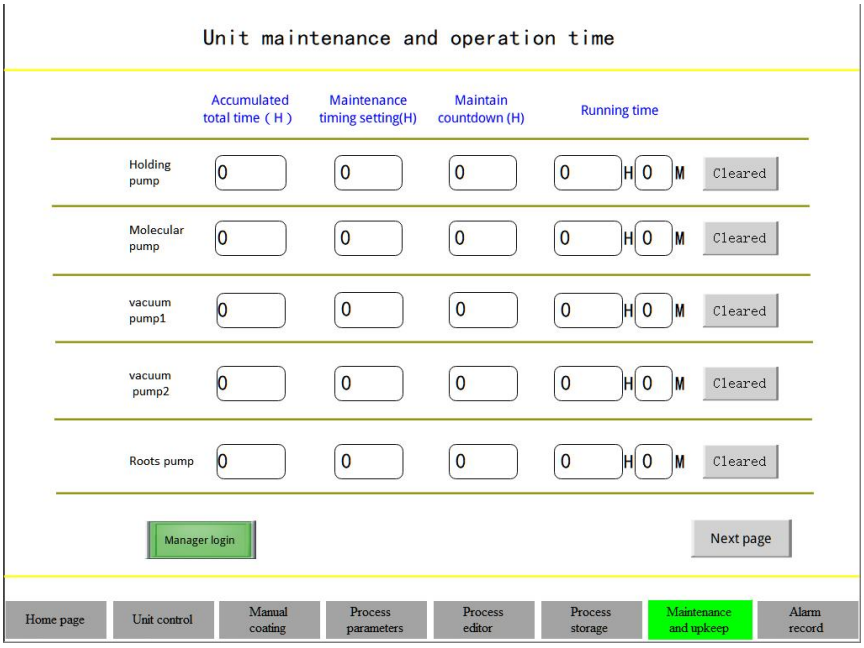
• According to the corresponding window, add or subtract 2 points, and when there is an error, adjust the resistance unit according to the full scale.

10. On the 4-channel mass flow control panel, check the "0" point of the 4 mass flow controllers:

• Confirm that the actual value of each mass flow is less than ±1-3%. If there is an error, manually perform zero point correction on the flowmeter (refer to the mass flow specification).

11. Check the operation of all emergency switches by pressing each emergency button, and then turn off the main circuit breaker in the main distribution cabinet.

▲ Aircraft Maintenance and Servicing



Core objective: Preventive maintenance of equipment. The main function of this interface is to manage the maintenance of vacuum pumps based on their operating duration, to prevent failures caused by prolonged operation.

Pump Type	Interval	Task
Holding/Roots Pump	180 days (approximately 4320 hours)	Oil change and maintenance
Molecular Pump	180 days (approximately 4320 hours)	Check bearings
Roughing Pump	60 days (1440 hours)	Oil change and maintenance

The "Maintenance Timer Settings" on the interface is used to input these cycles. During the operation of the equipment, the system will automatically accumulate the time and update the "Maintenance Countdown", and a maintenance reminder will be triggered when the countdown reaches zero.

Chapter 9 Common Faults and Solutions

9.1 Bias Power Supply Faults

Phenomenon	Reason	Solution
The "ON" button is not functioning.	The circuit breaker on the main distribution panel is not closed.	Close it
	The circuit breaker on the front door of the overvoltage control cabinet is not closed.	Close it
	The cables are not properly plugged in.	Check and plug in the cables
	The "ON" switch is damaged.	Locate and replace it
Voltage output (no load) < 60V	The poor contact of the circuit breaker in the main distribution cabinet caused a phase deficiency.	Replace it
	The circuit breaker on the rear panel of the biased voltage power supply was not closed.	Close the circuit breaker
	The front door was not closed or the sensor switch on the door failed.	Close the door or replace the switch
	There was a problem with the multi-core control cable (XG6).	Check and plug in the cables
	The multi-core plug on the control panel was not connected.	Plug in
	The high vacuum valve (V3) was not opened.	Open the V3 valve
	The workpiece turntable did not rotate.	Start the workpiece turntable
	The "ON" button on the control panel was damaged.	Replace one
	The connection terminals of the system control board (A1) were short-circuited.	Check and tighten
The voltage is not adjustable.	The connection terminals of the system control board (A1) are improperly connected.	Check and tighten
	There is a problem with the multi-core control cable (XG6).	Overhaul and plug the cables
The duty cycle of the	The connection terminals of the system control board (A1) are improperly	Check and tighten

Phenomenon	Reason	Solution
power pulse cannot be adjusted.	connected.	
	There is a problem with the multi-core control cable (XG6).	Inspect and plug the cables
	There are issues with other power supplies.	Locate and replace it

9.2 Workpiece Heater Faults

Phenomenon	Reason	Solution
The "ON" button is not functioning.	The circuit breaker in the main distribution cabinet is not closed.	Close it
	The circuit breaker on the front door of the central control cabinet is not closed.	Close it
	The multi-core plug on the control panel is not connected.	Check and plug in
	The system is not powered on.	Power on the system
	There is a problem with the heater power supply or the thermostat.	Find and replace it

9.3 HB-100 Arc Power Supply Faults

Phenomenon	Reason	Solution
The "ON" switch is not functioning.	The circuit breaker in the main distribution cabinet is not closed.	Close it
	The circuit breaker on the front door of the central control cabinet is not closed.	Close it
	The circuit breaker on the power supply front panel is not closed.	Close it
	Control cable connection failed	Check and plug in
	Power cable not plugged in properly	Inspect and plug the cables properly
	High valve V3 not opened	Open the high valve
	Workpiece turntable not rotating	Start the turntable
	Bias power supply not activated.	Activate the bias power supply.
	The cable from the system control board (A1) to the panel is not properly connected.	Check it and plug it in
	The "ON" switch is damaged.	Locate and replace it
Voltage output (no	The circuit breaker in the main	Replace it

Phenomenon	Reason	Solution
load) < 60V	distribution cabinet has poor contact, resulting in phase loss.	
	The circuit breaker on the power supply has poor contact, causing the power supply to have phase loss.	Replace it
	The AC relay has poor contact, causing the power supply to have phase loss.	Replace it
Current cannot be adjusted	Control cable connection failed	Connect them together
	The current knob (potentiometer) is broken	Check and replace it
	The current adjustment circuit board in the power supply is damaged	Locate and replace it
	Other power supply issues	Locate and replace it
The sputtering source does not create an arc.	The arc initiation needle was not in contact with the metal target block.	Adjust the position of the arc initiation needle
	The circuit breaker in the arc initiation circuit was not closed.	Close it
	The control cable was plugged into the wrong socket.	Check and correct it
	The arc initiation plate was damaged.	Check and replace it
	There was no compressed air.	Check and supply compressed air

9.4 Vacuum System Faults

Phenomenon	Reason	Solution
The vacuum pump has not been turned on.	The circuit breaker on the central control panel is not turned on.	Close it
	The front door of the vacuum chamber is not closed.	Close the front door
	The throttle valve (V4) is not fully opened.	Open the throttle valve
	The overcurrent relay has acted.	Reset it
	The air is too humid.	When the vacuum chamber is opened, keep it in a heated state.
	The temperature in the vacuum chamber is too high.	Normal phenomenon
	The workpiece in the vacuum chamber is fully loaded.	Normal phenomenon

Phenomenon	Reason	Solution
The vacuuming process took too long.	The vacuum chamber is too dirty.	Thoroughly clean the vacuum chamber
	The oil in the mechanical pump has deteriorated.	Check and replace the vacuum pump oil
	The cable connection of the vacuum gauge failed.	Check and correct it
	The vacuum gauge tube is damaged.	Check and replace it
	The vacuum gauge is out of control.	Check and improve it
	There is a leak in the vacuum chamber: air or cooling water has entered the vacuum chamber.	Find and solve it
	The mechanical pump is lacking oil.	Check and refuel it
The vacuum valve cannot be opened or closed.	No compressed air	Check the compressor and the pipes
	The electromagnetic coil of the directional valve is damaged	Replace a new coil
	The directional valve is damaged	Replace a new valve

9.5 Gas Supply System Faults

Phenomenon	Reason	Solution
The "ON" switch is not turned on.	The compound vacuum gauge is not turned on.	turn on the vacuum gauge.
	The vacuum level has not reached the required value.	Wait until the vacuum level reaches the desired value.
	The cable from the control cabinet to the right side of the vacuum chamber base is not properly connected.	Insert it properly.
The gas mass flow rate is not adjustable.	Control cable connection failed	Find and correct it
	Manual gas valve of the air path is closed	Check and open
	Gas has been used up	Check and replace the gas cylinder
	The gas mass flow control valve has lost control.	Check and replace it
	The gas mass flow control circuit board in the control cabinet is damaged.	Check and replace it

Phenomenon	Reason	Solution
	The vacuum solenoid valve is damaged.	Check and replace it

9.6 Color Unevenness

Phenomenon	Reason	Solution
The entire furnace shows a mixture of yellow and white tones, with significant color variations across different batches.	Vacuum leakage	Detect and seal the leakage points;
	Insufficient vacuum	Extend the high vacuum pumping time
	Problems with vacuum and chamber environment Residual substances from the pre-heating furnace, debris from fixtures	Dry the oven chamber
		Regular cleaning
	Insufficient cleaning	Regular thorough cleaning of the chamber, umbrella frame, and hanging fixtures
	Vacuum leakage	Strong plasma cleaning
Color difference between top and bottom	Asymmetric magnetic field distribution	Adjust the angle of the magnetic steel
	Target material aging	Replace the target material
	Gas pressure fluctuations, unstable power supply	Adjust the current of the arc target
	Uneven gas path arrangement in the furnace	Adjust the air holes in the intake pipe
	Uneven cooling	Improve the cooling of the target material to prevent local overheating and splashing
Difference in facial expressions between men and women	Too tight clamping / mutual obstruction	Arrange reasonably to avoid direct alignment of surfaces. Pay attention to the method of product clamping.
	Inappropriate coating time	The coating time should be appropriate, neither too long nor too short.

9.7 Film Peeling

Phenomenon	Reason	Solution

The film layer is not firmly attached and will fall off with just a slight touch.	The ion cleaning time is too short and the bias voltage is too low.	Appropriately increase the negative bias voltage and extend the ion bombardment time
Large areas of peeling, local block-like detachment, and distinct boundaries of the film layer detachment.	The oil removal is incomplete, the water washing is not thorough, and the drying process leaves dust adhered to it.	Pre-treatment should be done properly
		Do not allow hands to directly touch the coating surface of the workpiece. Wear dust-free gloves
	The coating process parameters are unreasonable.	Slowly heat up, apply coating, then cool down slowly in the furnace. Do not open the door to cool down abruptly.
	The ratio of the reaction gases (N2, O2) is imbalanced.	Maintain a stable MFC flow rate, fix the ratio of process gases, and avoid fluctuations.
Cracking, peeling and detachment	Excessive heating or cooling	Slowly heat up, apply coating, then cool down slowly in the furnace. Do not open the door to cool down abruptly.
The film layer has particles and uneven stress, and it may peel off locally	Target material aging	Replace the target material, clean the oxide layer on the target surface, stabilize the power supply, and suppress the arc generation.
The film layer is highly stressed and may crack and detach	Excessive bias voltage, excessive bombardment	Lower the bombardment voltage and shorten the strong bombardment time.
The deposition is uneven, and the back surface is prone to film detachment	Workpiece placement too close, severe obstruction	Arrange reasonably and leave gaps.

9.8 Target poisoning phenomenon

Definition
Target poisoning refers to the situation where, during the reaction sputtering process, the surface of the target material reacts with the reaction gas, resulting in the formation of a dense compound insulating layer.
Phenomenon

1. The sputtering rate has significantly decreased, resulting in a slower deposition process. 2. Frequent arcs / micro-arcs occur, causing particles and pinholes to appear on the film layer. 3. The target voltage shows abnormal increases or significant fluctuations.
Reason
1. Excessive reaction gas / Uncontrolled gas ratio 2. Leakage in the cavity 3. Excessive target temperature and insufficient cooling 4. Insufficient pre-sputtering time, and the oxide layer on the target surface of the previous batch was not cleaned properly
Solution
1、Emergency Target Recovery (Already Poisoned) Close reactive gases and only feed Ar; increase power appropriately and perform pure Ar sputter cleaning for 5–20 minutes; monitor for voltage recovery, arc elimination, and restoration of the target surface to a metallic color; add reactive gases slowly in small doses to avoid sudden full introduction. 2、Power Supply Upgrade (Long- Term Stability) Prioritize use of medium- frequency (MF) power supplies (dual- target) or pulsed DC power supplies, or DC power supplies with strong arc suppression. 3、Vacuum and MaintenanceL Eak detection and repair of air/water leaks; thorough baking and degassing to reduce moisture; regular cleaning of the chamber, shielding plates, and fixtures; ensure unobstructed target cooling and control target temperature.

9.9 Real-Time Alarm Handling

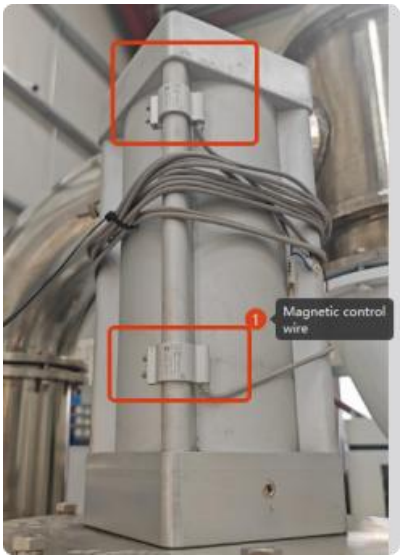
▲ Real-time Alarm Interface

Alarm: V3-1, V3-2, V3-3 not fully closed.

1. Check if the magnetic control wire is damaged or if it has shifted position;
2. Check if the cylinder is damaged;
3. Check if there is any foreign object pressing under the valve cover, causing V3-2 to not close properly.

Alarm: Valves V1 at the top and V2 at the bottom are not fully closed.

1. Check if the magnetic control wire is damaged or if it has shifted position;
2. Check if the cylinder is damaged.



Chapter 10 After-Sales Service and Technical Support

Thank you for choosing our company's products! Please make sure to use this equipment strictly in accordance with the instructions. Correct operation, maintenance and care can keep the equipment in good condition, ensure safety during use, and bring you greater economic benefits.

Our company's products have all passed the EU CE certification and the international ISO9001:2008 quality management system certification. We implement quality management in accordance with this quality standard. We strictly follow the manufacturing and acceptance standards for vacuum coating equipment in the industry and innovatively use the Chicheng manufacturing process.

The equipment warranty period is one year. Our company has been providing customers with high-quality and cost-effective spare parts, consumables, and replacement parts, as well as excellent after-sales services beyond the warranty period.

Chicheng has established a complete customer information file, and promptly tracks the operation and maintenance status of the customer's equipment to effectively ensure the normal operation of the equipment. Damage caused by improper use or other non-equipment-related reasons is not covered by the warranty, and spare parts are also not covered. The warranty period starts from the date when the equipment is completed with the debugging.

If there are any other details that you are interested in but are not clearly explained in this manual, please feel free to contact us at any time.

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