ICP700T

Inductively-coupled plasma-based emission spectrometer

Operating instruction

A & E LAB (UK) CO.,LTD.

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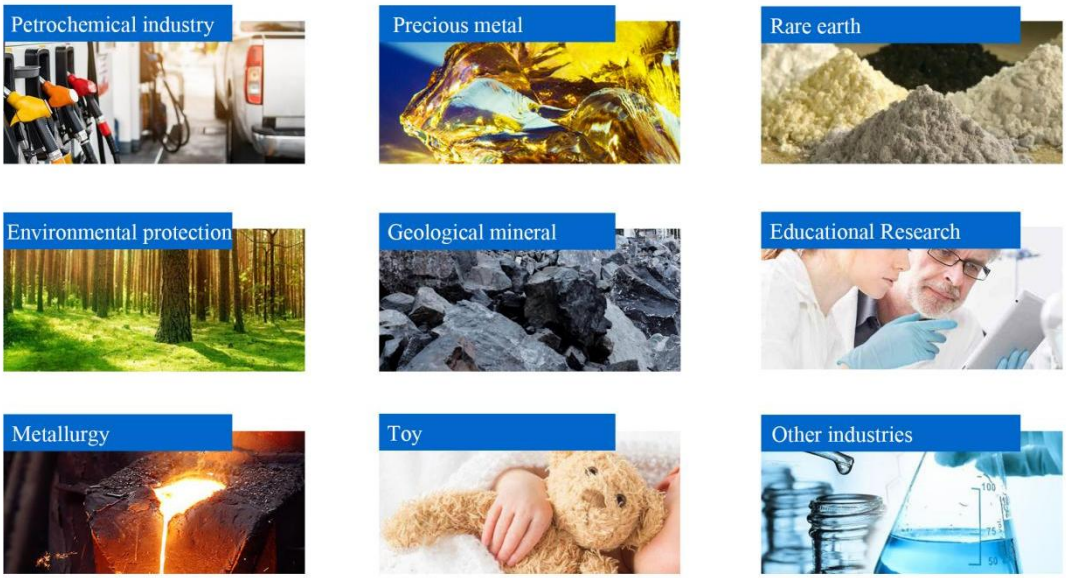
Catalogue

Chapter Ⅰ Overview

1.1 Product overview

ICP700T Is AELAB development and design of high-tech products, full name is single scanning inductance coupled plasma emission spectrometer (Inductively Coupled Plasma), mainly used in rare earth industry, silicon industry, petrochemical industry, ore analysis, metal smelting, geological research, drug safety, experimental research, environmental testing, and other fields.



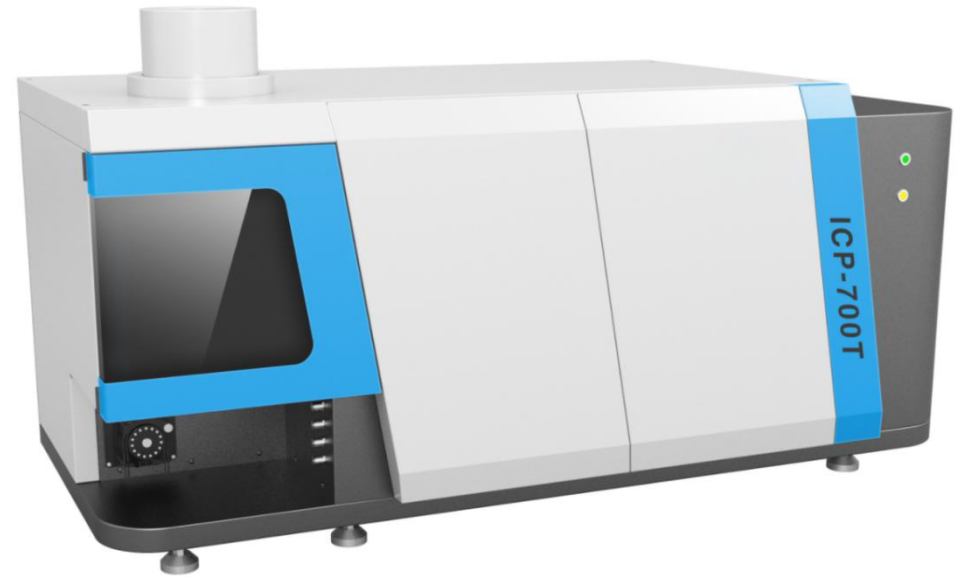
Chapter Ⅱ Instrument composition and working principle

2.1 Basic principles of instruments

ICP700T The instrument mainly consists of the following main parts: host control system, power matching system, injection system, etc. The details are as follows:

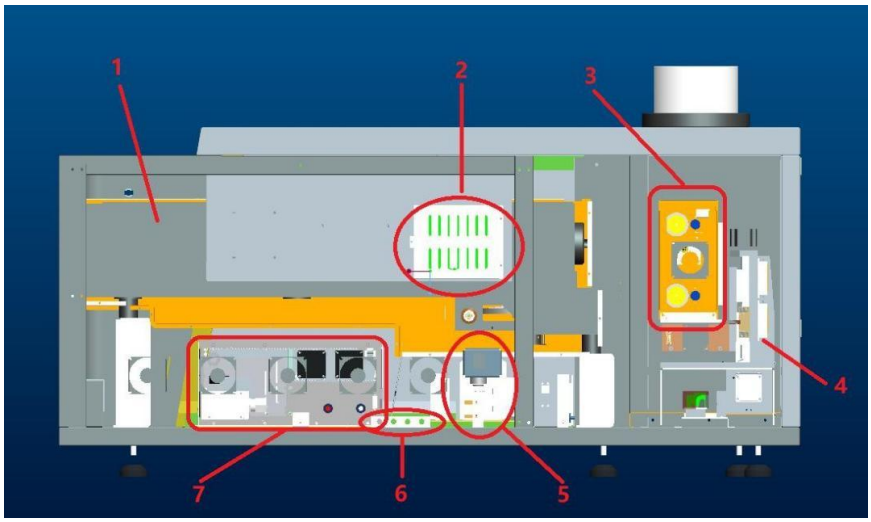
2.1.1 Instrument appearance

The appearance of this instrument is shown in the following figure:



Pic1. Instrument appearance diagram

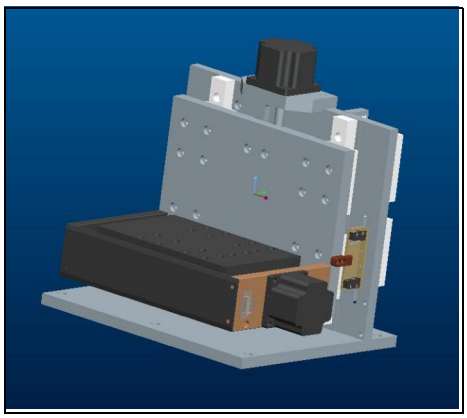
2.1.2 Internal structure diagram of the instrument



Pic2. Internal structure diagram of the instrument

1.Spectroscopic system	2.Main control system	3.Matcher	4.Mobile platform
5.Cooling the water route protection system	6.Gas route module	7.Solid-state RF power supply	

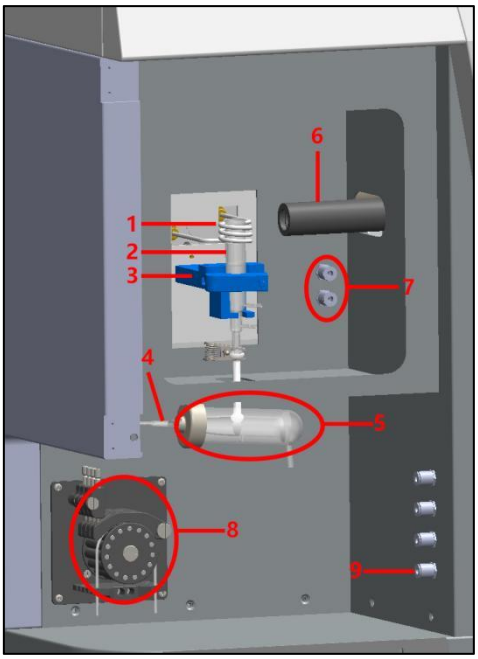
2.1.3 Automatic observation and regulation system



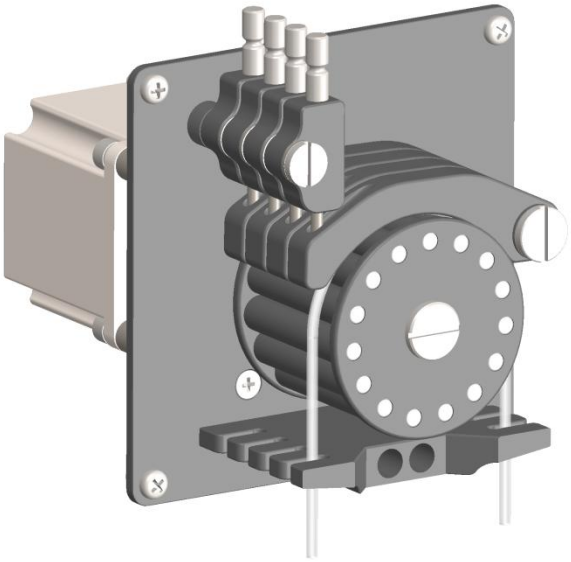
Pic3. Automatic regulation platform

Automatic observation and adjustment platform: The automatic observation platform has the X-axis and Y-axis bidirectional adjustable, the computer software automatic control, used to adjust the size of the flame center position, to achieve the best observation position.

2.1.4 sampling system



Pic4 Injection sample system



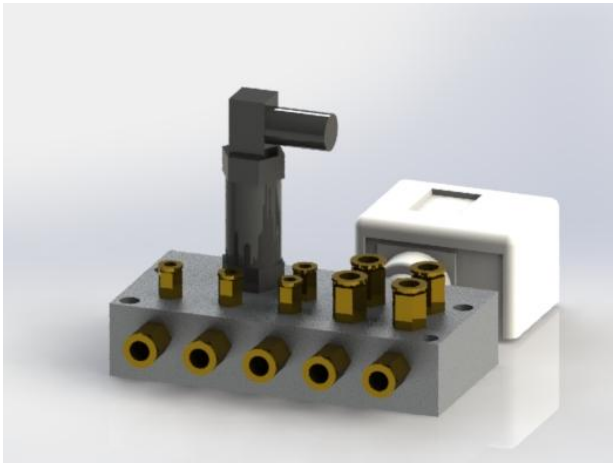
Pic5 Peristtic pump system

1. high-frequency coil	2. Torch tube	3. Torch pipe fixation
4. atomization device	5. atomizer chamber	6. lens cone
7. Auxiliary gas and plasma gas joint	8. Peristogenic pump gas inlet	9. Gas inlet

The injection system mainly includes: atomizer, double-cylinder fog

chamber, plasma gas, carrier gas, auxiliary gas, torch tube and peristaltic pump.

2.1.5 Water cooling and gas interface

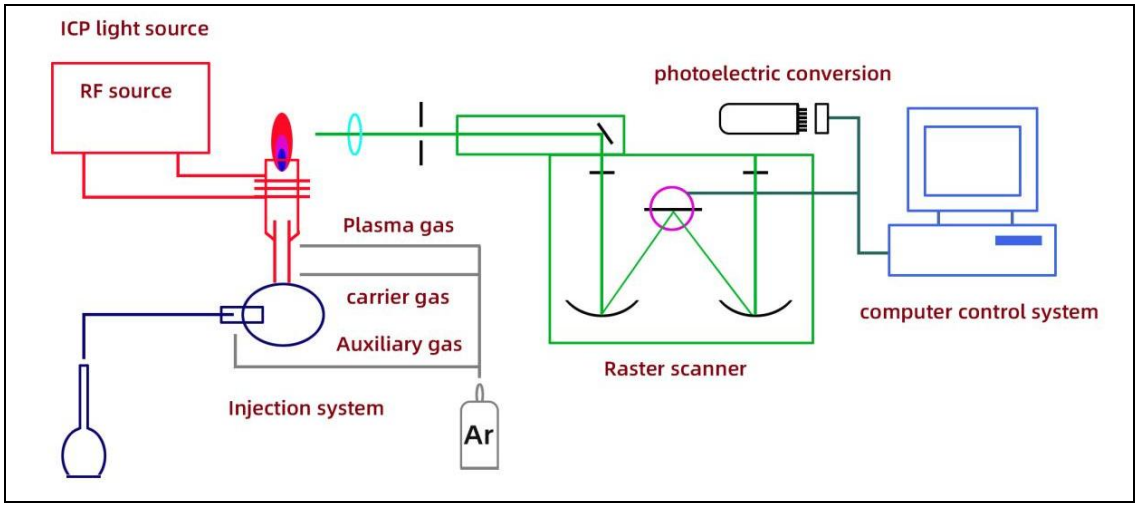


Pic 6 Waterway and gas interface

1.Gas route interface (plasma gas, auxiliary gas, carrier gas)	2.Water cooling into the water outlet

2.2 Basic working principle of the instrument

The basic working principle of this instrument is as follows:

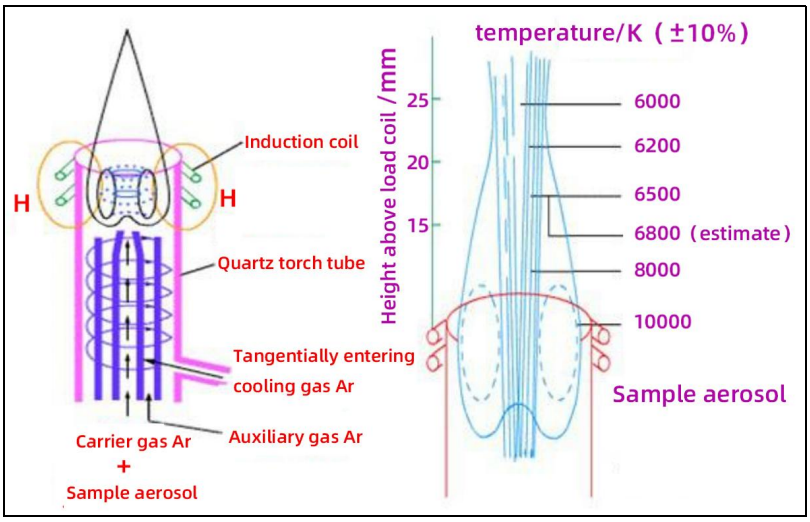


Pic7. Working schematic diagram

Working principle: the high frequency power generated by the RF generator is added to three layers of concentric quartz torch tube through the induction working coil to form high frequency oscillation electromagnetic field; and the argon gas is passed into the outer layer of the quartz torch tube and the high voltage discharge generates charged particles in the high frequency electromagnetic field, to produce more charged particles, and the temperature increases, finally forming the argon plasma, the plasma temperature can reach 6000K~8000K. The sample of the aqueous solution enters the central channel through the aerosols formed by the atomizer, and is excited in the high temperature environment to emit the characteristic spectral line of the elements contained in the solution. By lighting the plasma light source and scanning the scanning spectroitter, the light intensity of the spectral line into photocurrent through the phototomultiplier tube. After the circuit processing and analog-to-digital transformation, enter the computer for data processing, and finally the analysis results are printed by the printer.

2.3 Operating principle of the key components of the instrument

2.3.1 Formation principle of an inductively coupled plasma ICP



Pic8. Principles of ICP formation

The operating frequency of the high-frequency generator is 27.12MHz, with a maximum output power of 1500W. The main function is to produce a high-frequency electromagnetic field to supply the plasma energy. The torch tube is a three-layer concentric quartz glass tube with cooling argon flowing into the outer tube to avoid the plasma torch from burning out the quartz tube. The middle quartz tube exits in a trumpet shape, with argon gas flowing in to maintain the plasma. The inner diameter of the inner quartz tube is 1mm-2mm, and the sample aerosol is introduced into the plasma by the carrier gas.

When the high frequency power supply is connected to the load induction coil around the plasma torch tube, the high frequency induced current flows through the coil, generating an axial high frequency magnetic field. At this time, the cooling argon is injected to the tangent direction of the outer tube of the torch tube, and the auxiliary gas argon is axial (or tangential) into the middle tube, and the charged particles are excited with a high frequency ignition device. When the charged

particles are large enough to cause the gas to have enough conductivity, an annular vortex current is generated in the section perpendicular to the direction of the magnetic field. A powerful induced current of a few hundred amps instantly heated the gas to 6000K-8000K, forming a torch-like stable plasma torch above the torch tube mouth.

2.3.2 Solid-state generator and automatic matching box

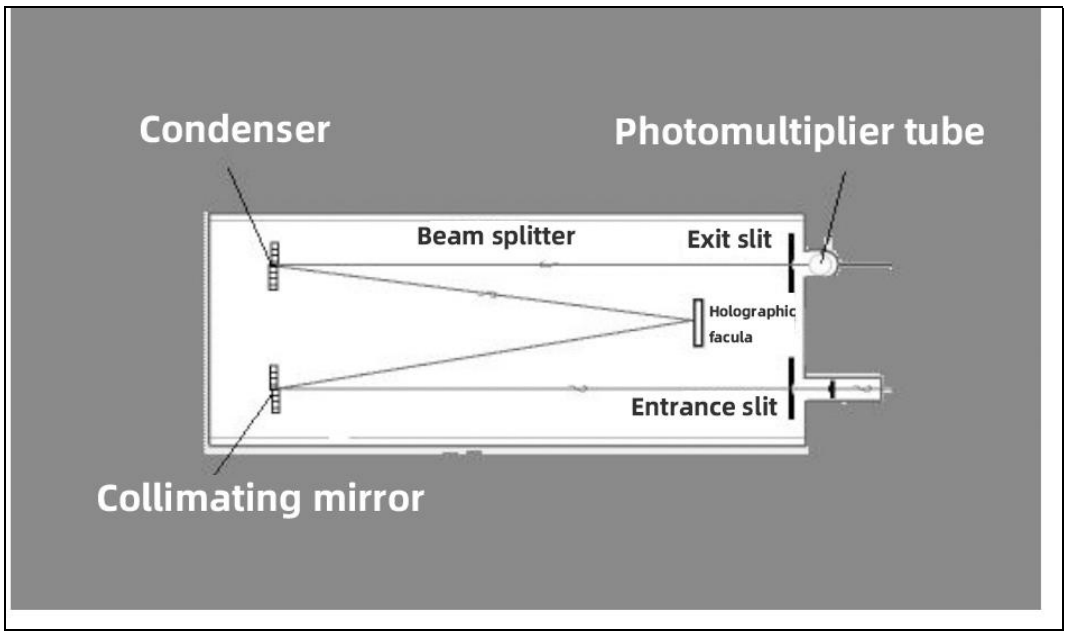
Solid state generator

ICP700T The high frequency generator is an all-solid state RF generator independently developed by A E L A B .
It uses the exciting oscillation circuit, with the maximum output power of 1500W and the frequency of 27.12MHz. Compared with the self-excited shock tube RF generator, the all-solid state RF generator has many advantages of smaller volume, higher output power, more stable frequency power and higher power efficiency.

Automatic matching box

ICP700T Automatic matching box has the advantages of fast matching speed and high accuracy, which eliminates many troublesome operation of manual matching.

2.3.3 Scan the light divider



Pic9. Working schematic diagram of the scanning spectrometer

The spectroitter consists of a light chamber, incident slit, reflector, grating, outgoing slit and grating drive device. The density of grating lines is optional with the specifications: 2400l / mm, 3600l / mm or 4320l / mm, and the focal length of the optical chamber is 1000mm. The composite light from the ICP is reflected to the mirror through the incident slit and diffracted to produce monochromatic light. The computer controls the grating drives the device and turns the grating to bring the required spectral wavelength mirror to the outlet slit. The photomultiplier tube receives the light signal and performs photoelectric conversion, and then performs the intensity detection and comparison.

2.3.4 Electronic measurement and control circuit

The circuit system has four functions: communication, gas circuit control, step motor control and signal acquisition.

2.3.4.1 Communication

The RJ 45 network port is used as the communication interface between the instrument and the computer. Network port communication has many advantages, such as stable interface, fast communication speed and strong anti-interference ability.

2.3.4.2 Gas control

ICP700T Gas path using advanced MFC (mass flow controller) as a control parts, control plasma gas, load gas, auxiliary gas, auxiliary gas, high control accuracy, fast response speed, stable flow, with flow feedback function at the same time, can monitor the actual gas flow in real time, ensure into the sample system work stability, improve the repeatability and stability of the instrument.

2.3.4.3 Signal acquisition circuit

The operational amplifier with high precision and high impedance is used as the regulating amplifier circuit of the signal output, and the amplifier signal of the amplifier is controlled by the central processing unit. The signal is amplified by the primary I / V conversion secondary signal and output to the VF conversion chip, and then connected by the FPGA count to the computer through the network port for data processing, and provided to the whole circuit by the linear power supply.

Chapter Ⅲ Product specifications and technical indicators

3.1 High-frequency generator and gas circuit and cooling water circulation

1) Circuit type: all-solid-state RF power supply and fully automatic matching function.

2) Working frequency: 27.12MHz

3) Output power: 800W~1500W

4) The leakage radiation intensity of electromagnetic field: 30cm away from the chassis, electric field: E 10V / m; magnetic field: H < 0.2A/m

5) Input power supply: 220V, 30A

6) Three-way gas control flow size

Plasma gas flowmeter: (1~20) L/min

Auxiliary air flow meter: (0.05～1.0) L/min

Gas flow meter: (0.05～1.0) L/min

7) Cooling water: the water temperature range is 20℃ ~25℃, and the water pressure is greater than 0.1MPa.

3.2 Scan the light divider

1) resolution ratio:

≤0.015nm (2400 line raster)

≤0.008nm (3600 line raster)

≤0.005nm (4320 line raster)

Scanning wavelength range:

2400 line raster: (190～800) nm

3600 line raster: (190～500) nm

4320 line raster: (190～460) nm

3.3 Electronic measurement circuit

1） Photomultiplier specification: Hamamatsu PMT

2） Communication circuit: network port communication

3.4 Computing system

1) Computer: a set of brand computer, suitable for WIN 7 and WIN10 operating system

2) Printer: one brand-name printer

3.5 Technical index of the whole machine

1) Scanning wavelength range:

A. 195 nm ~ 800 nm (2400L / mm grating)

B. 195nm~500nm (3600L / mm grating)

C. 195 nm ~ 460 nm (4320L / mm grating)

2) Repeatability: relative standard deviation RSD 1.5%;

3) Stability: relative standard deviation RSD 2%;

4) Detection Limit (μ g / L):

element	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb
Wavelength (nm)	408.672	413.765	414.311	401.225	360.946	381.967	342.247	350.917
detection limit	<3.0	<5.0	<5.0	<5.0	<10.0	<1.0	<10.0	<3.0

element	Dy	Ho	Er	Tm	Yb	Lu	Y	Sc
Wavelength (nm)	353.170	345.600	337.271	313.126	369.419	261.541	371.030	335.373
detection limit	<3.0	<3.0	<3.0	<3.0	<1.0	<3.0	<1.0	<1.0

element	Ta	Nb	Mn	Mg	B	Zn	Co	Si
Wavelength (nm)	226.230	313.340	257.610	279.553	249.773	213.856	228.616	251.611
detection limit	<5.0	<5.0	<3.0	<1.0	<10.0	<3.0	<3.0	<10.0
element	Ni	Cd	Fe	Ca	Mo	V	Be	Ti
Wavelength (nm)	232.003	226.502	239.562	393.366	281.615	310.230	313.041	334.941
detection limit	<5.0	<3.0	<3.0	<1.0	<5.0	<5.0	<1.0	<3.0

element	Cu	Cr	Al	Zr	Ag	Sr	Au	Pt
Wavelength (nm)	324.754	267.716	396.152	343.823	328.068	407.771	242.795	265.945
detection limit	<3.0	<5.0	<5.0	<5.0	<3.0	<1.0	<5.0	<5.0

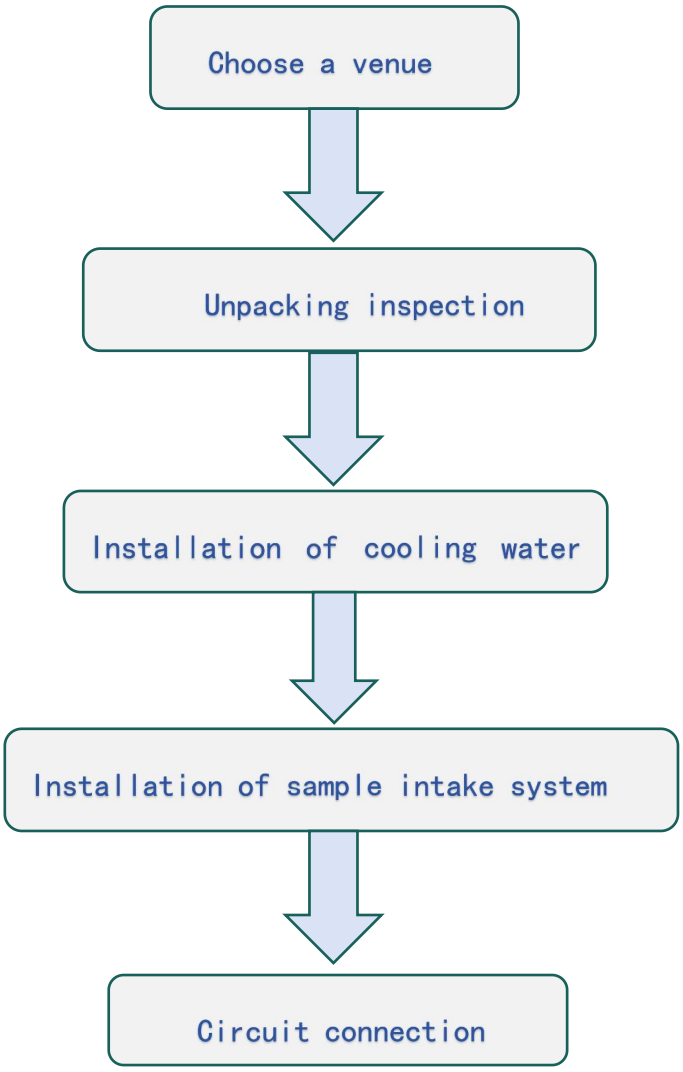
element	Pd	Ir	Rh	Ru	Ba	Li	Na	K
Wavelength (nm)	340.458	224.268	343.489	240.272	455.403	670.784	588.995	766.490
detection limit	<5.0	<10.0	<10.0	<5.0	<1.0	⩽3	⩽20	⩽60

element	As	Sb	Bi	Hg	Pb	Ga	Os	W
Wavelength (nm)	228.812	206.833	223.061	253.652	220.353	294.364	225.585	207.911
detection limit	⩽15	⩽15	⩽10	⩽15	⩽15	⩽10	⩽1	⩽10

element	Sn	Te	Ta	Th	Tl	Re	Ge	Se
Wavelength (nm)	242.949	214.281	226.230	283.730	276.787	227.525	209.426	203.985
detection limit	⩽20	⩽10	⩽5.0	⩽10	⩽30	⩽5	⩽15	⩽30

Chapter Ⅳ Installation of instruments

4.1 Flow chart of the instrument installation



Pic10 Installation flow chart of the instrument

The instrument installation is performed by the professional technical personnel of the company. The following is for brief description:

4.1.1 Select the site

ICP700T The external size of the spectrometer is 1585mm (long) 710mm (width) 745mm (height), and the weight is 200kg. For instrument installation, see the instrument installation environment conditions.

4.1.2 Unpacking inspection

Open the instrument packing box, remove the attachment carton, check the accessories for missing according to the packing list, and confirm whether the instrument shell is damaged.

4.1.3 Installation of cooling water

Remove the cooling water pipes and the gas path plastic pipes from the accessory box. The cooling water pipe is connected to the inlet and outlet of the cooling water after the instrument. [Note: The outlet pipe of the cooling water tank should be connected with the inlet of the instrument, and the return pipe of the cooling water tank should be connected with the outlet of the instrument.] Then, open the power supply of the cooling water tank, observe whether there is water leakage at the joints of the cooling water, and observe whether the water pressure switch is engaged. The sound of the suction closing can be heard during the suction closing. The two gas pipes are connected to the air inlet of the plasma gas, the carrier gas and the auxiliary gas, and the other two ends are connected to the gas pressure reducing valve on the argon bottle.

4.1.4 Installation of sample injection system

Remove the quartz torch tube, fog chamber, atomizer, plastic bucket, etc. from the accessory box. The quartz torch tube is installed in the center of the high-frequency coil. Request to be concentric with the high-frequency coil. One turn of the bottom end of the three-turn working

coil should be 3-5mm higher than the central pipe port of the quartz torch tube. Plasma gas plastic tube is connected with the air inlet at the upper end of the quartz torch tube. The auxiliary air plastic pipe is connected with the secondary air inlet of the quartz torch tube. The upper mouth of the fog room is connected to the quartz torch pipe and clamped with a clip. The air inlet of the atomizer is connected with the gas-carrying plastic pipe, and the air spray nozzle is inserted into the front hole of the fog chamber. The connection between the capillary and the atomizer does not leak air. The tail of the fog chamber was connected with a Φ 6mm plastic hose to a peristaltic pump injection latex tube through a transfer joint. During ignition and testing, ensure that the peristaltic pump tube has a small amount of waste liquid and the peristaltic pump tube is installed. After the installation of the injection system, set the lighter output wire (red high-voltage line) at the plasma gas inlet of the quartz torch tube.

4.1.5 Air route regulation

Open the two argon bottles, the plasma gas outlet pressure is adjusted to 0.3MPa, and the carrier gas / auxiliary gas outlet pressure is adjusted to 0.3MPa. Turn on the gas through the software on the computer, and observe whether the gas flow rate is normal.

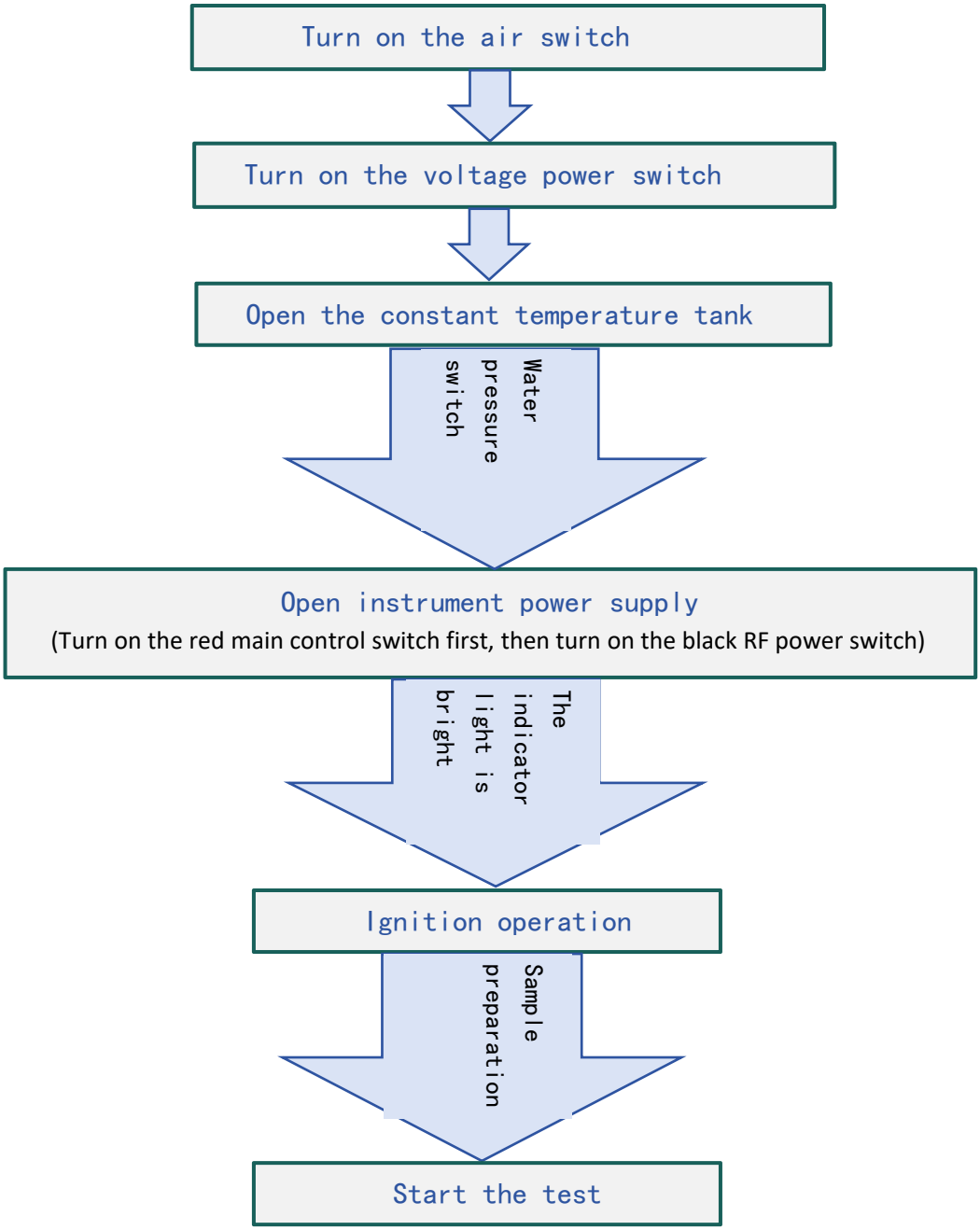
4.1.6 Circuit connection

Open the accessory box, connect the instrument black power cord to the regulator, and connect the regulator input to the air switch (ensure that the maximum output of the air switch is 32A). The network port interface of the computer is connected with the rear communication output port of the instrument, and the computer and printer are connected

according to the instruction manual. The high frequency ground wire is connected to the ground behind the instrument. The computer ground wire is connected with the instrument ground wire.

Chapter V Operation of instruments

5.1 Instrument operation process



Pic11 Flow chart of the instrument operation

Operation process description:

1. Turn on the air switch

2. Turn on the voltage stabilizing power supply switch

After the voltage power switch is turned on, the sound of the voltage power relay will be heard, and the LED shows the output voltage 220V and the output current 0A.

3. Open the constant temperature cooling water tank

Turn on the power supply of the constant temperature cooling tank, you can hear the sound of the water pressure switch in the instrument. If the cooling tank does not start, the instrument will not be able to fire.

4. Turn on the instrument power supply

Turn on the switch controlling control power at the back of the instrument. Note: Open the control circuit switch (red boat switch) and then the air switch (black). When turning off the instrument, first break the air switch (black), and then break the control circuit switch (red).

5. Ignition

After the successful online, open the plasma control interface, set the inflation time, and then you can directly click the ignition button to ignite.

Ignition airflow settings recommend using the default settings.

The ignition gas purge time is 30 seconds.

If the ignition fails, extinguish the operation, and then check the air path problem according to the software prompts.

After the ignition is successful, you can click the "incoming sample

preparation" button. Note to avoid inhaling air when entering samples to avoid flameout. When not testing, place the injection tube in the blank fluid.

6. Start the test

Start building up methods and prepare for testing.

Other considerations:

1. Before the instrument works, first observe whether the water level height in the cooling water tank is normal.

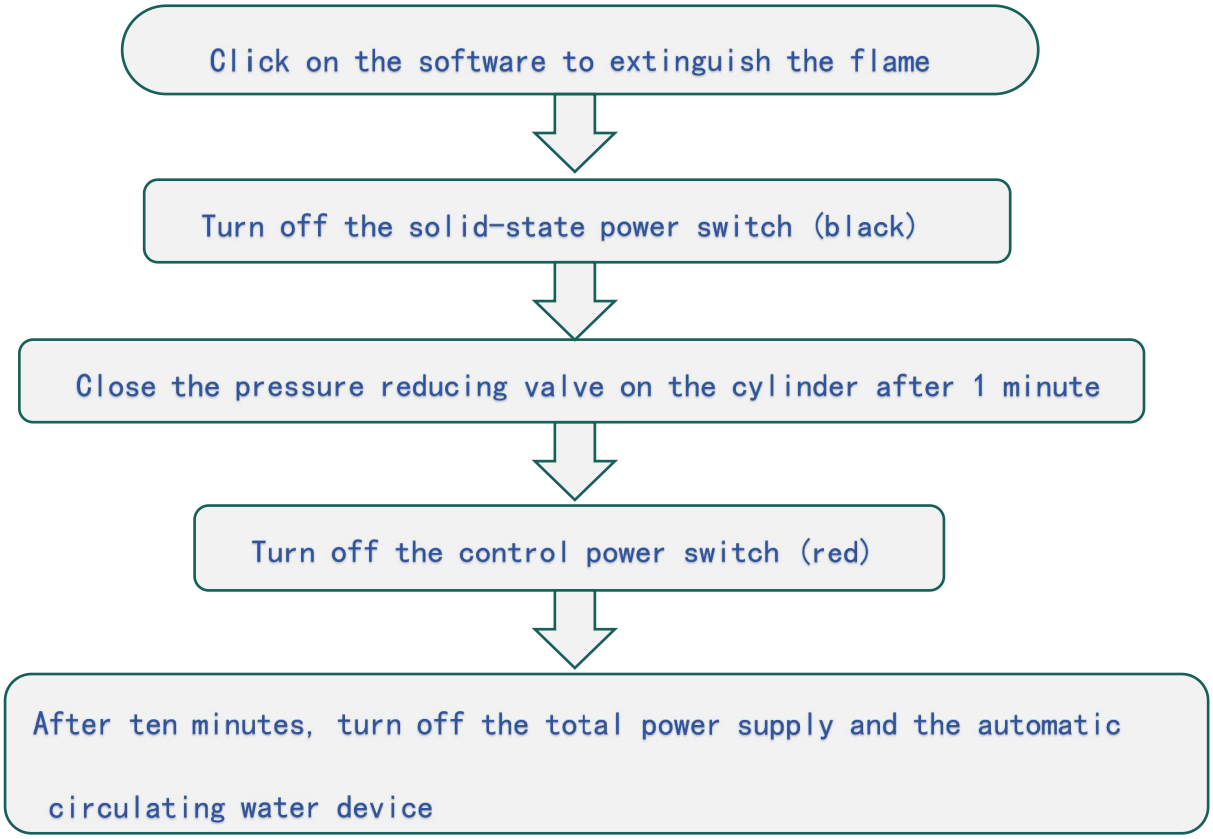
2. Observe the argon table on the argon bottle and whether argon is enough to test time. The consumption of the plasma argon gas bottles is approximately 1.1MPa for 1 hour, and the carrier gas consumption is approximately 0.1MPa per hour.

3. The best value should be determined according to the increase of the atomizer, and generally set between (0. 6~0.7) L / min.

4, when the indoor humidity is more than 70%, or the room temperature is higher than 30℃, the ignition is prohibited.

5.2 Instrument shutdown process

The instrument shutdown process must be strictly in accordance with the specifications to avoid the impact of the wrong action on the instrument, which will affect your normal test work. The following is the correct shutdown process. Please read it carefully before operating the instrument.



Pic 12 Flow chart of the instrument shutdown

5.3 Software operation

When the flame of ICP instrument is stable and the injection system can be continuously stable, you can use the software tailored for you to test the work. Please follow the instructions for using the software below for the detailed steps.

Chapter VI Software instructions

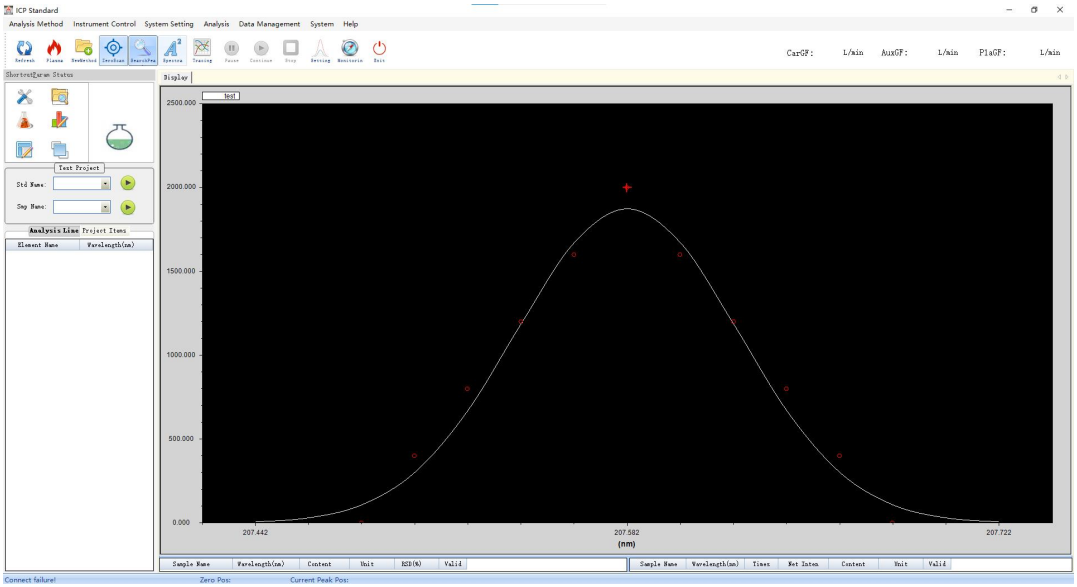
6.1 Software startup

Double-click the shortcut icon for the desktop “  ”, Then the login box appears as shown in Pic1:

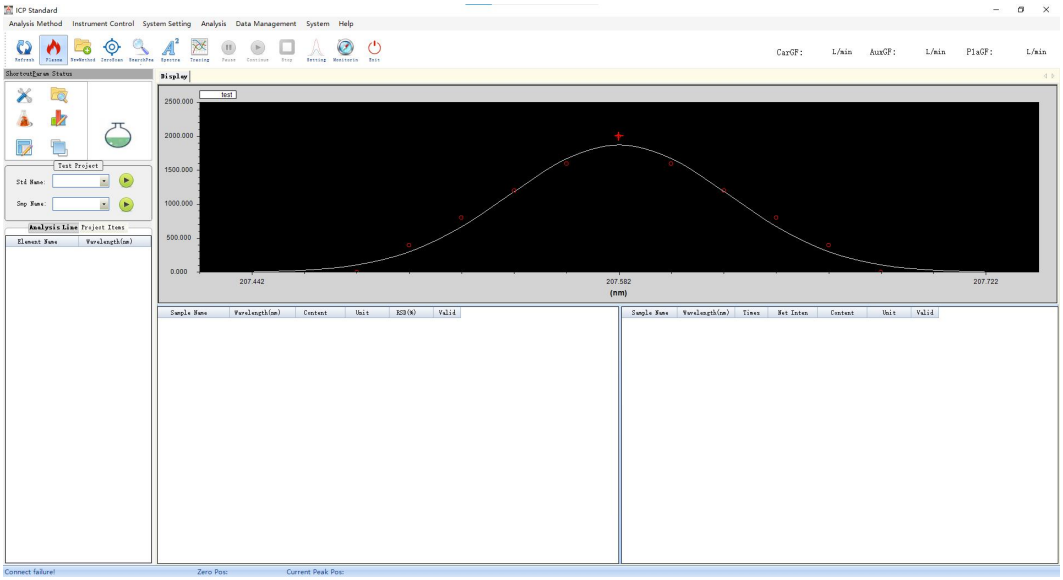
Pic 1 Software landing interface

Select the user name that you want to log in to and enter the corresponding login password. Click "login" to enter the main interface of the software, as shown in Pic2. Click "Cancel" to exit the software login interface (default user name: User, default password: 8 8 8 8 8 8 8 8 , user Admin is only for after-sales engineers).

Double-click the "Spectrum map" area to switch to the display interface in Pic2 or Pic3.



Pic 2 Software main interface



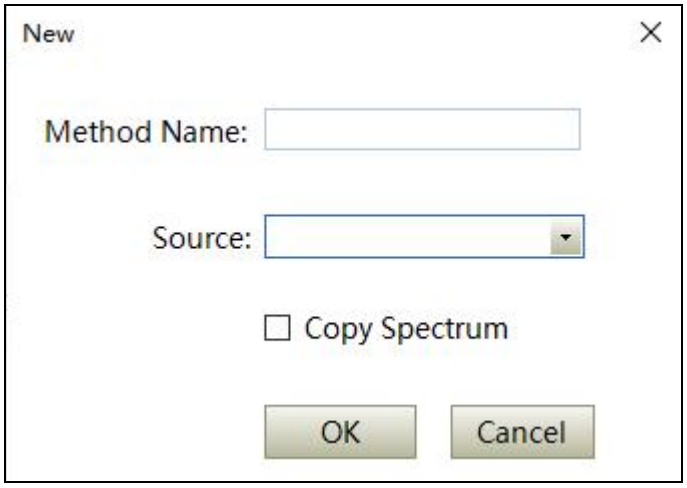
Pic 3 Software main interface

The main interface of the software is divided into seven parts: file, control, setting, analysis and measurement, data management, system and help.

6.2 Analytic procedure

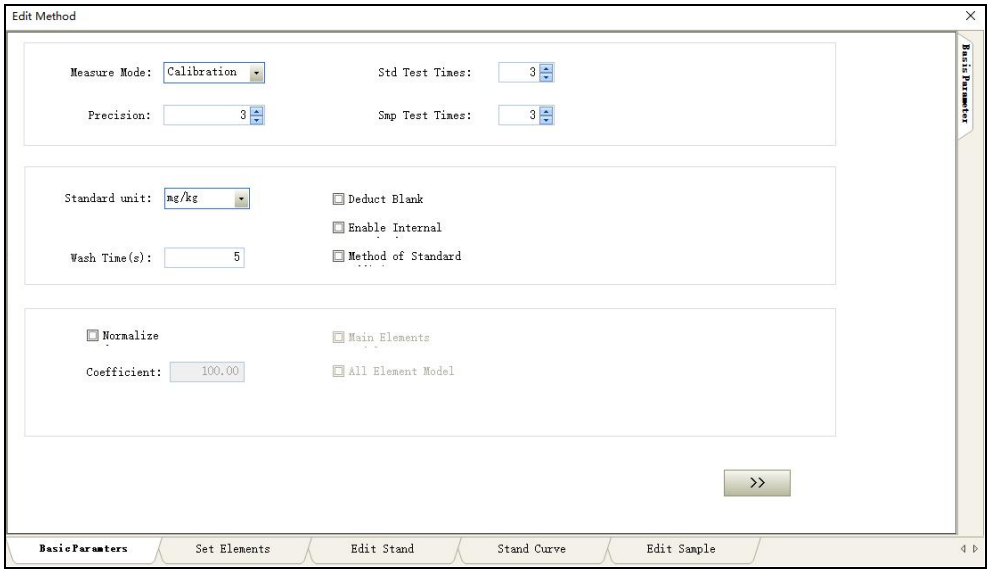
6.2.1 New method

choose “document - >New method”, Open the new method page, as shown in Pic4, enter the new method name, create a brand new method when the "source" drop-down box is empty, and you can also select the existing method for replication.



Pic 4 New method interface

After clicking "OK", the "Basic Parameters" window will pop up, as shown in Pic5:



Pic 5 Basic parameter setting interface

Measurement method: refers to the working curve production method (currently it is the standard curve method). Number of standard measurements: the number of measurements when measuring the standard.

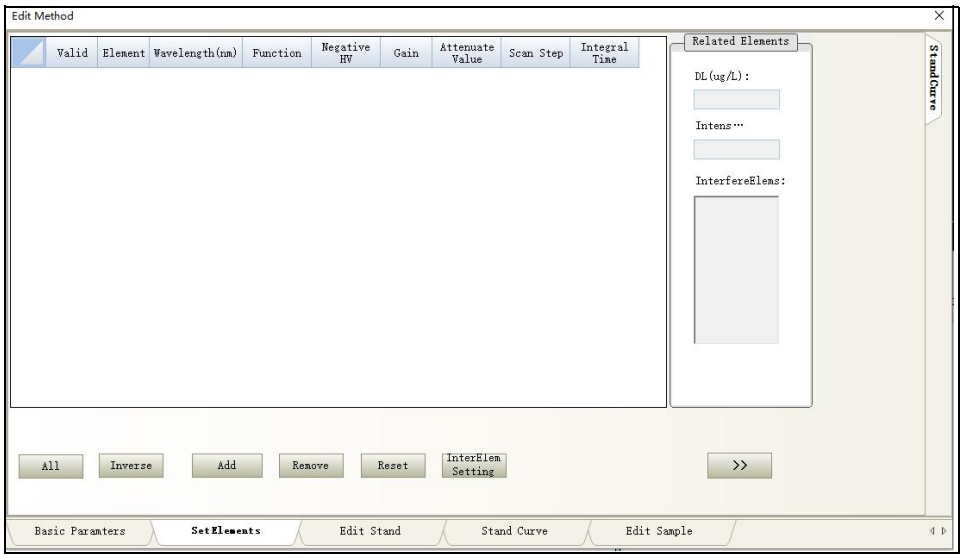
Keep the decimal places: the accuracy of the measurement results (content) when measuring the samples.

Number of Sample measurements: the number of measurements when measuring the sample.

Normalization: Indicates whether the measurements are normalized or not.

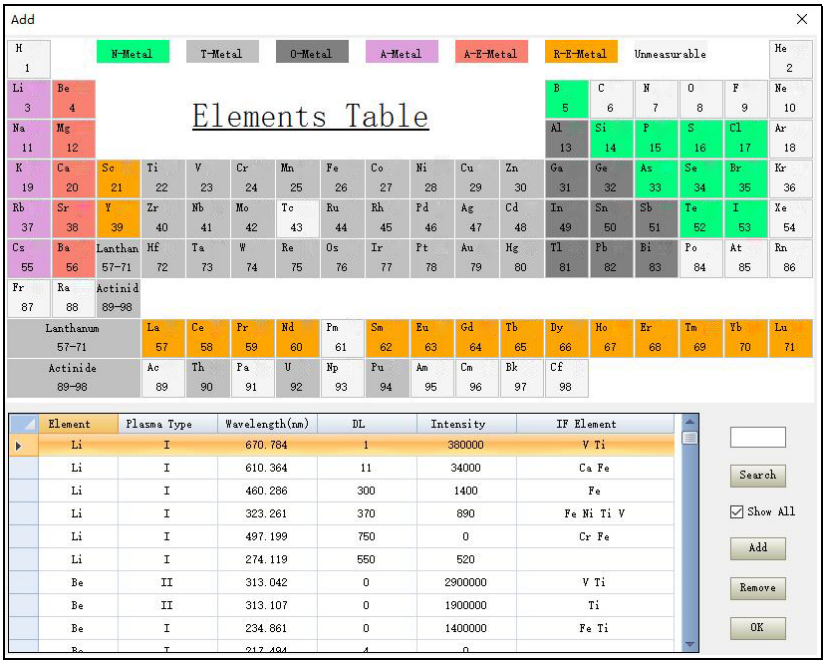
Deduct the sample blank: Indicates whether the sample blank intensity is deducted when measuring the sample.

After modifying the above parameters, click " OK to save the parameters and display the analysis line dialog box. As shown in PicPic66:



Pic 6 Analyze the spectral line interface

Analysis line can be divided into "analysis line (Analyze)" and "internal line (Internal)"; add multiple lines as valid or invalid; add analysis line to the current method, click the dialog box as shown in Pic7.



Pic 7 Elemental spectral line diagram

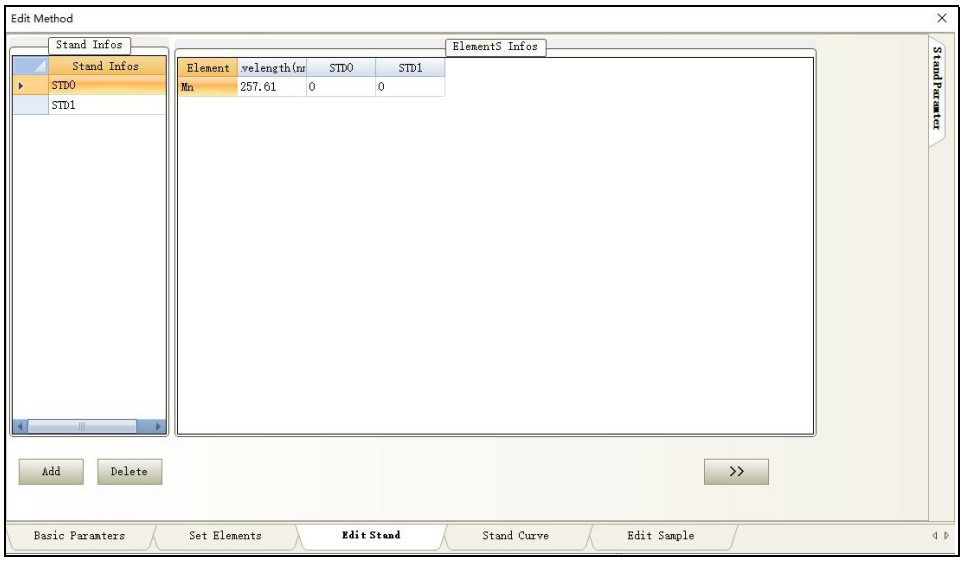
Click the element name in the periodic table, the corresponding line will be displayed in the list below, select the line to be added, click "Add" to add the line to the "Selected Wavelengths" list, click "OK", the selected line will be added to the current edited method and return to the interface shown in Pic8.

Delete: Remove the currently selected analysis line.

Save: Save all analysis lines for the current set values.

Reset: the current analysis line peak position zero.

Edit standard: Select "File editing Standard" to add a standard to each analysis line and set the content of the standard sample, and set whether the standard sample is valid (i. e., whether to participate in the fitting curve). As shown in PicPic88:



Pic 8 Edit the standard interface

Add: Add a standard to all analysis lines.

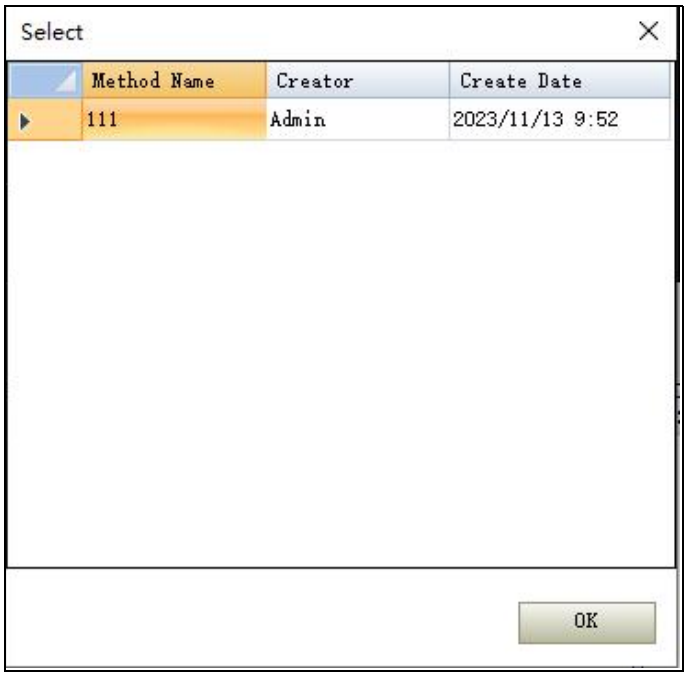
Delete: Delete the last standard of all analysis lines.

Save: save the standard data value of the current analysis line.

Close: Close the current dialog box.

6.2.2 System of selection

Click "File Open Method" will pop up as shown in Pic9. Select a method and click "OK" to open, and double-click the target method to also open the method. You must select a method before analyzing.



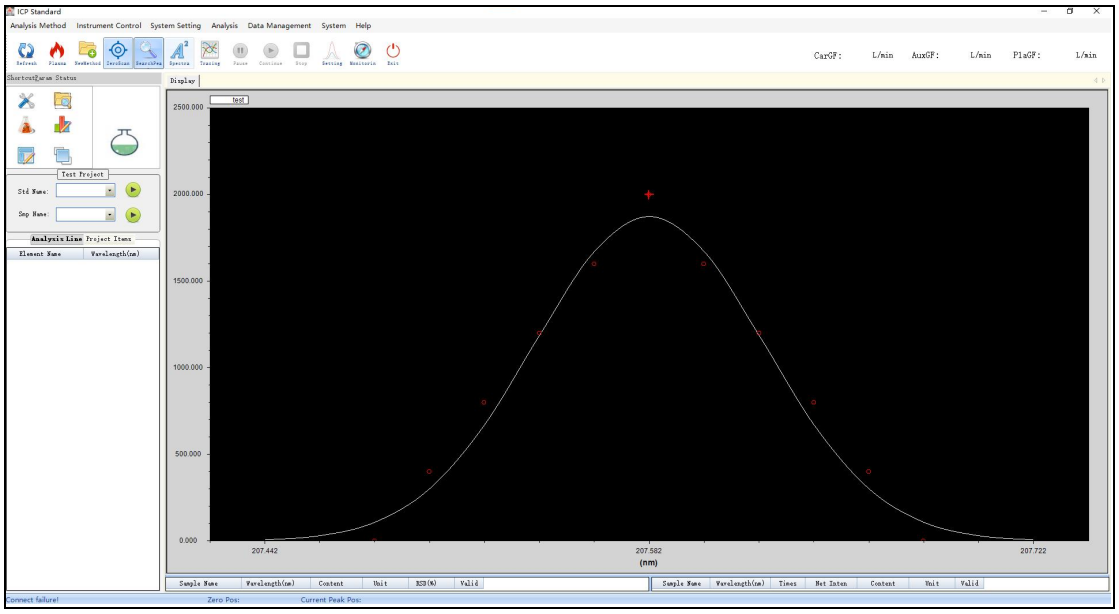
Pic 9 Method interface diagram

6.3 Starting up

6.3.1 Online

Open the red power switch of the whole machine and click "Instrument Control Online", as shown in Pic10. After the online connection is

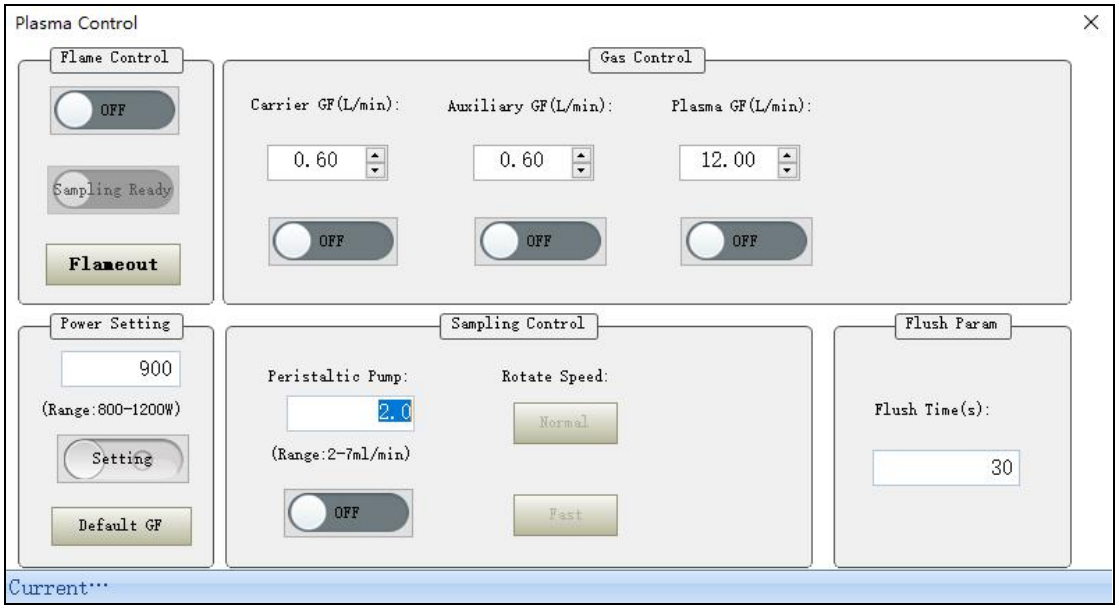
successful, "Online success" will be displayed in the lower left corner of the software status bar, otherwise "online failure" will be displayed. If "online failure" appears, check whether the instrument is connected to the computer. After checking, click "Instrument Control Online" to come online again.



Pic 10 Master control interface diagram

6.3.2 Plasma control

Click on the menu “control - > stir up trouble” Or the toolbar buttons “ Plasma ” The window appears as shown in PicPic11.



Pic 11 Plasma-based control interface diagram

1. Blow Settings

Set the gas flow and purge time. The software default 0.6 L/min, double-click the value to modify the setting in its traffic.

2. Gas control

The switch of plasma gas and auxiliary gas valves can be controlled respectively, and the flow value of each gas can be set.

3. Intake control

The switch of the carrier gas and the peristaltic pump can be controlled respectively, and the flow value of the carrier gas and the speed of the peristaltic pump can be set. During the measurement process, "normal" speed is used, and "fast" is used to quickly discharge the waste liquid in the fog chamber.

4. Power setting

Set the operating power of the power supply, can set the range of 800-1200W.

5. Ignition operation

Ignition: includes ignition preparation and ignition processes during which "Current State" is displayed in the status bar.

Injection preparation: set the relevant parameters of the power supply measurement, and restart the load gas and the peristaltic pump.

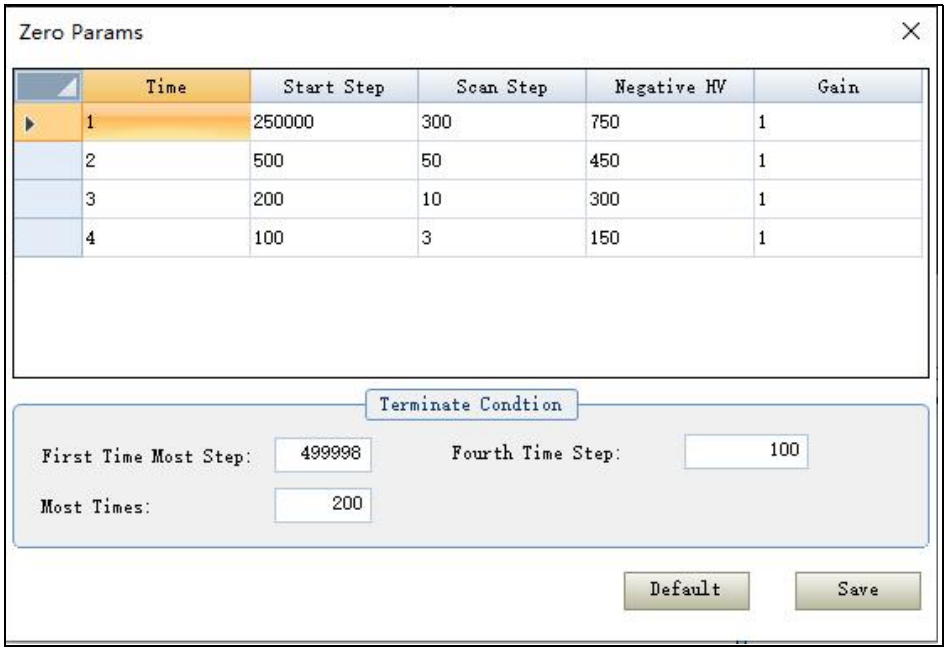
flameout: When the flameout operation is required to close the solid-state power supply power output.

6. Restore the default gas flow rate

Return the flow rate of plasma gas, carrying gas and auxiliary gas to the factory default setting value.

6.4 Zero level scan

6.4.1 Set zero-level parameters



Pic 12 Zero-level parameter setting interface diagram

Choose“intercalate - >Zero level parameters”,You can enter the above Settings interface.

In the table, the start position, scanning step distance, negative high pressure, gain and other parameters of the zero search process, in which the start position of the first time is the number of motor steps relative to the mechanical zero, and the start position of 2,3 and 4 times is the corresponding number of steps set by the zero position after the previous zero search.

In the termination condition, "the first maximum number of steps" indicates the maximum number of steps moved by the zero search motor for the first time. If the motor has reached the maximum position, the zero search will be terminated. The "maximum number of measurements" means the maximum number of measurement points for the 2nd and 3rd times, and if the zero is not successful, the zero search will be terminated."Number of fourth measurements" indicates the number of points for the last measurement.

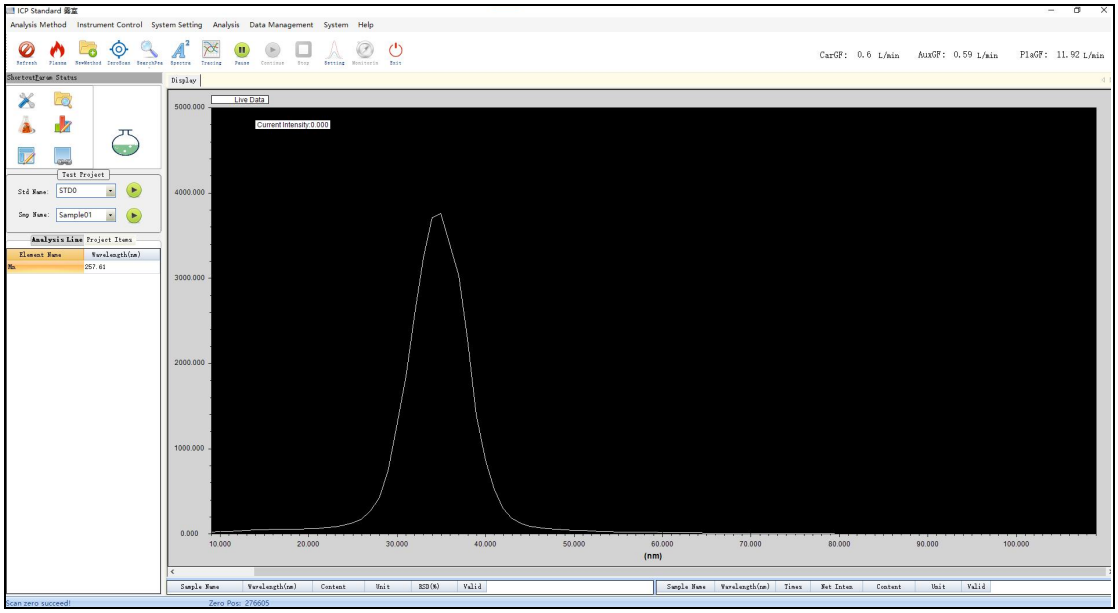
Default setting: restore the factory zero level parameter settings.

Save: Save the current parameter values.

Close: Exit the current form.

6.4.2 Zero level scan

Click“control - >Zero level scan”, The zero scanning operation can be conducted to find the location of the zero light as the measurement reference point. After successful zero search, "Zero success" will be displayed in the status bar in the lower left corner of the main interface. As shown in Pic13 below:



Pic 13 Zero-level parameter setting interface diagram

Tip: If the zero finding fails, check whether the cutting part in the instrument setting is consistent with the grating cutting line used by the instrument, or the first start point position in the zero parameter is too large and the zero light position is skipped.

6.4.3 Skip zero

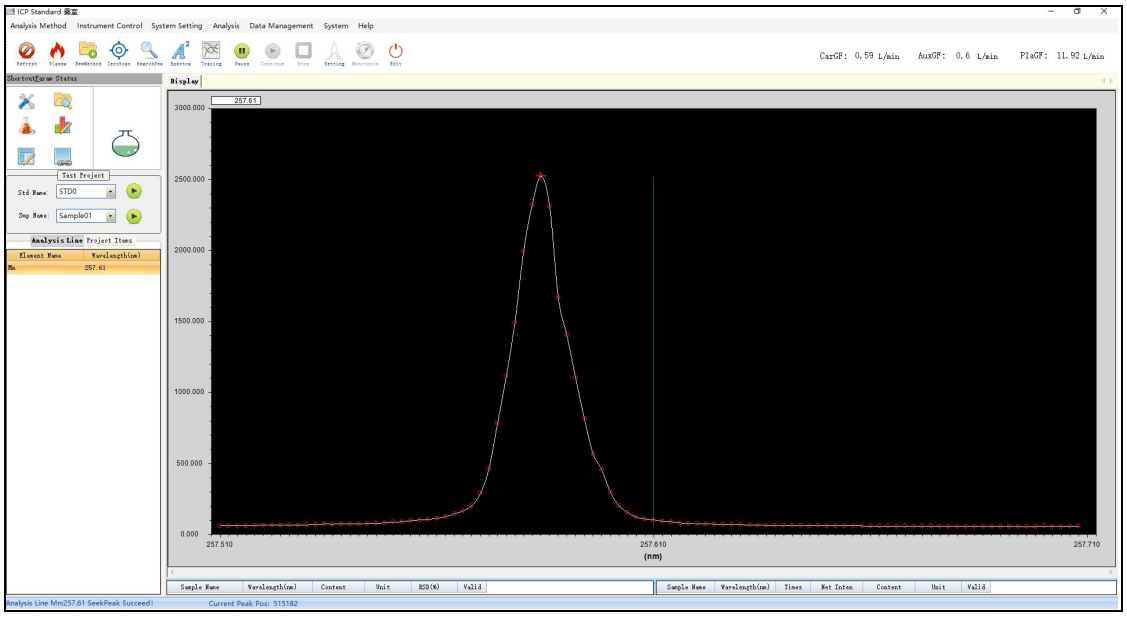
Click “control - >A zero-level scan was skipped”, You can skip the software zero level scanning process, the software "zero success" sign is true, can carry out peak search, measurement and other related operations.

6.5 Analytical measurement

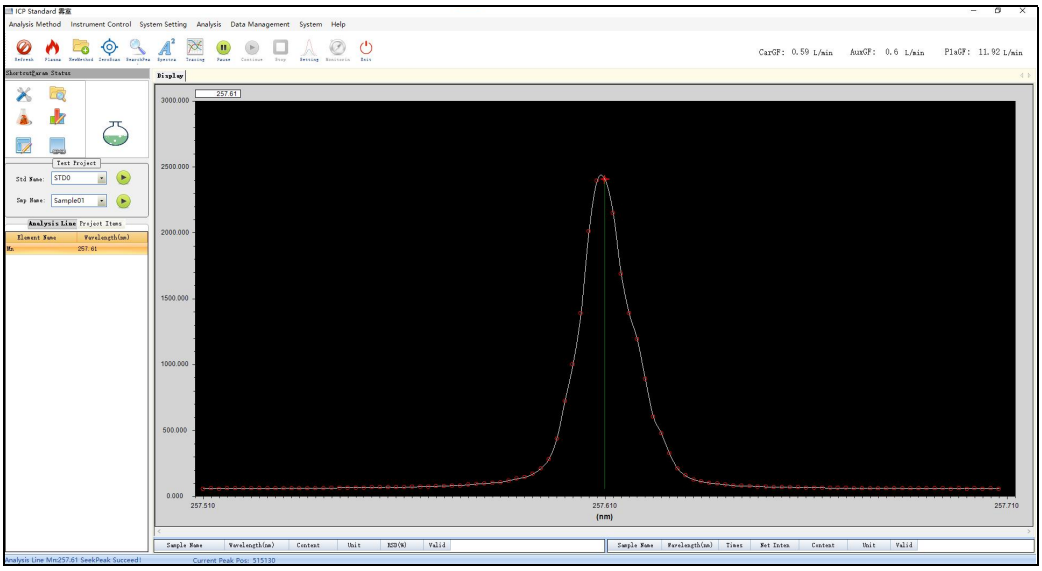
6.5.1 Automatic peak search

After successful zero-finding, select the analytical method,click “Analytical measurement - >Automatic peak search” The software automatically controls to correct the peak position of each analysis line. In the process of continuous peak searching, a spectral line can click after the peak searching “ ” Button pause to look for the peak positions of the next spectral line。

If the peak position of the current spectral line is not in the position indicated by the center line (green), as shown in Pic14, the cross cursor (red) to the peak position, as shown in Pic15, the peak position will be searched according to the return car to complete the peak position correction,click “ ” The next line will be searched for peaks。



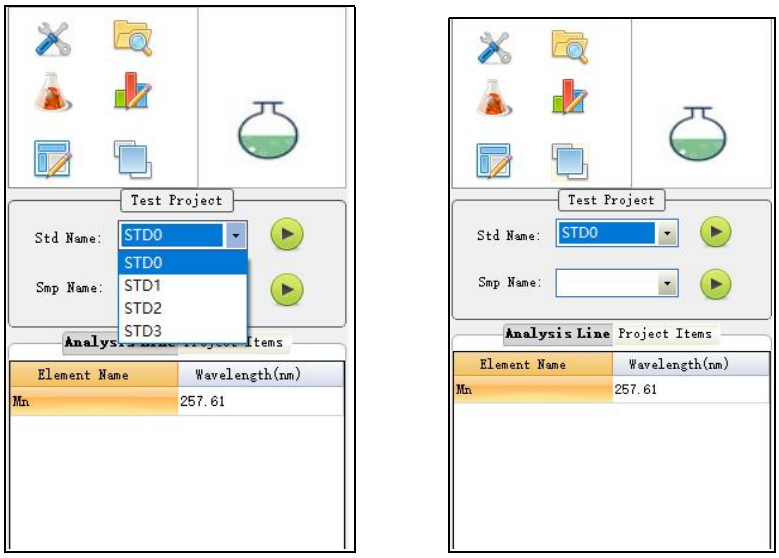
Pic 14 Automatic peak-finding display interface diagram



Pic 15 The interface diagram after automatic peak-finding correction

6.5.2 Metric

After completing the above operations,click “Analytical measurement - >The standard of measurement” Start measuring the standard sample, or click the standard sample name on the left side of the software interface to select the name of the standard sample to be measured for measurement.

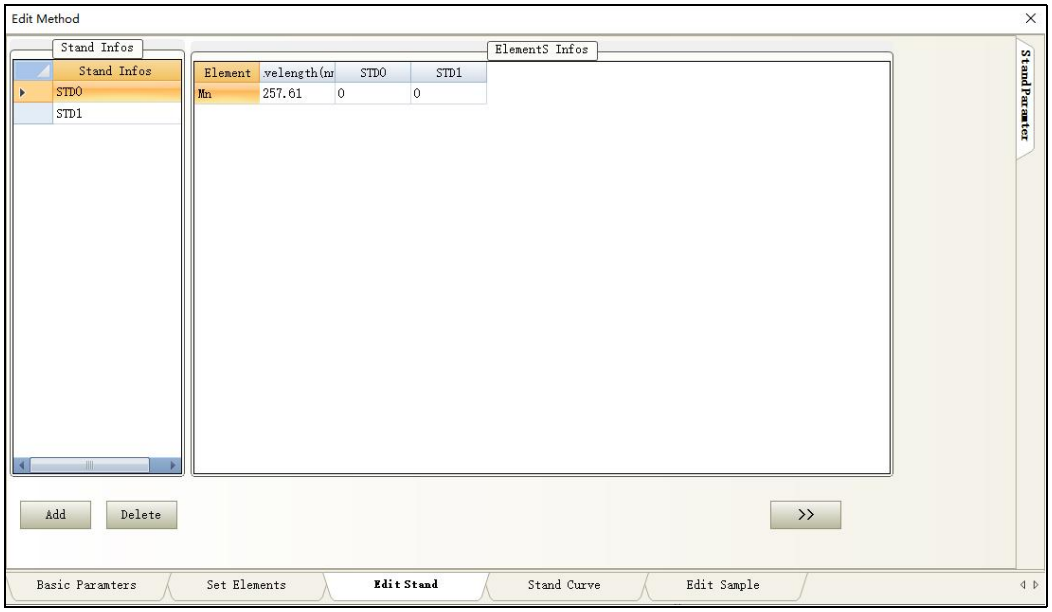


Pic 16 Select the standard solution required to be measured

After a standard sample is measured, the standard solution is replaced and the next standard measurement is continued until all the standard measurement is completed. Then click "OK" in the result display box to save the measurement data as the standard data, as shown in Pic17.

Pic 17 Select box after sample measurement

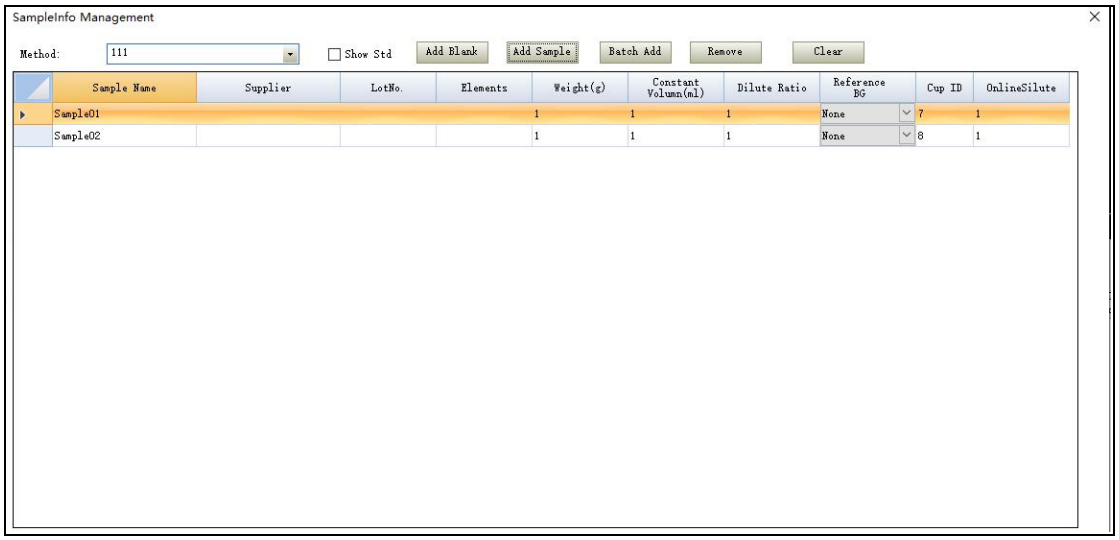
By clicking “document - >Edit the standard”, Or the left-side interface of the software  You can view the standard curve establishment status,As shown in PicPic18 。



Pic 18 Test standard results show Fig

6.5.3 Measure the sample

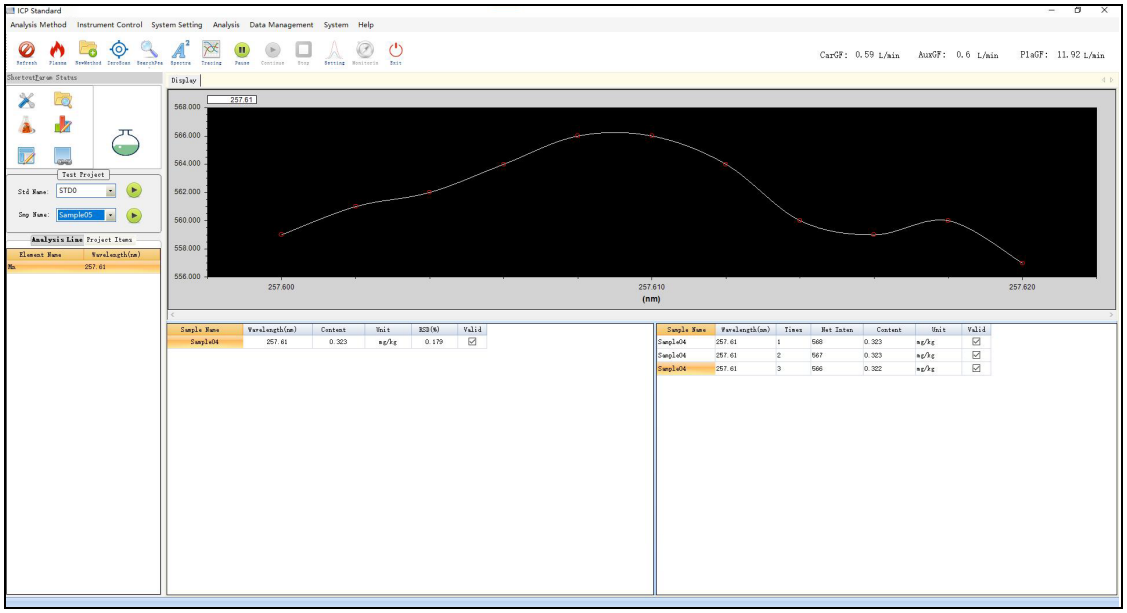
After establishing the standard curve, first edit the sample information (click "Data Management Sample Information"), or click the icon on the left side of the software interface  Do the sample information editing. Click Add to add the sample data to be tested, as shown in Pic19:



Pic 19 Sample information management interface diagram

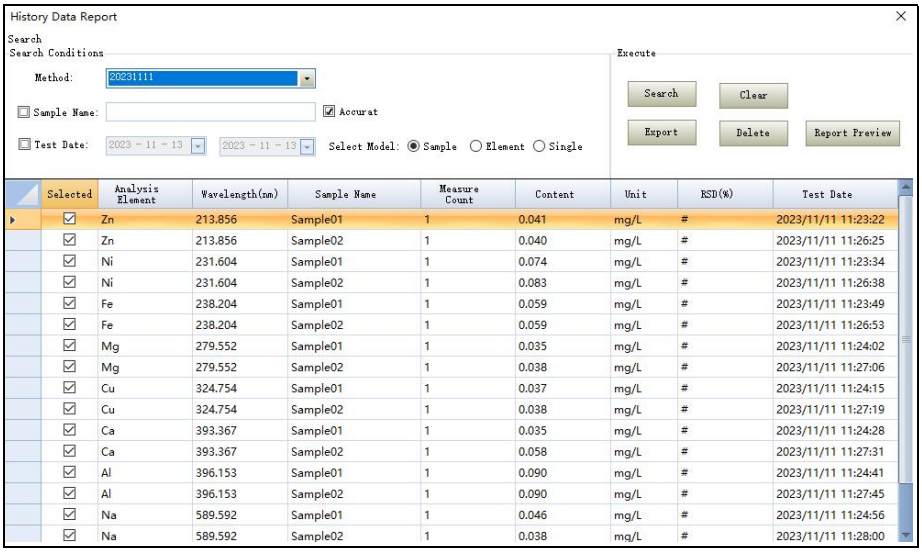
After the editing is completed, all the sample names will be displayed in the "Sample Name" drop-down box. You can select the sample to be measured, and click "Analyze the Measurement Sample" to start the measurement, or click the icon “ 

”。After the measurement, the measurement results will be displayed in the result display box, as shown in Pic20:



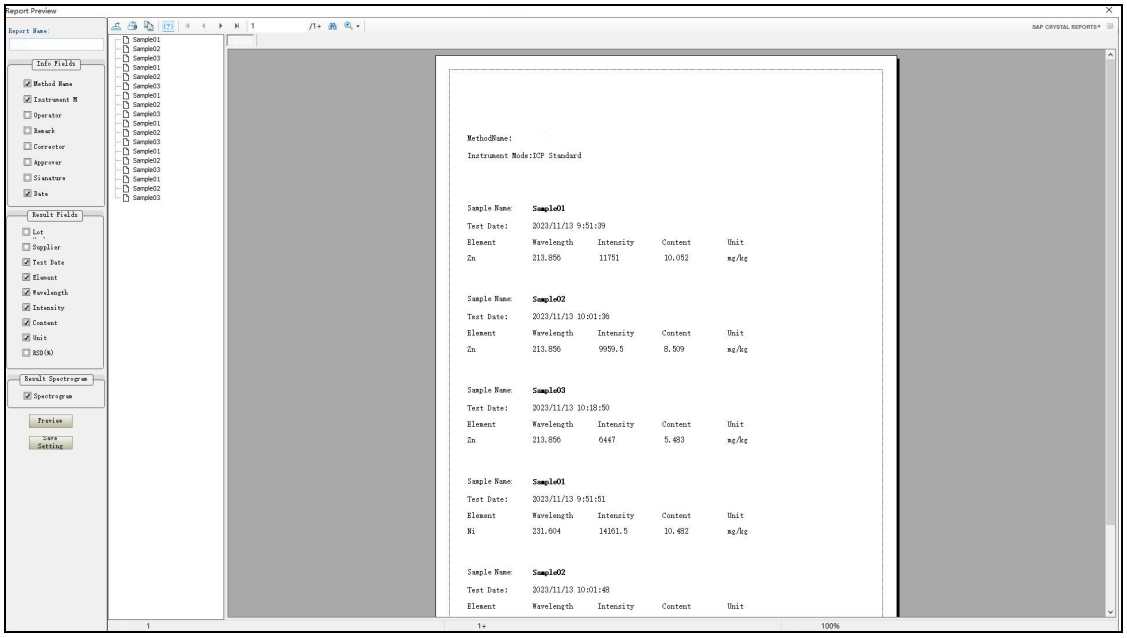
Pic 20 Test results display the interface diagram

Click "Data Management History", enter the historical data report page, click query to preview and analyze the measured sample information. As shown in PicPic21:



Selected	Analysis Element	Wavelength(nm)	Sample Name	Measure Count	Content	Unit	RSD(%)	Test Date
☑	Zn	213.856	Sample01	1	0.041	mg/L	#	2023/11/11 11:23:22
☑	Zn	213.856	Sample02	1	0.040	mg/L	#	2023/11/11 11:26:25
☑	Ni	231.604	Sample01	1	0.074	mg/L	#	2023/11/11 11:23:34
☑	Ni	231.604	Sample02	1	0.083	mg/L	#	2023/11/11 11:26:38
☑	Fe	238.204	Sample01	1	0.059	mg/L	#	2023/11/11 11:23:49
☑	Fe	238.204	Sample02	1	0.059	mg/L	#	2023/11/11 11:26:53
☑	Mg	279.552	Sample01	1	0.035	mg/L	#	2023/11/11 11:24:02
☑	Mg	279.552	Sample02	1	0.038	mg/L	#	2023/11/11 11:27:06
☑	Cu	324.754	Sample01	1	0.037	mg/L	#	2023/11/11 11:24:15
☑	Cu	324.754	Sample02	1	0.038	mg/L	#	2023/11/11 11:27:19
☑	Ca	393.367	Sample01	1	0.035	mg/L	#	2023/11/11 11:24:28
☑	Ca	393.367	Sample02	1	0.058	mg/L	#	2023/11/11 11:27:31
☑	Al	396.153	Sample01	1	0.090	mg/L	#	2023/11/11 11:24:41
☑	Al	396.153	Sample02	1	0.090	mg/L	#	2023/11/11 11:27:45
☑	Na	589.592	Sample01	1	0.046	mg/L	#	2023/11/11 11:24:56
☑	Na	589.592	Sample02	1	0.038	mg/L	#	2023/11/11 11:28:00

Pic 21 Query interface

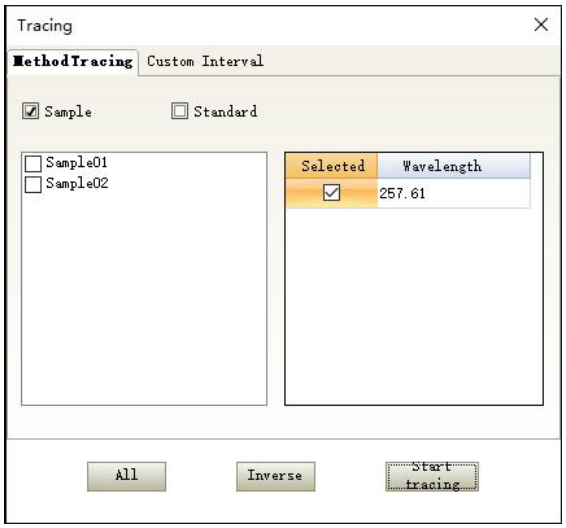


Pic 22 Report preview diagram

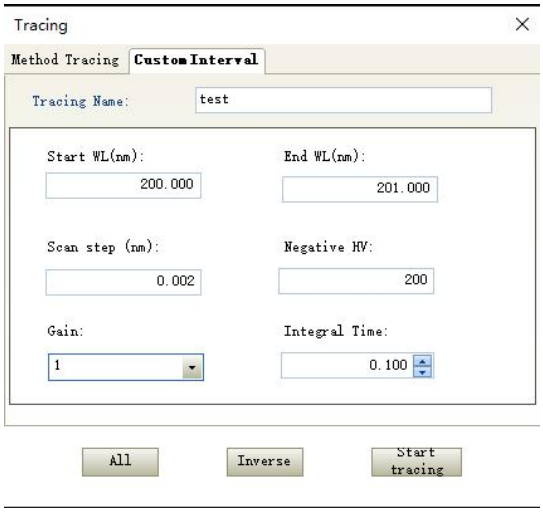
You can also set the name of the analysis report and the contents of the report (including information fields and result fields). After setting, you can click "Save Settings" to save the setting. Click Preview to preview the report content to preview the generated analysis report. click “ ” You can save the report and click “ ” You can print the current report directly.

6.5.4 Interval tracing

Click "Analyze the measurement line trace" to pop up the dialog box as shown in Pic23. Select the sample name to trace and then click Start trace to perform the sample tracing test:

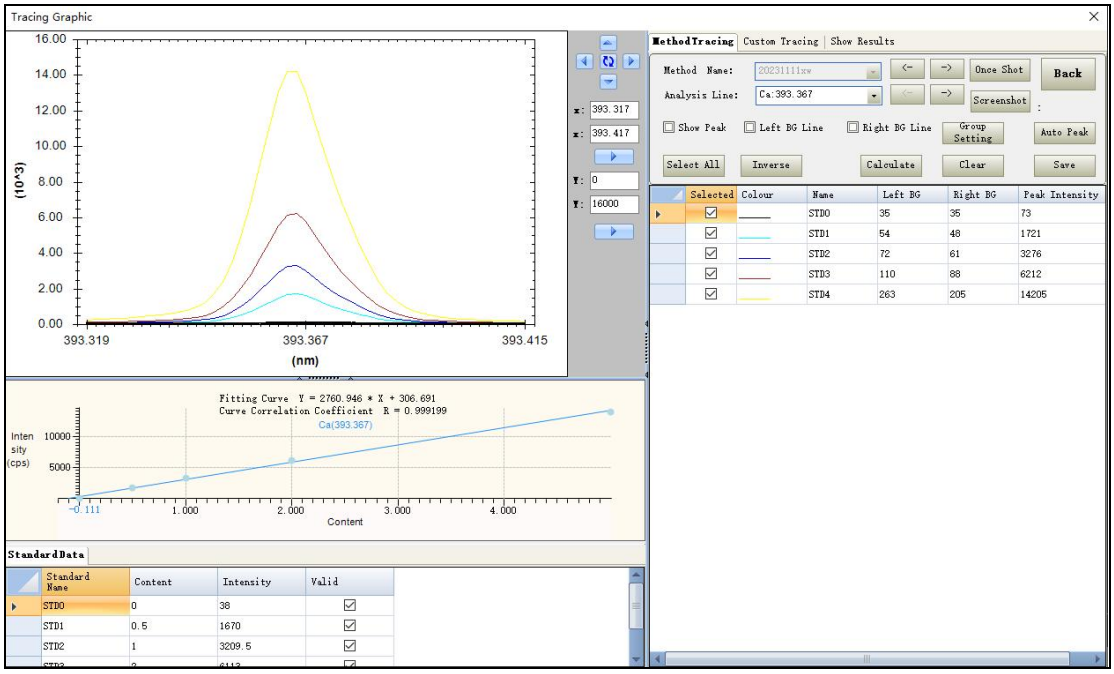


Pic 23 Interval tracing method editing interface



Pic 24 Interval tracing for self-defined trace Intersection editing interface

In method tracing, select the sample or sample to trace all lines in the current open method. You can also customize the trace interval and set its trace parameters (negative high pressure, gain, integration time), enter the trace name, and click "OK" to start the trace. After the tracing completion, the software automatically saves the information of the trace. You can view trace information through Data Management trace Drawing.



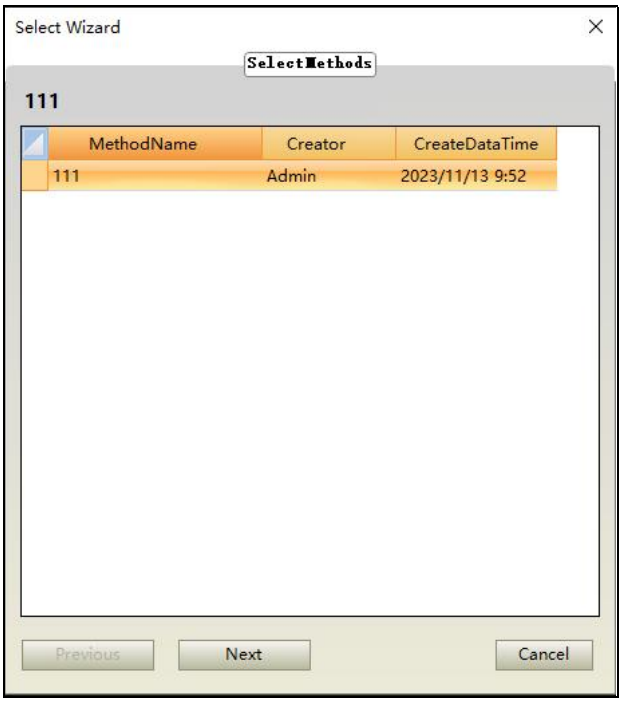
6.6 Shut down

Step: Click “ Plasma ” Enter the plasma control interface, click "turn off" and wait for 2 minutes. After the torch tube cooling, close the gas valve and peristaltic pump, and finally cut off the air switch (black) of the solid power supply, and then close the main power switch (red) to complete the shutdown.

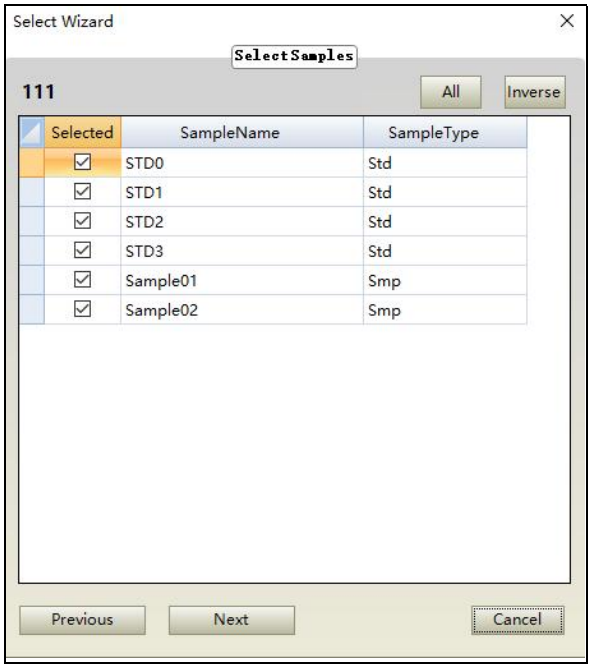
6.7 Data management

6.7.1 Sketch diagram

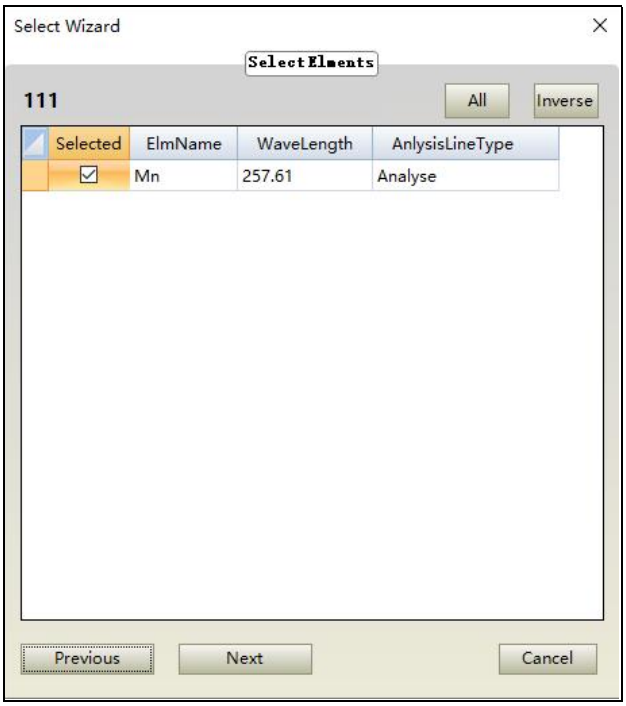
Click "Data Management Drawing Picture" to pop up the drawing picture window, as shown in Pic25, select the corresponding test method to record and click Next:



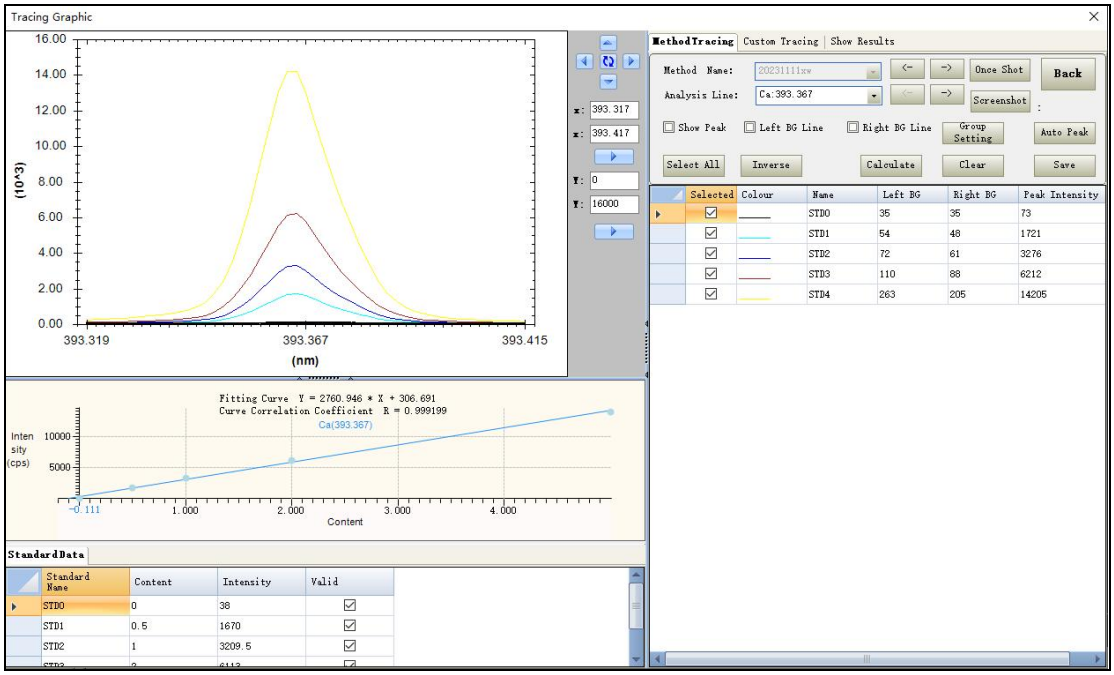
After selecting the sample name to be viewed, select the next step:



After selecting the illustration of the elements to view, click Next:



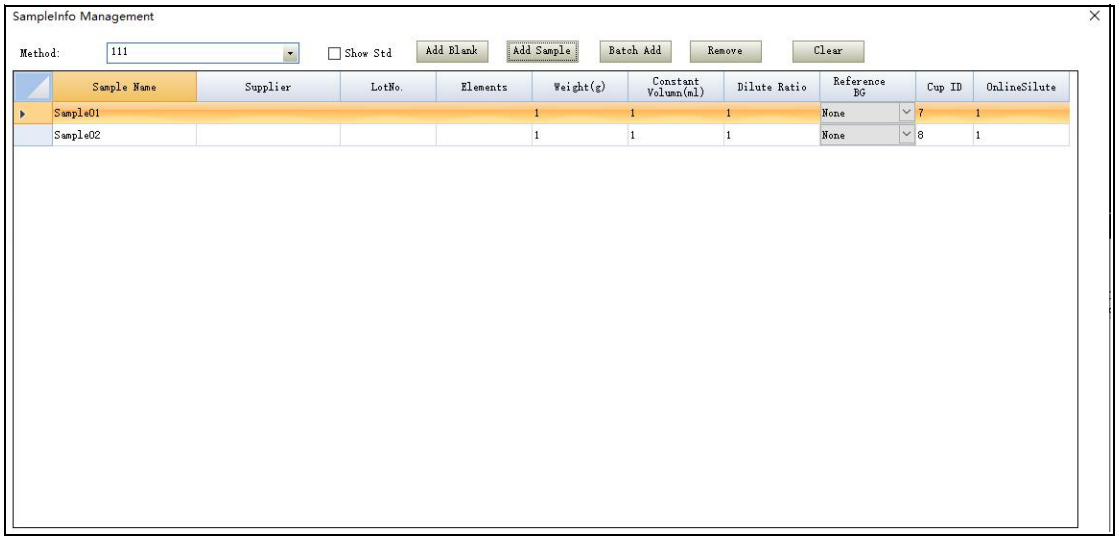
After selecting the corresponding element, the description of the sample shown in FIG. 26 is entered:



Pic 26 Tracing diagram interface diagram

6.7.2 Sample information management

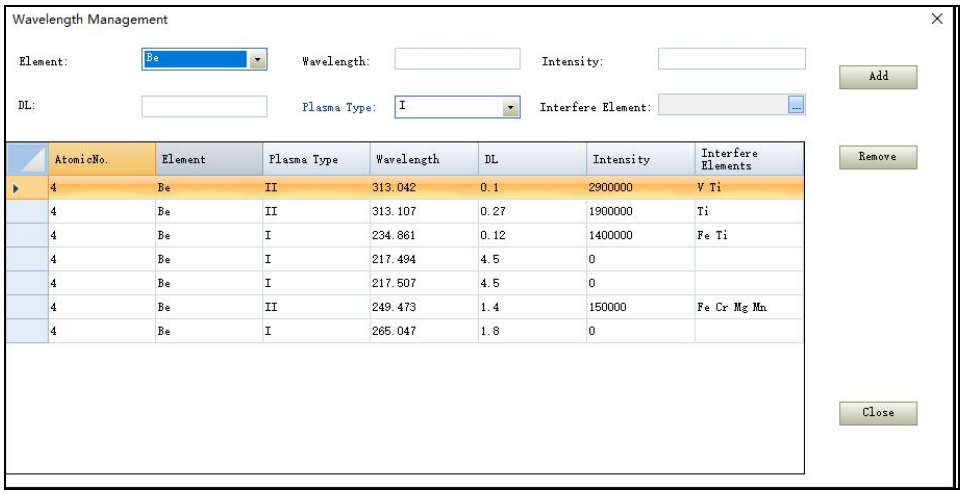
As shown in Pic27, addition, deletion, empty, and save operations can be performed. For the three column information of sample weight, fixed volume and dilution multiple, you can fill the same value as the first row of all samples by double-clicking the corresponding column head.



Pic 27 Sample management interface diagram

6.7.3 Wavelength library

As shown in Pic28, you can add a new wavelength or delete the currently selected wavelength (add a unique wavelength value, cannot delete the already selected wavelength in the method).

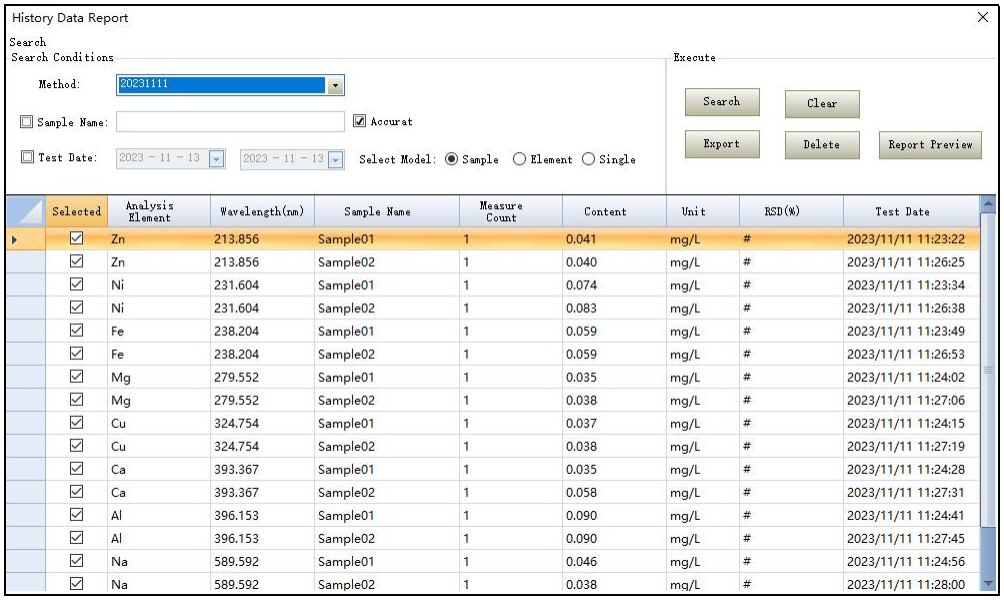


AtomicNo.	Element	Plasma Type	Wavelength	DL	Intensity	Interfere Elements
4	Be	II	313.042	0.1	2900000	V Ti
4	Be	II	313.107	0.27	1900000	Ti
4	Be	I	234.861	0.12	1400000	Fe Ti
4	Be	I	217.494	4.5	0	
4	Be	I	217.507	4.5	0	
4	Be	II	249.473	1.4	150000	Fe Cr Mg Mn
4	Be	I	265.047	1.8	0	

Pic 28 Interface diagram of the wavelength library maintenance

6.7.4 Surveying record

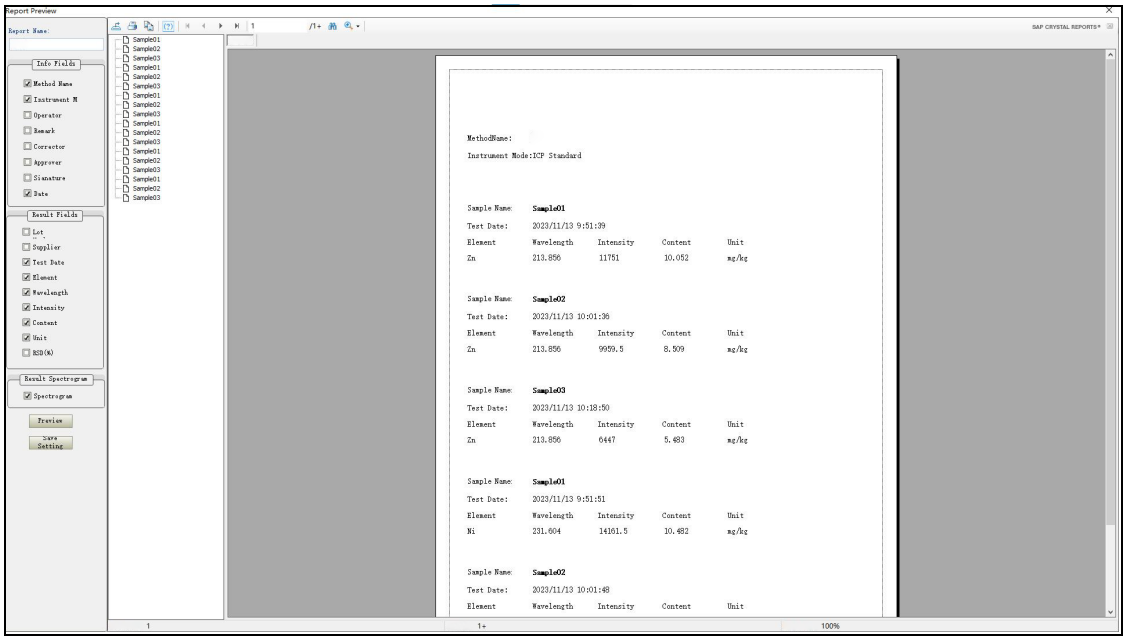
"Data Management History", you can select the analysis method, sample name (exact match and fuzzy match), measurement date query, and can export Excel save.



Selected	Analysis Element	Wavelength(nm)	Sample Name	Measure Count	Content	Unit	RSD(%)	Test Date
☑	Zn	213.856	Sample01	1	0.041	mg/L	#	2023/11/11 11:23:22
☑	Zn	213.856	Sample02	1	0.040	mg/L	#	2023/11/11 11:26:25
☑	Ni	231.604	Sample01	1	0.074	mg/L	#	2023/11/11 11:23:34
☑	Ni	231.604	Sample02	1	0.083	mg/L	#	2023/11/11 11:26:38
☑	Fe	238.204	Sample01	1	0.059	mg/L	#	2023/11/11 11:23:49
☑	Fe	238.204	Sample02	1	0.059	mg/L	#	2023/11/11 11:26:53
☑	Mg	279.552	Sample01	1	0.035	mg/L	#	2023/11/11 11:24:02
☑	Mg	279.552	Sample02	1	0.038	mg/L	#	2023/11/11 11:27:06
☑	Cu	324.754	Sample01	1	0.037	mg/L	#	2023/11/11 11:24:15
☑	Cu	324.754	Sample02	1	0.038	mg/L	#	2023/11/11 11:27:19
☑	Ca	393.367	Sample01	1	0.035	mg/L	#	2023/11/11 11:24:28
☑	Ca	393.367	Sample02	1	0.058	mg/L	#	2023/11/11 11:27:31
☑	Al	396.153	Sample01	1	0.090	mg/L	#	2023/11/11 11:24:41
☑	Al	396.153	Sample02	1	0.090	mg/L	#	2023/11/11 11:27:45
☑	Na	589.592	Sample01	1	0.046	mg/L	#	2023/11/11 11:24:56
☑	Na	589.592	Sample02	1	0.038	mg/L	#	2023/11/11 11:28:00

Pic 29 Survey and record query and display interface

Select one or more history records, and click Report Preview to view the history reports. As shown in PicPic30:

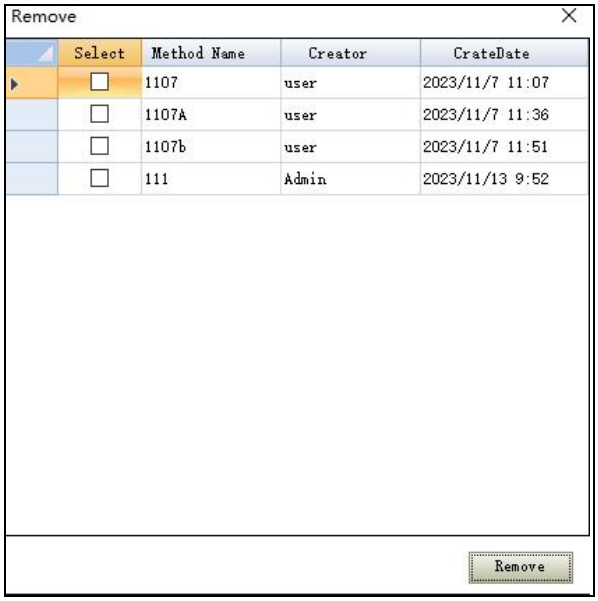


Pic 30 Report to the preview interface diagram

6.7.5 Analytic procedure

6.7.5.1 Removal method

Click "File Delete Method" to display the dialog box as shown in Pic31. Select one of the methods (not the currently open method) and click "Delete" to delete the method.

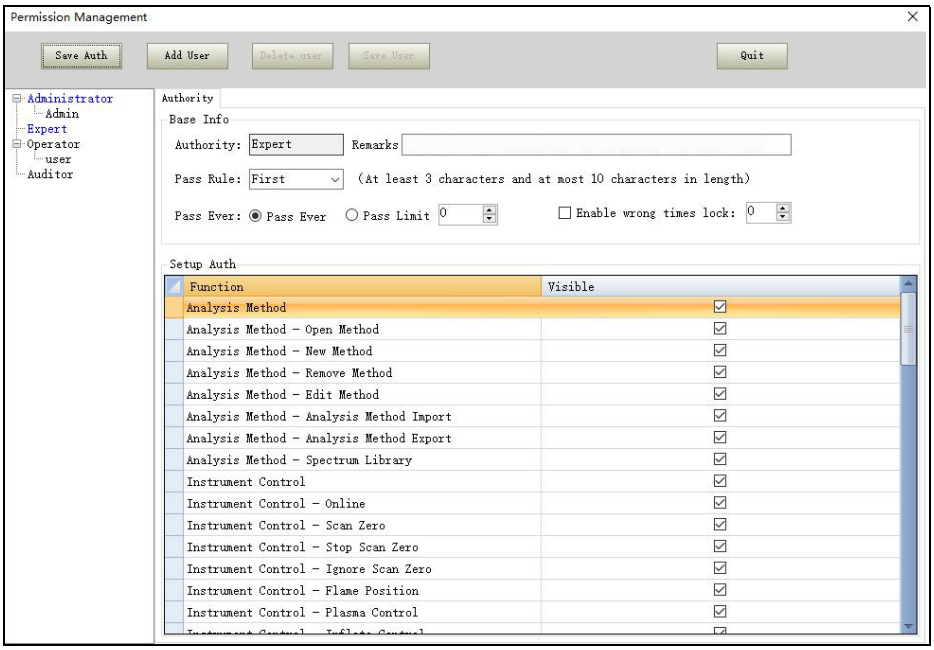


Pic 31 Method management interface diagram

6.8 User management；user administration

6.8.1 Authority management

As shown in Pic32, the permissions are divided into three levels: Administrator, Expert and Operator, and different operation rights can be set for users at each level. This operation is only owned by the Admin.



Pic 32 Rights management interface diagram

6.8.2 User management

The administrator (Admin) has permission to add, delete user, change user permission, change password, and other levels of users only have permission to change password. As shown in PicPic33:

Pic 33 User management password modification interface diagram

6.8.3 User switch

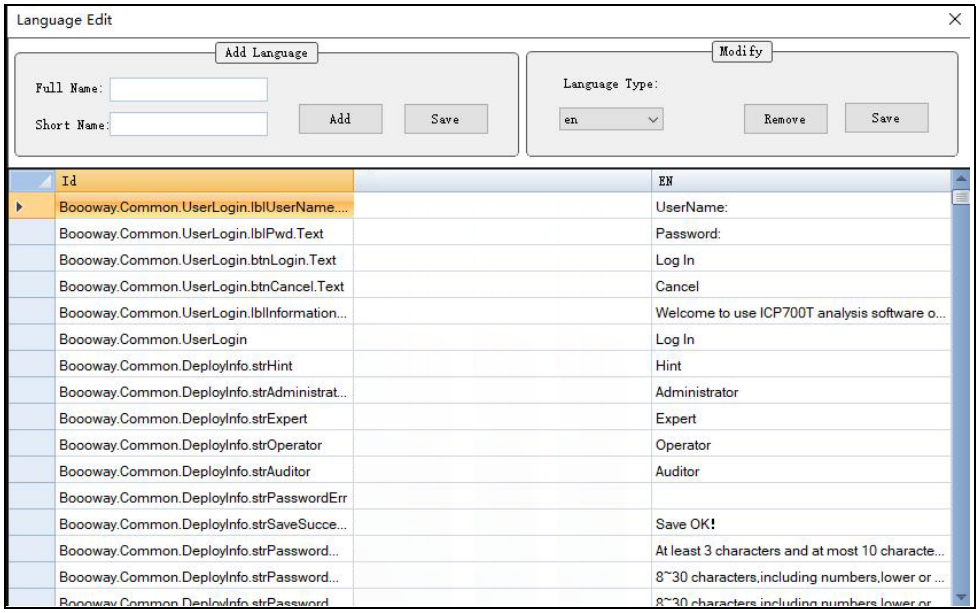
As shown in Pic34, select the account to be logged in, enter the corresponding password and click "Login" to switch the user.

Pic 34 User login interface diagram

6.9 Language

6.9.1 Language editor

As shown in Pic35, you can add, delete, and modify the UI display language.



Pic 35 Language editing interface diagram

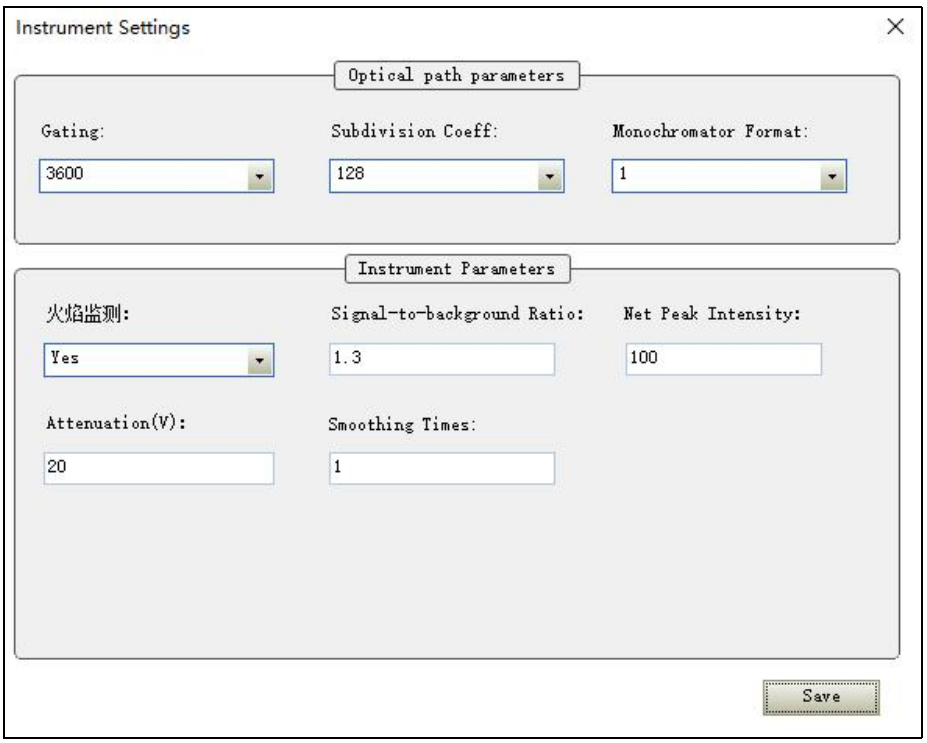
6.9.2 Language switching

All the languages added above are added as the submenu to the language menu bar of the main interface and can be switched through.

6.10 Additional function

6.10.1 Instrument parameter

Click "System Parameters" to pop up the dialog box shown in Pic36 to set the relevant parameters (this parameter will be set when the factory, the user does not need to change it).



Pic 36 Instrument parameter setting diagram

6.10.2 Flame position adjustment

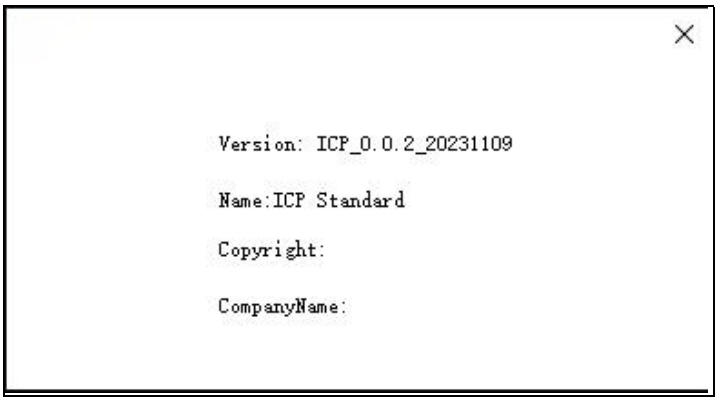
As shown in Pic37, the observation height adjustment range is 0-20mm, and the height position is observed by controlling the flame adjustment of the torch tube motor.

Pic 37 View the height adjustment interface Fig

6.11 Assist

6.11.1 About

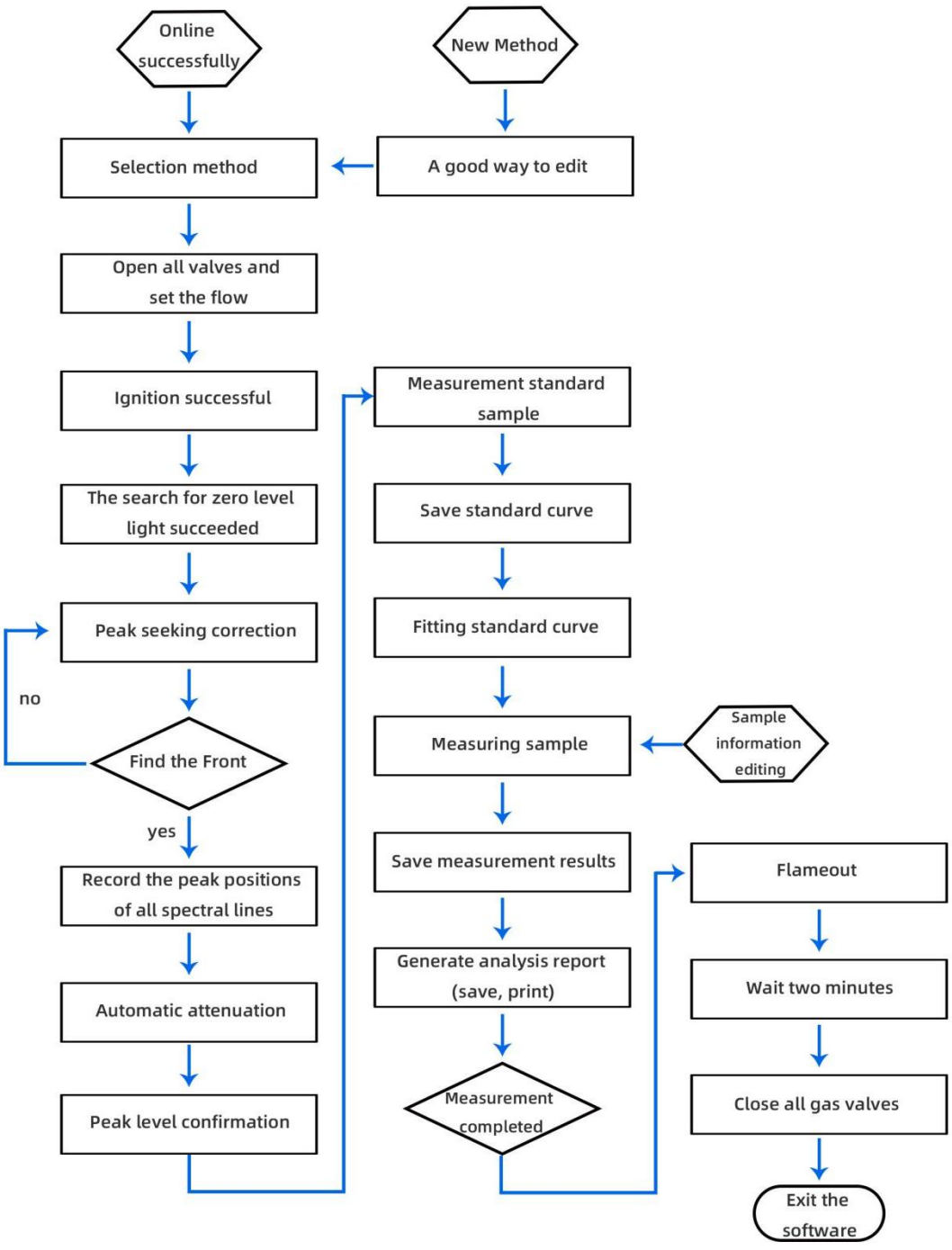
Displays the software version, ownership and other related information. As shown in PicPic38:



Pic 38 Software version information interface diagram

6.12 Attached map [drawing

6.12.1 Flow chart of the software operation



Pic 40　Software flow pattern

Chapter Ⅶ Maintenance and maintenance of the products

ICP700T, able to analyze the concentration from several ppb to a few or even a few percent of the sample. If the analytical environmental conditions are not strictly controlled, it also requires strict maintenance of the instrument to strictly control the analytical quality and extend the life of the instrument.

7.1 Cleaning of the laboratory utensils

Commonly used laboratory utensils, such as beakers and volumetric flasks, need to be cleaned before use. Polytetrafluoroethylene (PTFE) and borosilicate glassware can be cleaned with soap or detergent, rinsed with water, and then soaked in (1+1) HNO3 for 24 hours (or boiled). Wash with water and deionized water (three times). Some glassware has severe oil stains, which can be soaked in detergent (prepared with concentrated sulfuric acid and potassium dichromate) and then thoroughly rinsed with water.

7.2 Use and maintenance

7.2.1 Environment

This instrument requires that the room temperature is generally maintained at a fixed temperature between 20 and 25 ° C, and the temperature change should be less than ± 1 ° C. Indoor humidity should be less than 70%, the best control between 45%~60%, and equipped with air purification device.

7.2.2 Power supply circuit

In order to ensure the safe operation of the ICP instrument, the power supply line must have a large enough capacity, otherwise the voltage of the line will be too large when the instrument runs, which will affect the life of the instrument. Refer to the Instrument Installation Conditions for specific requirements for the circuit environment.

7.2.3 Dustproof

Laboratory need to use exhaust fan, eliminate the heat of the instrument and working toxic gas, laboratory and external pressure difference, laboratory produce negative pressure, outdoor air containing a lot of dust from the window gap into the indoor, a large number of accumulation in all parts of the instrument, easy to cause high voltage components or joint ignition, circuit board and wiring, socket short circuit, leakage and other kinds of faults, therefore, the need to often dust removal. In particular, the computer, electronic control circuit, high frequency generator, display, printer, disk drive, etc., regularly remove or open, with a small brush cleaning, and at the same time use a vacuum cleaner to each part of the dust suction. On the photomultiplier tube negative high voltage power line, and the high voltage line and joint of the computer display, but also with gauze stained with a little absolute alcohol carefully wipe away the carbon and dust. After the disk drive and printer remove the dust, add a little instrument oil to the mechanical moving parts. The print head of the printer should be removed, swept with a soft brush, and wiped with a flannelette to prevent the pinhole from being blocked by paper scraps, and then adjust a certain printing pressure

according to the instructions. For the instrument dust removal, generally by the electronic, instrument repair or computer professional personnel to help, if the instrument use or management personnel do not understand the electronic knowledge, do not understand the structure of the instrument, do not easily touch, in order to avoid accidents, dust removal should be stopped in advance and turn off the power supply before proceeding.

7.2.4 Maintenance of the atomizer

The atomizer is the most fragile and critical part of the injection system, which requires good maintenance and use. To regular cleaning, especially after the determination of high salt solution, the top of the atomizer, the torch tube nozzle will accumulate salt, resulting in poor aerosol channel, often reflects the decrease of the measurement intensity, the reflection power of the instrument, etc. Dust or carbon accumulation on the torch will affect the ignited plasma flame torch and maintain stability, and also affect the reflected power. Therefore, it should be washed regularly, washed, and finally, wash with absolute ethanol and blow dry, and keep the injection system and the torch tube clean.

7.2.5 Reduce the number of start and stop times in use

Start before determination, must be arranged, do the preparation work in advance, avoid by all means in the same time frequently open, the instrument frequently open easy to cause damage, this is because the instrument at every time open, instantaneous current greatly higher than the normal current, instantaneous pulse impact, easy to cause power tube, vacuum capacitor and other chip damage.

7.2.6 Other matters needing attention

1. Inspection of the incoming and forward sample system;

2, the determination of the backward sample system inspection and cleaning;

3, the waste liquid in the waste liquid bucket should be cleaned up frequently;

4, torch tube, atomizer, fog chamber cleaning;

5. Regular replacement of cooling water;

6. Please note before each startup: when the plasma gas is less than 1 Mpa and can only ignite for one hour, it is recommended to replace the gas cylinder;

7, the instrument ignited can not casually adjust the plasma gas flow meter and pressure gauge, otherwise it will burn out the quartz torch pipe;

8, the instrument ignited the capillary must be placed in the solution, the solution of the capillary from the liquid (into the air) can not be more than 10 seconds, otherwise it will lead to flameout;

9. If the quartz torch tube is found to be very dirty, please clean it in time;

10. Pay attention to remove and assembling torch, sprayer and fog chamber (quartz glass products are fragile).

Chapter Ⅷ Fault analysis and troubleshooting

Common fault phenomena and related solutions:

8.1 Ignition failed

1) According to the software prompt, to see if there is a hint of insufficient airflow. If indicated, please check the gas route as indicated and replace the gas cylinder if necessary.

2) Check whether the cooling water tank is opened and whether the water pressure is normal (not less than 0.1MPa);

3) Check whether the torch line is connected to the torch tube.

4) Check whether the injection tube has been inserted into the solution to form a liquid seal.

8.2 Click in the sample to prepare for the fire extinguishing

1) Check whether the capillary tube is not placed in the solution, resulting into the air;

2) The gas pressure is too large, generally limited to 0.3MPa-0.35MPa. Please check the cylinder pressure to confirm whether the pressure is within this range.

8.3 Software failed online

1) Check whether the network cable contact is good;

2) Check whether the instrument is powered on.