ICP700T
Inductively Coupled Plasma Emission Spectrometer
User Manual

DRAWELL
Artist of Science

Please read operating manual before installation and operation.

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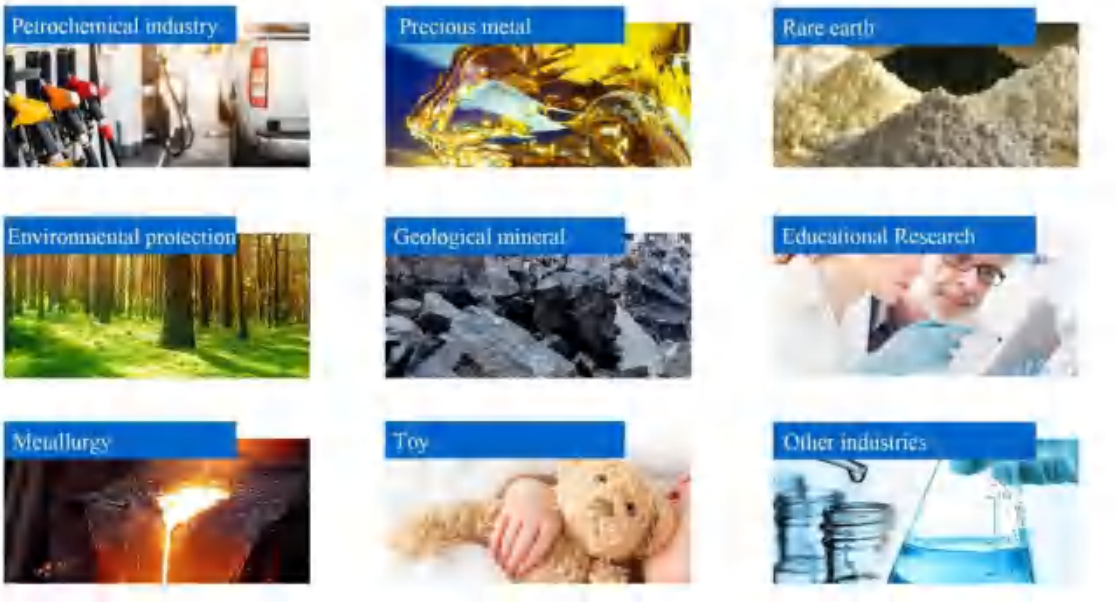
Catalogue

Chapter I　Overview

1.1　Product overview

Inductively coupled plasma emission spectrometer's full name is single cha nnel scanning inductively coupled plasma emission spectrometer（Inductively Co upled Plasma），mainly used in rare earth industry，silicon industry，petroche mical industry，ore analysis，metal smelting，geological research，drug safety，experimental research，environmental detection and other fields.



Chapter II Instrument Composition And Working Principle

2.1 Basic principles of instruments

The instrument mainly consists of the following main parts: host control system，power matching system，sampling system，etc.，as detailed below：

2.1.1 Instrument appearance

The appearance of this instrument is shown in the following figure

Figure 1 Instrument appearance diagram

2.1.2 Internal structure diagram of the instrument

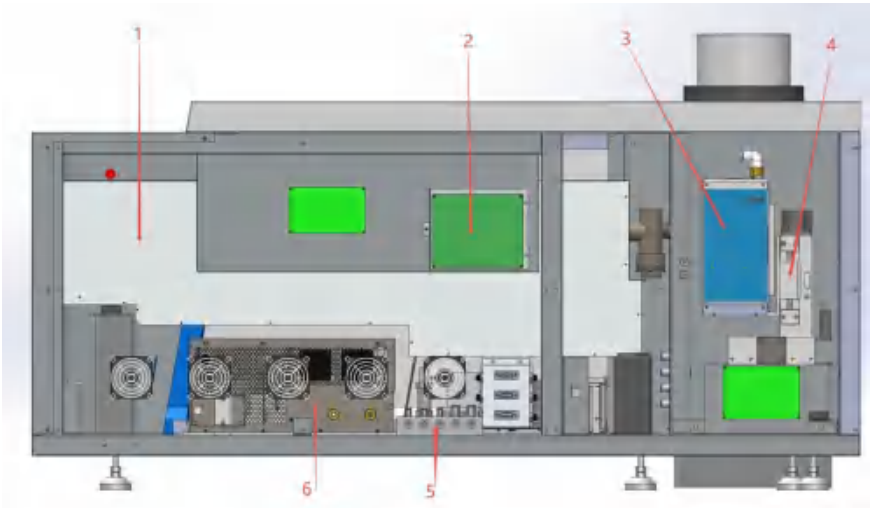


Figure 2 Internal structure diagram of the instrument

1.Spectroscopic system	2.Main control system	3.Matcher	4.Mobile platform

5.Cooling the water route protection system	6.Solid-state RF power supply		

2.1.3 Automatic observation and regulation system

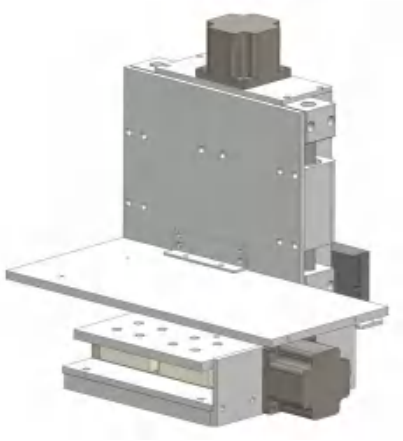


Figure 3 Automatic regulation platform

Automatic observation and adjustment platform: The automatic observation pla tform has adjustable X-axis and Y-axis directions，and is automatically controlled by computer software to adjust the size of the flame core position to achieve the optimal observation position.

2.1.4 Sample injection system

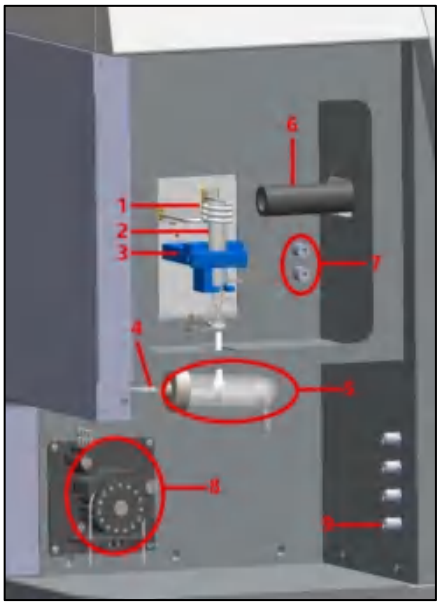


Figure 4 Sample injection system

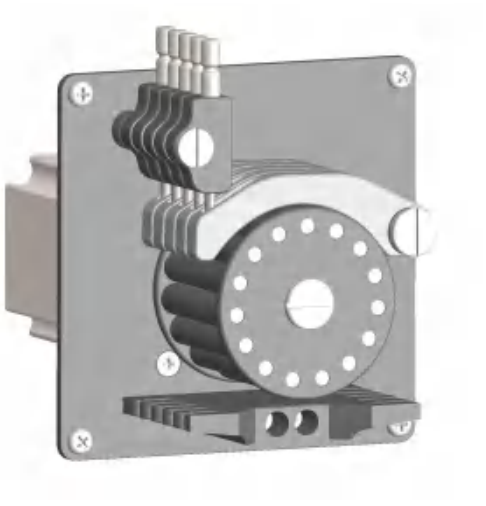


Figure 5 Peristaltic pump system

1.High-frequency coil	2.Torch tube	3.Torch tube fixing device

4.Atomizer	5.Atomization chamber	6.Lens cone
7.Auxiliary gas and plasma gas joints	8.Peristogenic pump gas inlet	9.Carrier gas inlet

The sample injection system mainly includes: atomizer，dual tube fog cha mber，plasma gas，carrier gas，auxiliary gas，torch tube，peristaltic pump.

2.1.5 Water cooling and gas interface

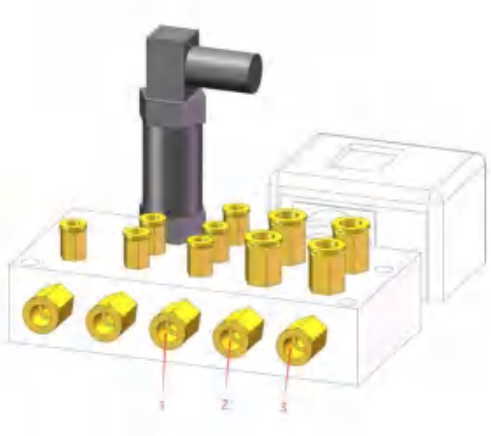


Figure 6 Water and gas circuit module

1.Gas interface（Plasma gas，auxiliary gas，carrier gas）	2/3.Water cooling inlet and outlet

2.2 Basic working principle of the instrument

The basic working principle of this instrument is as follows:

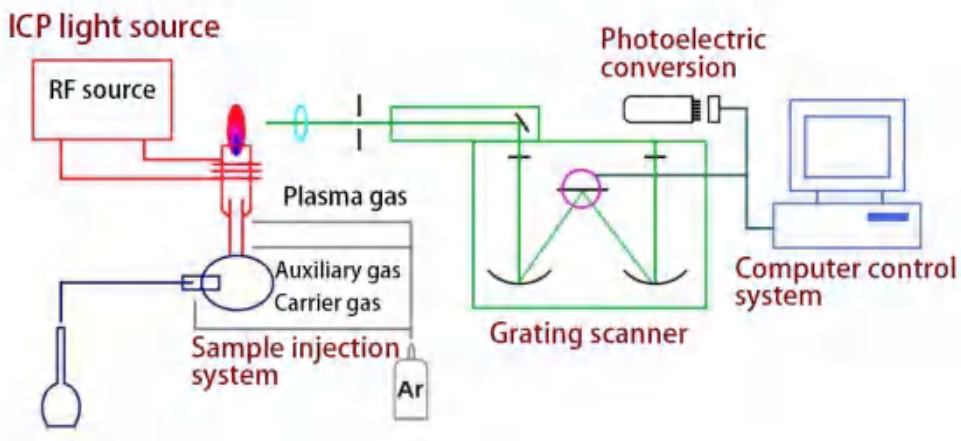


Figure 7 Working schematic diagram

Working principle: The high-frequency power generated by the RF generator is applied to a three-layer concentric quartz torch tube through an induction coil，forming a high-frequency oscillating electromagnetic field；Inject argon gas into the outer layer of the quartz torch tube and perform high-voltage discharge to generate charged particles.The charged particles move back and forth in a high-frequency electromagnetic field and collide with other argon atoms，producing more charged particles.At the same time，the temperature rises，ultimately forming an argon plasma with a temperature of 6000K-8000K.The aerosol formed by the atomizer of the test aqueous solution sample enters the central channel of the quartz torch tube and is excited at high temperatures，emitting characteristic spectral lines of the elements contained in the solution；By illuminating the plasma light source and using a scanning spectrometer for scanning and splitting，the characteristic spectral line intensity of the element to be measured is accurately determined to be located at the exit slit.The spectral line intensity is converted into photocurrent using a photomultiplier tube，and then processed by a circuit and analog-to-digital converter before entering the computer for data processing.Finally，the analysis results are printed out by a printer.

2.3 Operating principle of the key components of the instrument

2.3.1 Formation principle of an inductively coupled plasma ICP

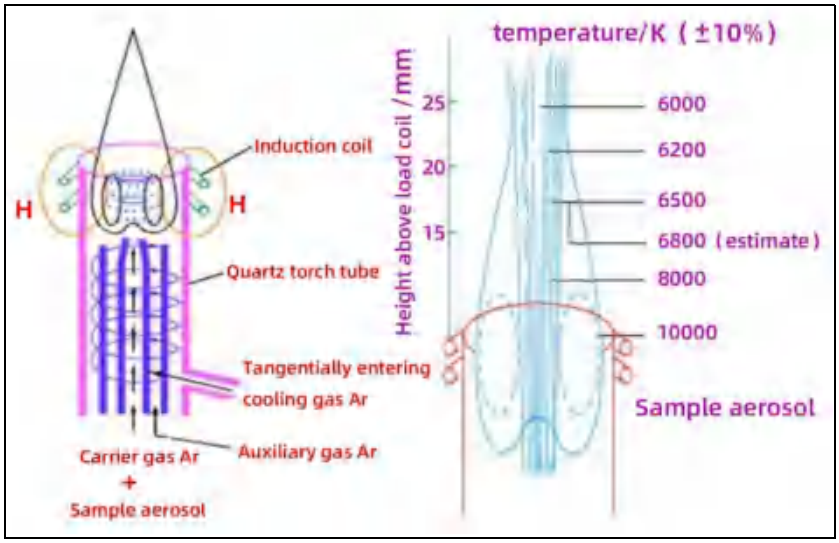


Figure 8 Principles of ICP formation

The main function of a high-frequency generator is to generate a high-frequency electromagnetic field and supply plasma energy.The torch tube is a three-layer concentric quartz glass tube，with cooling argon gas flowing into the outer tube to prevent the plasma torch from burning out the quartz tube.The outlet of the middle quartz tube is shaped like a horn and argon gas is introduced to maintain the plasma.The inner diameter of the inner quartz tube is 1mm-2mm，and the sample aerosol is introduced into the plasma from the inner tube by a carrier gas.

When the high-frequency power supply is connected to the load induction coil surrounding the plasma torch tube，high-frequency induced current flows through the coil，generating an axial high-frequency magnetic field.At this time，cooling argon gas is introduced into the tangential direction of the outer tube of the torch tube， and auxiliary gas argon gas is introduced into the axial (or tangential) direction of the middle tube.A high-frequency ignition device is used to excite and generate charged particles.When the number of charged particle streamers is sufficient to give the gas sufficient conductivity， a circular eddy current is generated in the cross-section perpendicular to the magnetic field direction.A powerful induction current of several hundred amperes instantly heats the gas to 6000K-8000K， forming a stable plasma torch in the shape of a torch above the torch mouth.

2.3.2 Solid-state generator and automatic matching box

Solid-state generator

High frequency generators have many advantages such as smaller size，higher output power，more stable frequency power，and higher power efficiency.

Automatic matching box

The automatic matching box has the advantages of fast matching speed and high accuracy，which eliminates many troublesome operations of manual matching.

2.3.3 Scan the light divider

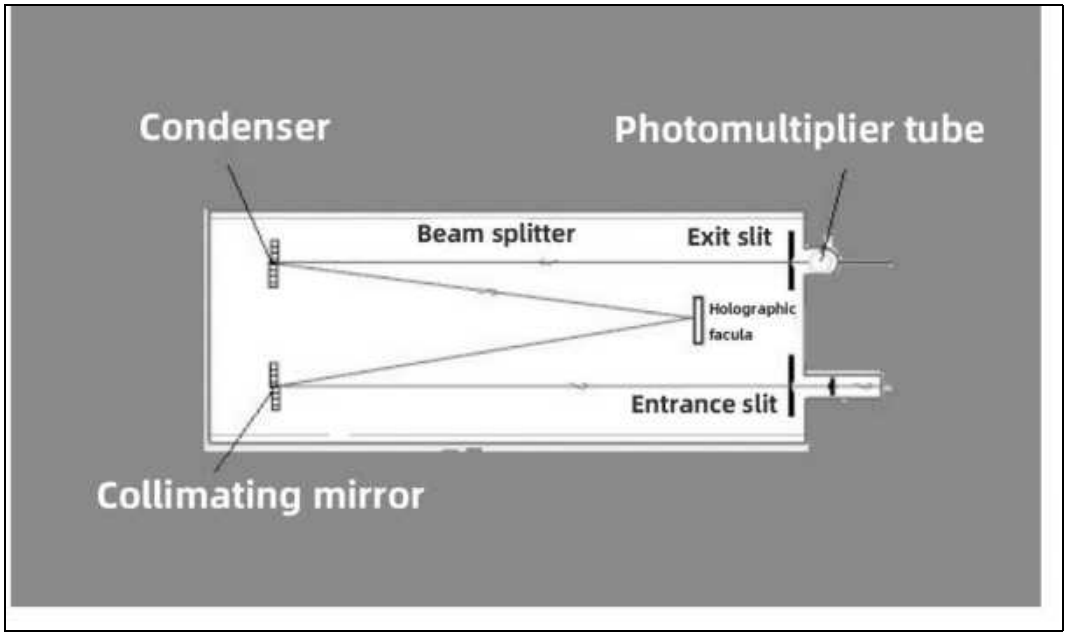


Figure 9 Working schematic diagram of the scanning spectrometer

The spectrometer consists of a light chamber, an incident slit, a reflector, a grating, an exit slit, and a grating driving device.The grating line density is optional, with specifications of 2400L/mm, 3600L/mm, or 4320L/mm.The com posite light emitted by ICP passes through the incident slit and is reflected by the mirror onto the grating for diffraction, generating monochromatic light. Controlled by a computer, the grating driving device rotates the grating to refl ect the required spectral wavelengths onto the exit slit.The photomultiplier tube receives the light signal and performs photoelectric conversion, followed by in tensity detection and comparison.

2.3.4 Electronic measurement and control circuits

The circuit system has three functions: communication, gas circuit control, signal acquisition circuit.

2.3.4.1 Communication

Use RJ45 Ethernet port 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 circuit control

The gas circuit adopts advanced MFC (Mass Flow Controller) as the contr ol component，which controls plasma gas，carrier gas，and auxiliary gas separ ately.It has high control accuracy，fast response speed，and stable flow rate.At the same time，it has flow feedback function，which can monitor the actual fl ow rate of each gas in real time，ensure the stability of the injection system，and improve the repeatability and stability of the instrument.

2.3.4.3 Signal acquisition circuit

A high-precision and high impedance operational amplifier is used as the signal output adjustment amplification circuit，and the amplification signal of th e amplifier is controlled by the central processor.The signal is converted from primary I/V to secondary signal and amplified before being output to the VF c onversion chip.It is then counted by FPGA and connected to the computer thro ugh the network port for data processing.The entire circuit is supplied by a lin ear power supply.

Chapter III Installation Of Instruments

3.1 Instrument installation process diagram

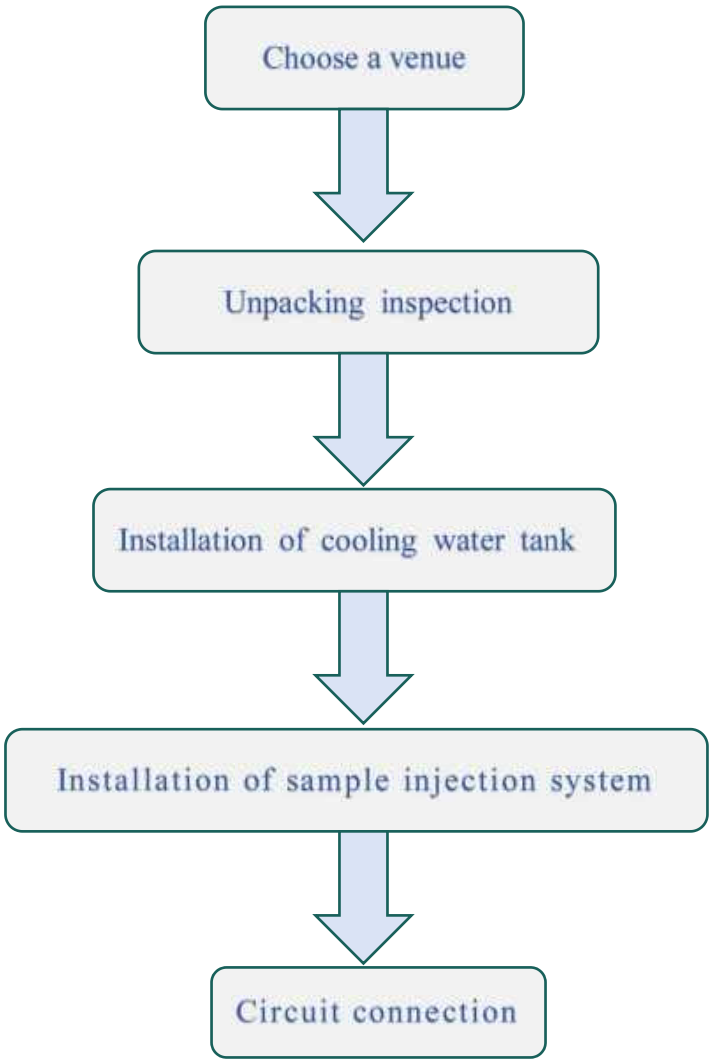


Figure 10 Installation flow chart of the instrument

The installation of the instrument is carried out by our professional techni cal personnel，and the following is only a brief explanation：

3.1.1 Choose a venue

The external dimensions of the spectrometer are 1585mm (length) x 710mm (width) x 745mm (height)，and the weight is 200kg.Please refer to the environmental requirements for instrument installation for details.

3.1.2 Unpacking inspection

Open the instrument packaging box，take out the accessory cardboard box，check for any missing accessories according to the packing list， and confirm if the instrument casing is damaged.

3.1.3 Installation of cooling water

Remove the cooling water pipe and pneumatic plastic pipe from the accessory box.The cooling water pipe is connected to the inlet and outlet of the cooling water below the instrument，［Note: The outlet pipe of the cooling water tank should be connected to the inlet of the instrument，and the return pipe of the cooling water tank should be connected to the outlet of the instrument.］Then，turn on the power supply of the cooling water tank and observe whether there is any leakage at the joints of the cooling water.At the same time， observe whether the water pressure switch is closed.You can hear the sound of suction during suction.Two gas pipelines are respectively connected to the inlet ports of plasma gas，carrier gas，and auxiliary gas，and the other two ends are respectively connected to the gas pressure reducing valve on the argon gas cylinder.

3.1.4 Installation of sample injection system

Remove the quartz torch tube，mist chamber，atomizer，plastic bucket，etc. from the accessory box.Quartz torch tube installed at the center of high-frequency coil.Require to be concentric with the high-frequency coil.The lowest end of the three turn working coil should be 3-5mm higher than the center of the quartz torch tube.Connect the plasma gas plastic tube to the upper inlet of the quartz torch tube.The auxiliary pneumatic plastic tube is connected to the secondary air inlet of the quartz torch tube.Connect the upper grinding port of the fog chamber to the lower grinding port of the quartz torch tube and clamp it with a clamp.The inlet of the atomizer is connected to the carrier gas plastic pipe， and the atomizer nozzle is inserted into the front hole of the fog chamber.There should be no air leakage at the connection between the capillary tube and the atomizer.The tail of the fog chamber is connected to the peristaltic pump injection latex tube through a plastic hose with a

diameter of 6mm and a conversion joint.During ignition and testing，ensure that there is a small amount of waste liquid in the peristaltic pump injection tube and that the peristaltic pump injection tube is properly installed.After the installation of the sampling system is completed，place the output wire (red high-voltage wire) of the ignition gun at the plasma gas inlet of the quartz torch tube.

3.1.5 Gas path regulation

Open two argon gas cylinders，adjust the outlet pressure of plasma gas to 0.3MPa，and adjust the outlet pressure of carrier gas/auxiliary gas to 0.3MPa.Open the gas through software on the computer and observe if the gas flow rate is normal.

3.1.6 Circuit connection

Open the accessory box and connect the black power cord of the instrument to the voltage regulator.Connect the input terminal of the voltage regulator to the air switch (ensure that the maximum output of the air switch can withstand 32A).The network interface of the computer is connected to the communication output port behind the instrument，and the computer and printer are connected according to the requirements of the user manual.The high-frequency ground wire is connected to the grounding behind the instrument.Computer ground wire and instrument ground wire are interconnected.

Chapter IV Operation of Instruments

4.1 Instrument operation process

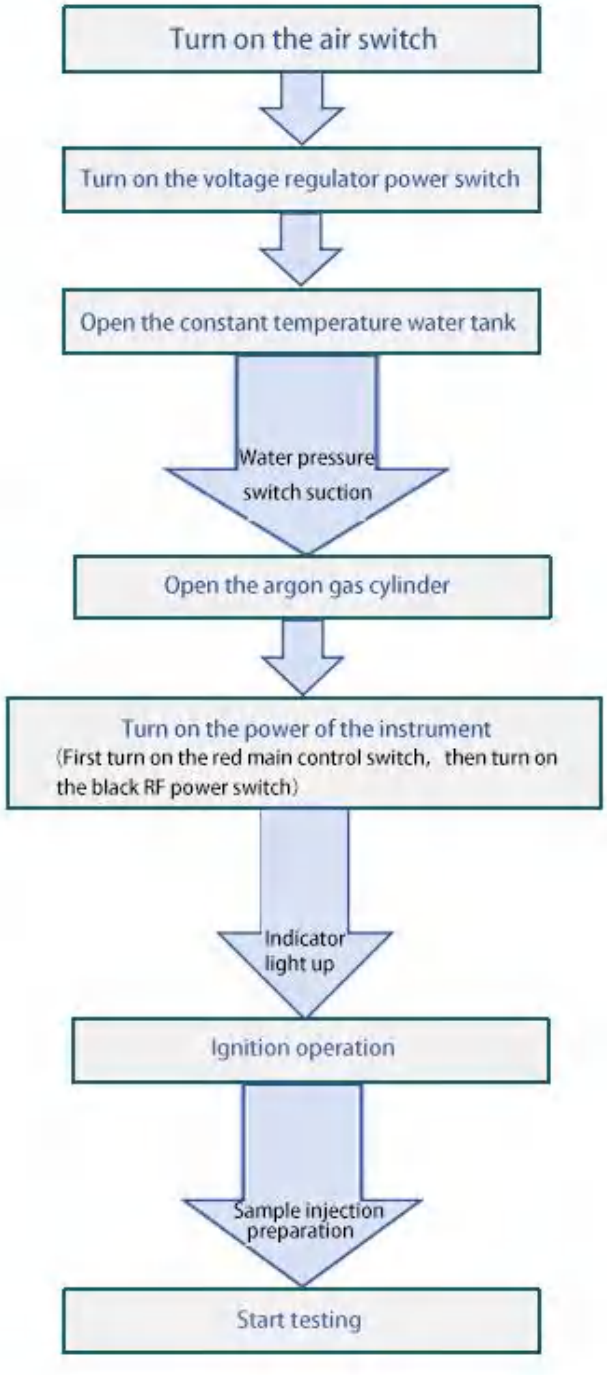


Figure 11 Instrument operation flowchart

Operating procedure description：

1.Turn on the air switch

2.Turn on the voltage regulator power switch

After the voltage regulator switch is turned on，the sound of the voltage regulator relay will be heard，and the LED will display an output voltage of 220V and an output current of 10A.

3.Open the constant temperature water tank

Turn on the power supply of the constant temperature cooling water tank， and you can hear the sound of the water pressure switch closing inside the instrument.If the cooling water tank does not start， the instrument will not be able to perform ignition operation.

4.Open the argon gas cylinder

Open the main valve of the argon gas cylinder at least twice, observe whether the argon pressure on the pressure gauge inside the pressure reducing valve is greater than 3MPa, and the output pressure gauge reading is around 0.3MPa.

5.Turn on the power of the instrument

Turn on the power switch behind the instrument.Attention: First turn on the control circuit switch (red boat shaped switch)， then turn on the air switch (black).When turning off the instrument，first disconnect the air switch (black)，and then disconnect the control circuit switch (red).

6.Ignition

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

It is recommended to use the default settings for ignition airflow settings.

The ignition gas purge time is 30s.

If the ignition fails， it is necessary to perform a shutdown operation and then check the air circuit problem according to the software prompts.

After successful ignition，you can click the“Sample Preparation”button.Attention，avoid inhaling air during injection to prevent stalling.When not testing， place the

injection tube in the blank solution.

7.Start testing

Start establishing methods and prepare for testing.

Other matters needing attention：

1.Before the instrument starts working， it is necessary to observe whether the water level in the cooling water tank is normal.

2.Observe the argon meter on the argon cylinder to see if the argon gas is sufficient for testing time consumption.The consumption of plasma argon gas cylinder is about 1.1MPa per hour， and the consumption of carrier gas is about 0.1MPa per hour.

3.The optimal value of carrier gas pressure should be determined based on the lifting amount of the atomizer，generally set between (0.6~0.7) L/min.

4.When the indoor humidity exceeds 70% or the room temperature is above 30 ℃，ignition is prohibited.

4.2 Instrument shutdown process

The shutdown process of the instrument must be strictly operated according to the specifications to avoid the impact of incorrect actions on the instrument， which may affect your normal testing work.The following is the correct shutdown process.Please read carefully before operating the instrument.

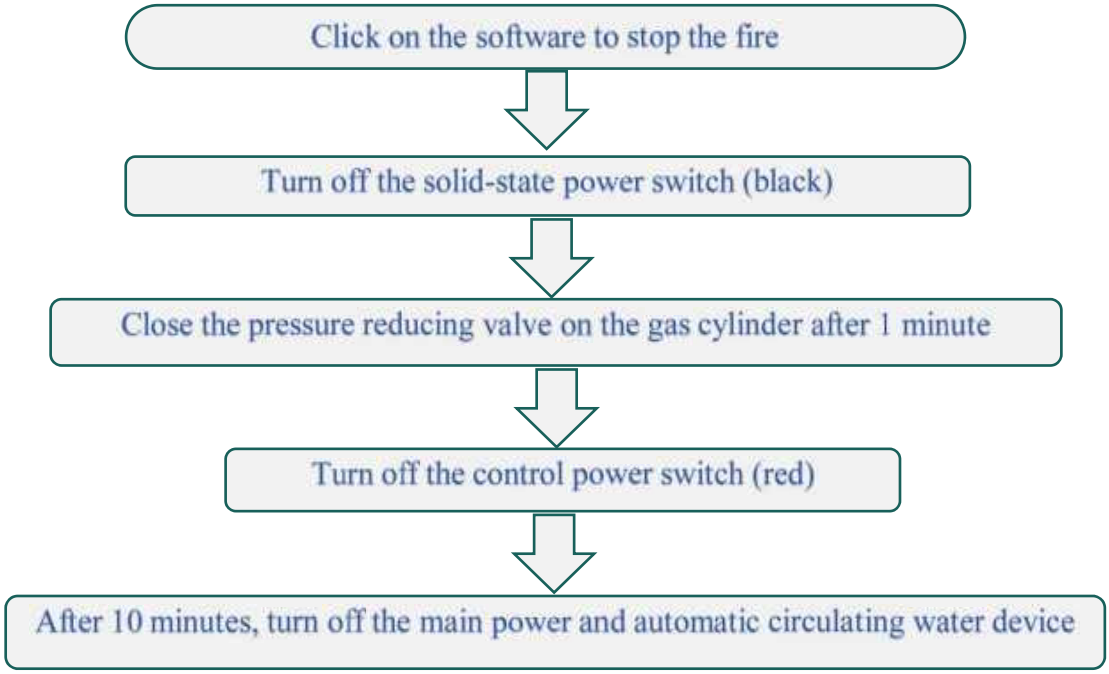


Figure 12 Instrument shutdown flowchart

4.3 Software operation

After the flame of the ICP instrument stabilizes and the injection system can inject continuously and stably， you can use the software tailored for you to carry out the testing work.Please refer to the software usage instructions below for detailed steps.

Chapter V Software Instructions

5.1 Software startup

Double click the shortcut icon on the desktop“  ”，Then a login box pops up as shown in figure 1：

Figure 1 Software login interface

Select the username to log in and enter its corresponding login password.Click “Login” to enter the main interface of the software， as shown in figure 2.Click “Cancel” to exit the software login interface（Default user name： user， default password：123，user Admin for the use of after-sales engineers only）.

Double click the “Spectrum” area with the left mouse button to switch to the display interface of figure 2 or figure 3.

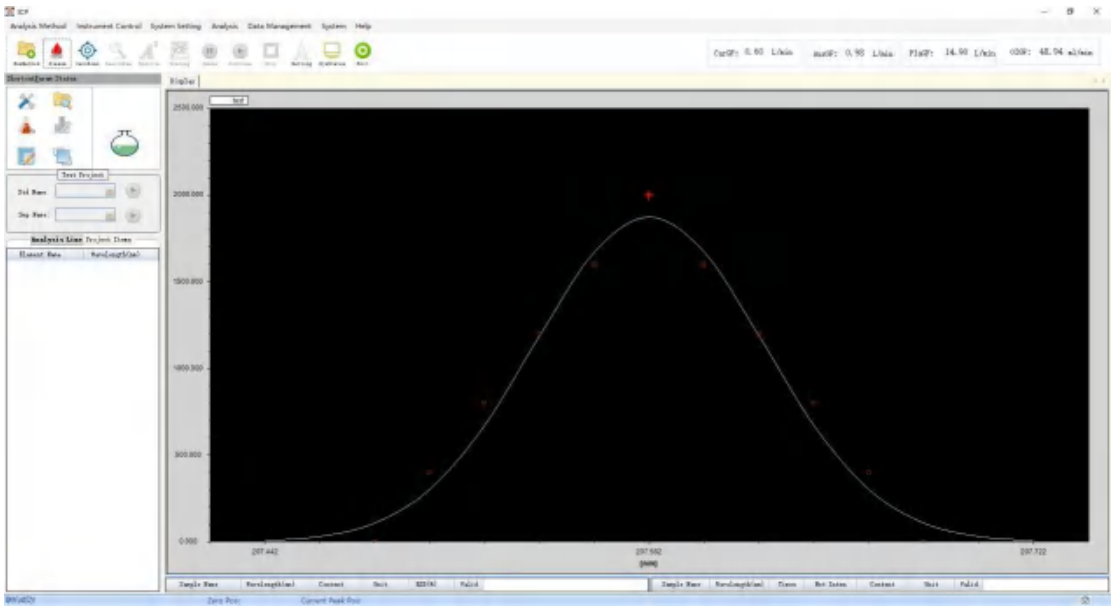


Figure 2 Software main interface

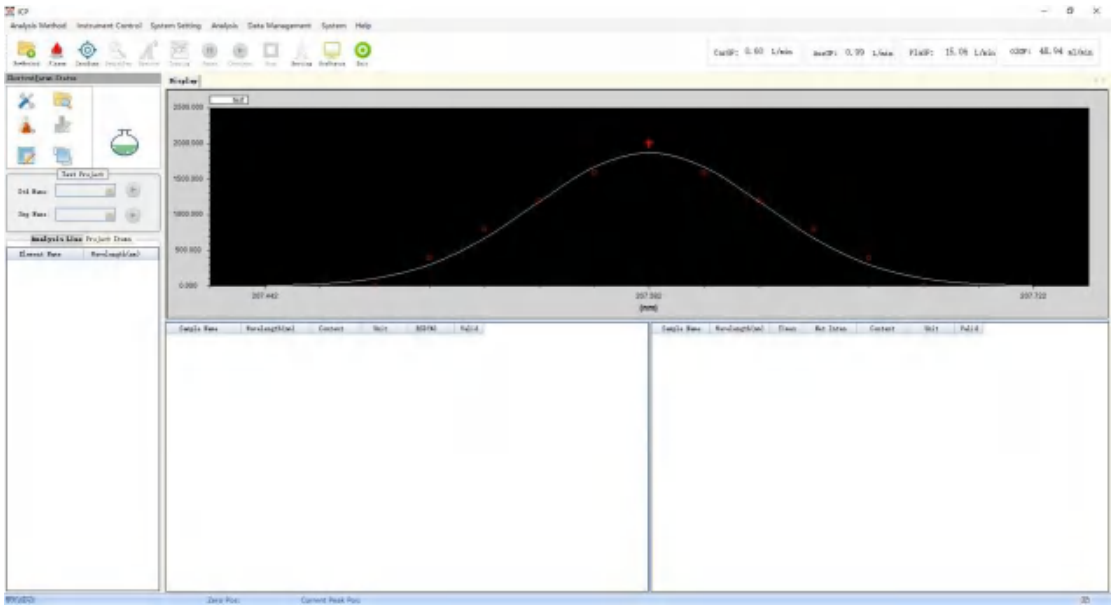


Figure 3 Software main interface

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

5.2 Analysis method

5.2.1 New method

Select“File ->New Method”，open the new method page，as shown in figure 4，enter the name of the new method，and when the “Source”drop-down box is empty，create a new method，or you can choose an existing method to copy.

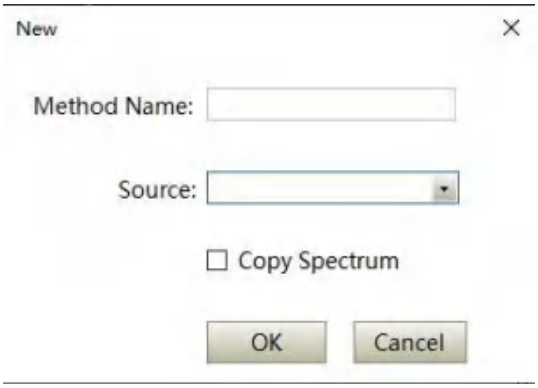


Figure 4 New method interface

After clicking“OK”，the “Basic Parameters”window will pop up，as shown in figure 5：

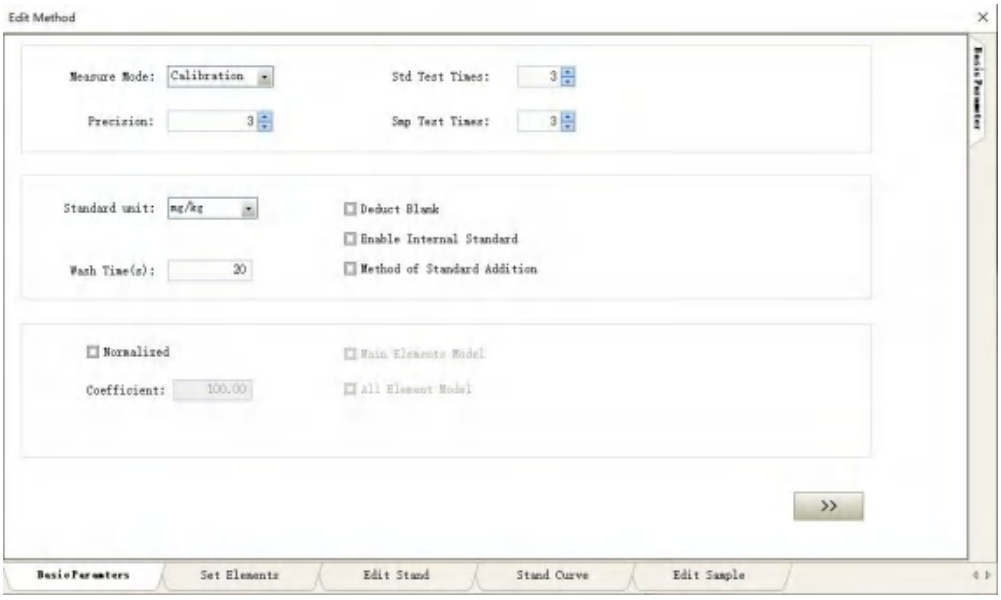


Figure 5 Basic parameter setting interface

Measurement method: refers to the method of creating a working curve (currently the standard curve method).Standard measurement frequency: the number of measurements taken when measuring a standard.

Retain decimal places: the accuracy of the measurement result (content) when measuring samples.

Sample measurement frequency: the number of measurements taken when measuring the sample.

Normalization: Indicates whether the measurement results have been normalized.

Deducting 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 a dialog box for analyzing spectral lines will pop up.As shown in figure 6：

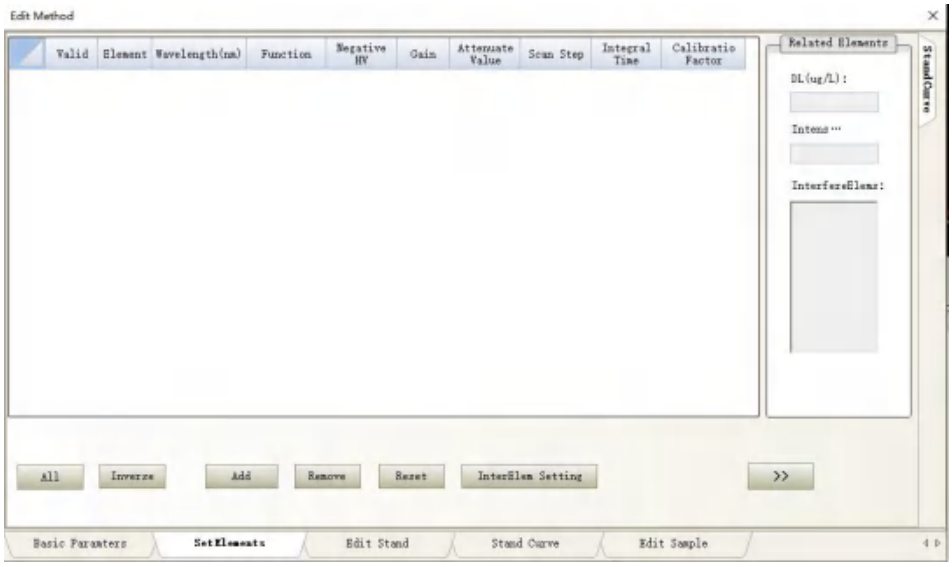


Figure 6 Analyze the spectral line interface

The analysis of spectral lines can be divided into “Analyze” and “Internal” full/reverse selection according to their functions；Add multiple spectral lines as valid or invalid； Add analysis spectral lines to the current method.Clicking this button will bring up a dialog box as shown in figure 7.

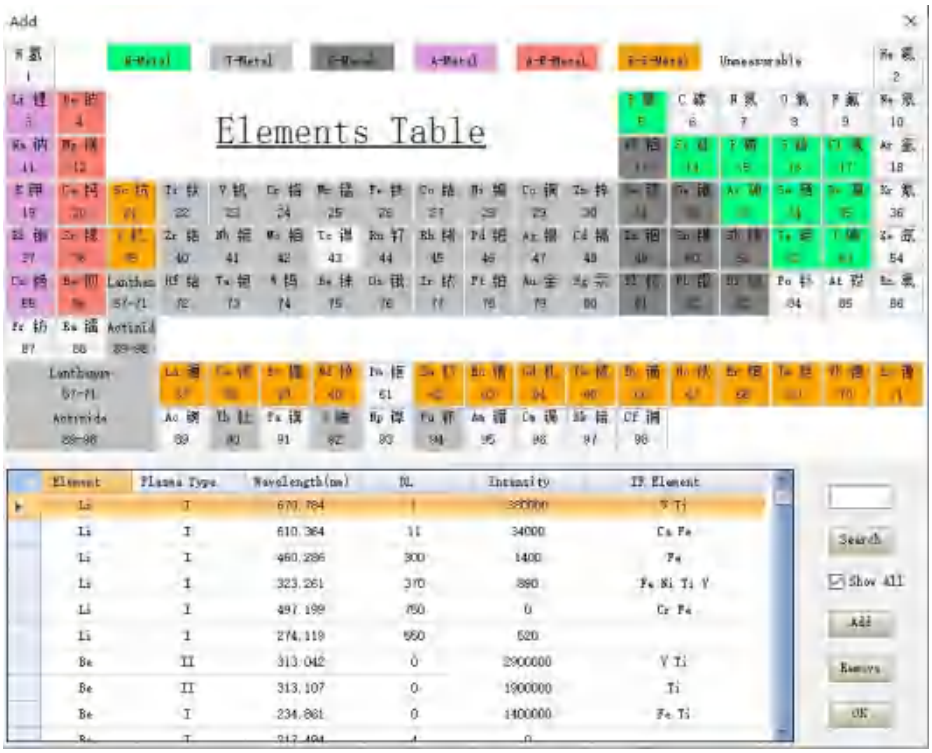


Figure 7 Elemental spectral line diagram

Click on the element name in the periodic table，and its corresponding sp ectral line will be displayed in the list below.Select the spectral line you want

to add，click “Add”to add it to the “Selected Wavelength” list，and clic k “OK” to add the selected spectral line to the current editing method and r eturn to the interface shown in figure 8.

Delete: Remove the currently selected analysis spectral line.

Save: Save all parameters of the analysis line as the current set values.

Reset: Zero the peak position of the current analyzed spectral line.

Edit Standards: Select “File ->Edit Standards” to add standards for each analysis spectral line and set the standard sample content.Set whether the stand ard sample is valid (i.e. whether it participates in fitting the curve).As shown in figure 8：

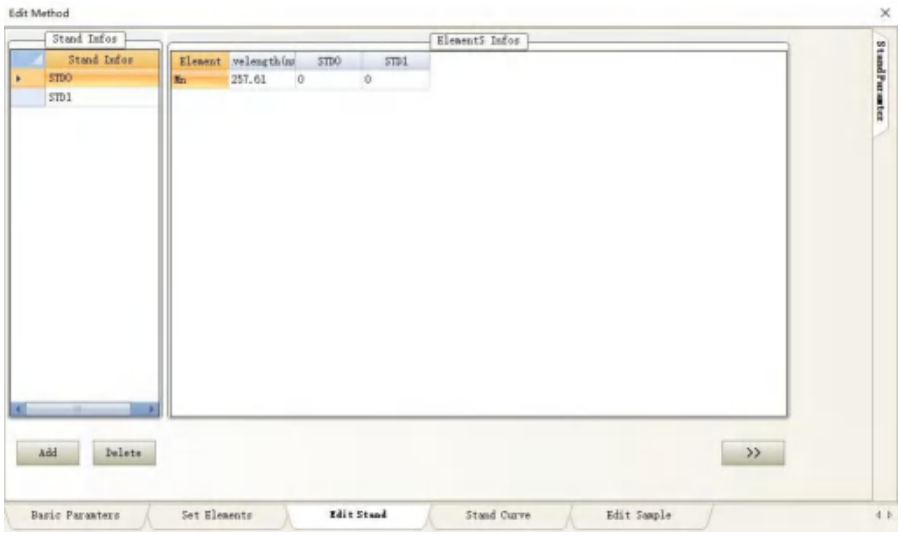


Figure 8 Edit the standard interface

Add: Add a standard sample for all analyzed spectral lines.

Delete: Remove the last standard sample of all analyzed spectral lines.

Save: Save the standard data values of the current analysis spectral lines.

Close: Close the current dialog box.

5.2.2 System of selection

Clicking on “File ->Open Method” will bring up a pop-up as shown in figure 9.Select a method，click “OK”to open it，or double-click the target method to open it.Before analyzing，you must choose to open a method.

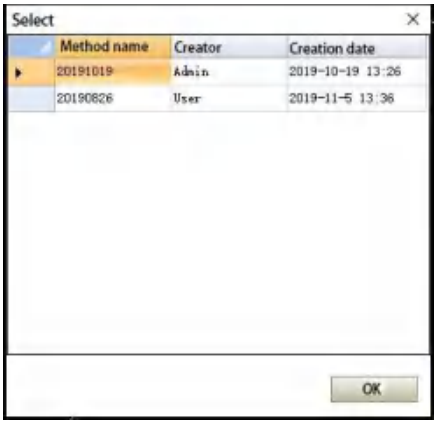


Figure 9 Method interface diagram

5.3 Power on

5.3.1 Online

Turn on the red power switch of the whole machine，click “Instrument Control ->Online”， as shown in figure 10.After successful online connection， “Online Successful” will be displayed in the lower left corner of the software status bar.Otherwise， “Online Failed”will be displayed.If it displays“online failure ”， it is necessary to check whether the instrument is connected to the computer normally.Check completed，click on“Instrument Control ->Online”to reconnect.

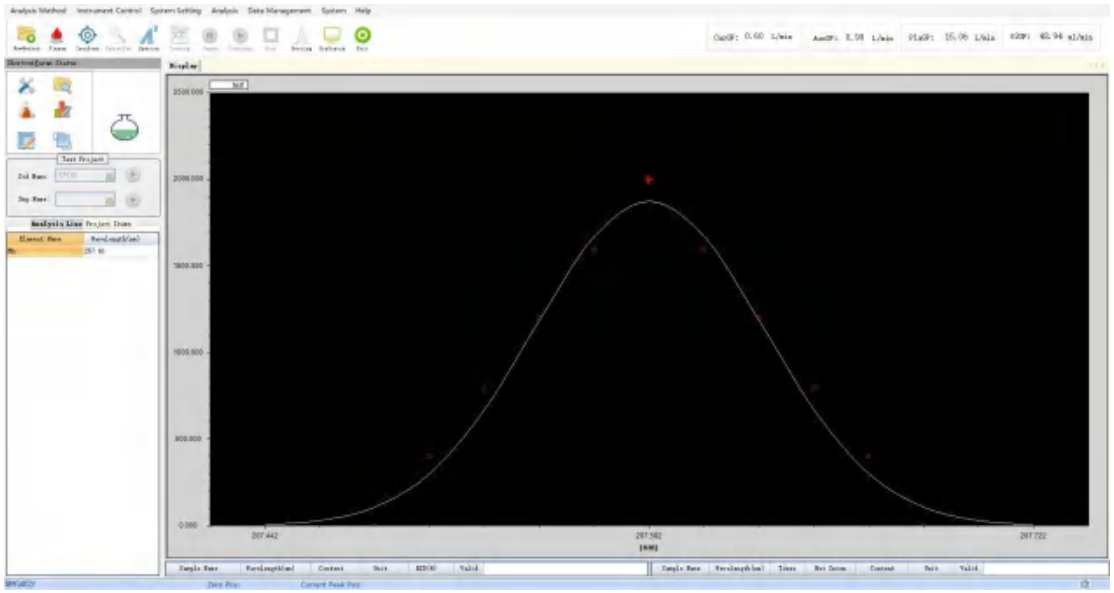


Figure 10 Main control interface diagram

5.3.2 Plasma control

Click on the menu“Control ->Ignition”or toolbar button“ ”then a window

as shown in figure 11 will pop up.

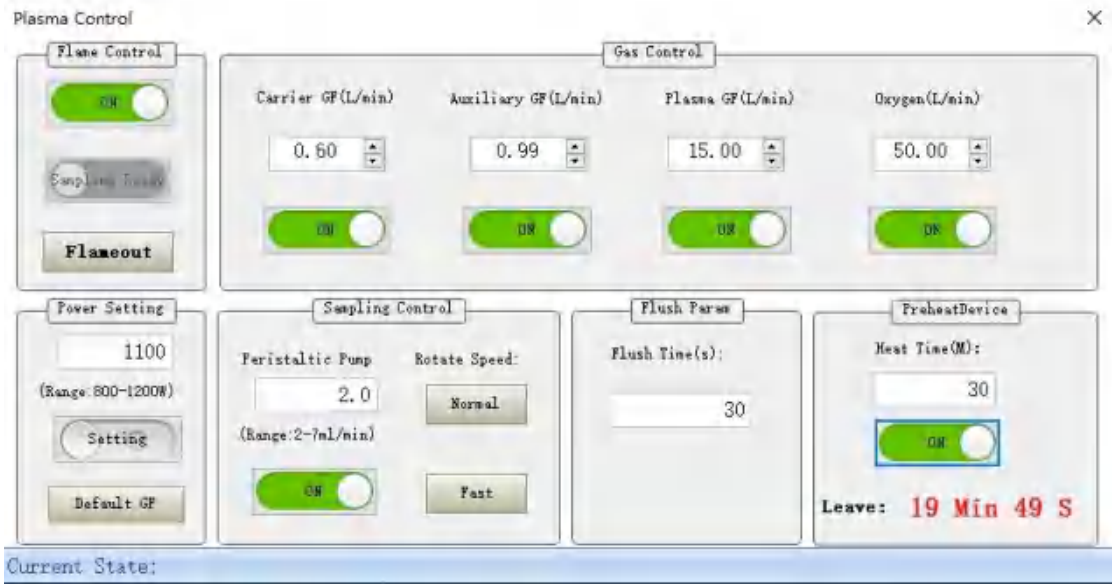


Figure 11 Plasma control interface diagram

1、Purge setting

Set the flow rate of the carrier gas and the blowing time.The software def aults to 0.6L/min，double-click the value to modify the flow rate settings.

2、Gas circuit control

It can control the opening and closing of plasma gas and auxiliary gas va lves separately，and set the flow rate values of each gas channel.

3、Sample injection control

It can control the switches of the carrier gas and peristaltic pump separate ly，and set the flow rate of the carrier gas and the speed of the peristaltic pu mp.During the measurement process，the“normal”speed is used，and when it is necessary to quickly discharge the waste liquid in the fog chamber，the“fas t”speed is used.

4、Power setting

Set the working power of the power supply.

5、Ignition operation

Ignition: including ignition preparation and ignition process，during which “current status”will be displayed in the status bar.

Sample injection preparation：Set the relevant parameters for power measur

ement work，turn on the carrier gas and peristaltic pump again.

Shut down：When the shutdown operation is required，click on the shutdo wn button to turn off the solid-state power output.

6、Restore default gas flow rate

Restore the flow rates of plasma gas，carrier gas，and auxiliary gas to the factory default settings.

5.4 Zero level scanning

5.4.1 Set zero level parameters

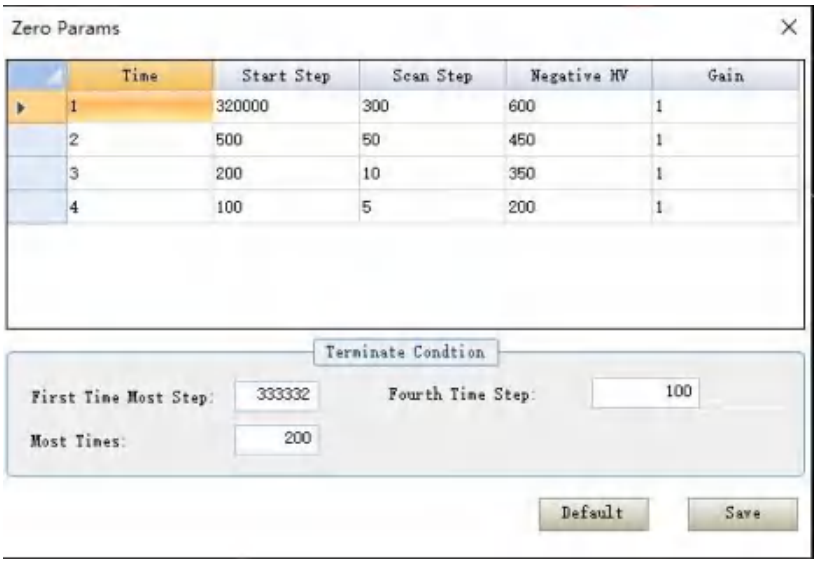


Figure 12 Zero level parameter setting interface diagram

Select“Settings ->Zero level Parameters”to enter the settings interface above.

The table shows the starting position，scanning step length，negative high voltage，gain，and other parameters of the four zeroing processes.The starting position of the first time is the number of motor steps relative to the mechani cal zero point，while the starting positions of the second，third，and fourth ti mes are the corresponding steps set to reverse the zero level position after the previous successful zeroing process.

The“first maximum step count”in the termination condition represents the maximum number of steps taken by the first zeroing motor movement.If the m otor has reached its maximum position and zeroing is not successful，zeroing

will be terminated.The “maximum number of measurements” indicates the maxi mum number of measurement points for the second and third attempts.If the zero search is not successful，it will be terminated.The “fourth measurement co unt” represents the number of points measured in the last measurement.

Default setting: Restore factory zero level parameter settings.

Save: Save the current parameter values.

Close: Exit the current form.

5.4.2 Zero level scanning

Click“Control ->Zero level Scan”to perform zero level scanning operation，find the position of the zero level light，and use it as the measurement reference point.After successful zero finding， the status bar in the lower left corner of the main interface will display “Zero finding successful”.As shown in figure 13 below：

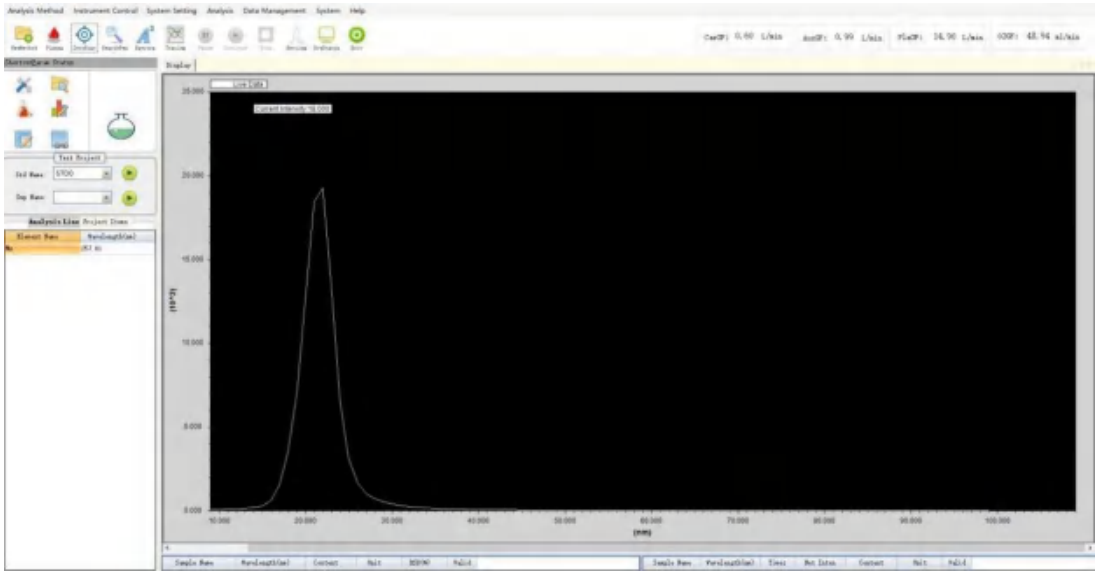


Figure 13 Zero level parameter setting interface diagram

Tip: If zero finding fails， please check if the engraved line in the instrument settings is consistent with the grating engraved line used by the instrument， or if the first starting point position in the zero level parameter is set too large，causing the zero level light position to be skipped.

5.4.3 Skip level zero

Click on “Control ->Skip Zero Scan” to skip the software zero scan process.Set the “ Zero Search Successful ” flag to true before performing peak searching，

measurement，and other related operations.

5.5 Analysis and measurement

5.5.1 Automatic peak searching

After successful zeroing，select the analysis method and click“Analysis M easurement ->Automatic Peak Finding”，The software will automatically contr ol the search and correction of the peak position for each analysis spectral line. During the continuous peak searching process，after the peak searching of a sp ectral line is completed，you can click “  ” the button to pause searching fo r the peak position of the next spectral line.

If the current peak position of the spectral line is not at the position indic ated by the center line (green)，as shown in figure 14，the cross cursor (red) can be moved to the peak position by using the left and right directional keys， as shown in figure 15.Pressing Enter will perform peak searching again to com plete peak position correction，and clicking “  ” will perform peak searching for the next spectral line.

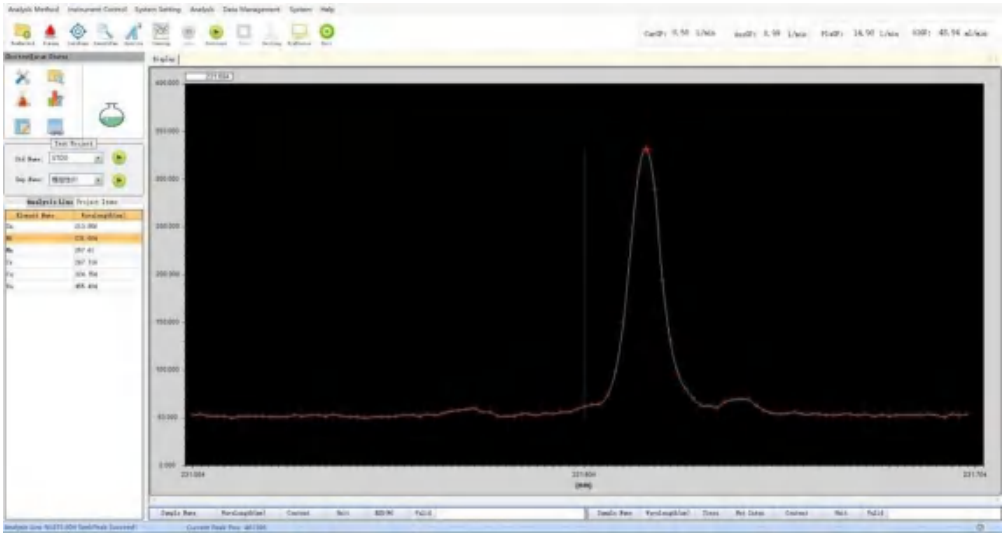


Figure 14 Automatic peak finding display interface diagram

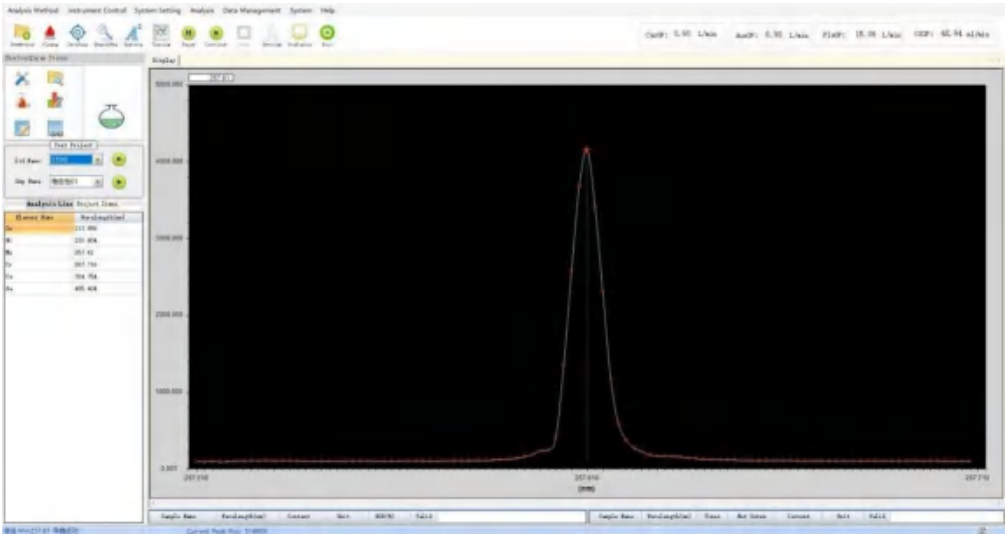


Figure 15 Interface diagram after automatic peak seeking correction

5.5.2 Measurement standards

After completing the above operations，click “Analysis Measurement ->Measurement Standards” to start measuring the standard sample，or click on the standard sample name on the left side of the software interface and select the name of the standard sample to be measured for measurement.

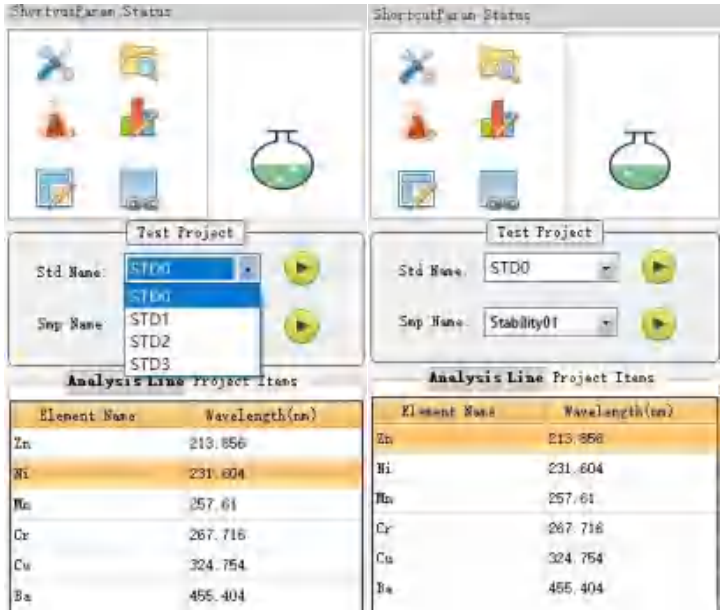


Figure 16 Select the standard solution to be measured

After measuring a standard sample，replace the standard solution and inject it to continue the next standard measurement until all standard measurements are completed.Right click on the result display box and click “OK” to save the measurement data as standard data，as shown in figure 17.

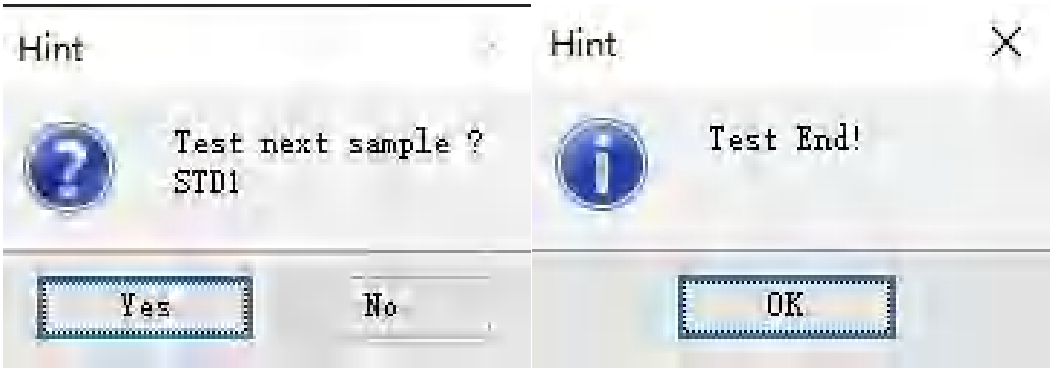


Figure 17 Selection box after standard sample measurement is completed

You can view the establishment status of the standard curve by clicking on “File ->Edit Standard” or on the left interface of the software , as shown in figure 18.

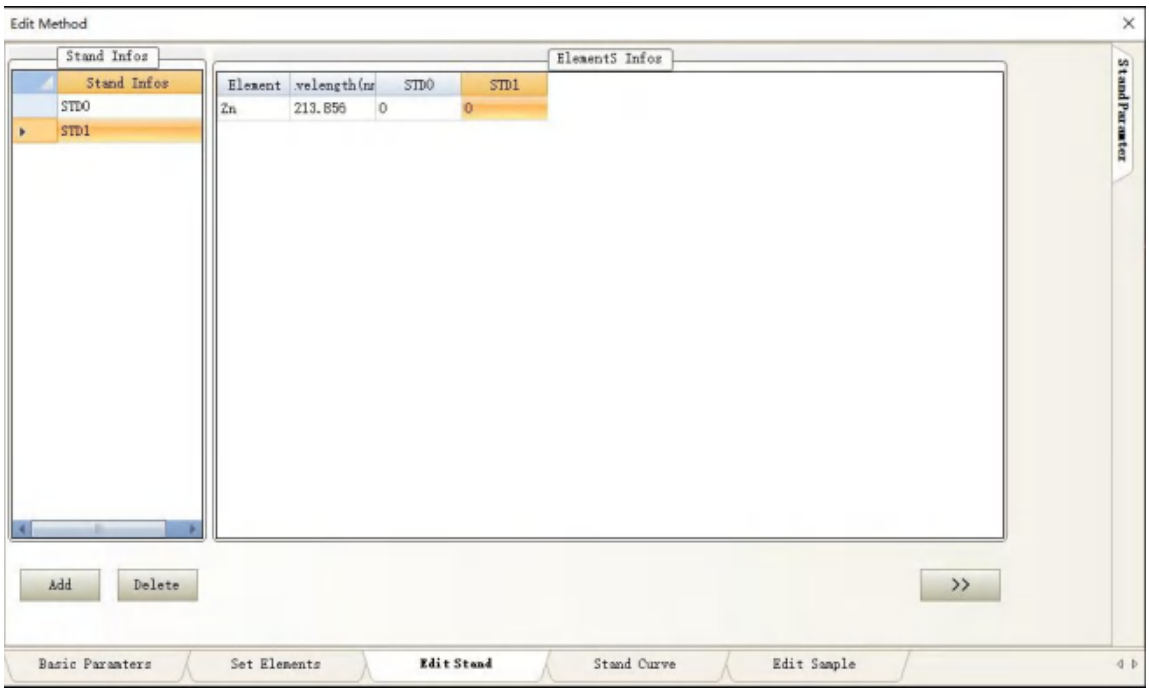


Figure 18 Test standard result display diagram

5.5.3 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 to edit the sample information.Click “Add” to add the sample data to be tested，as shown in figure 19：

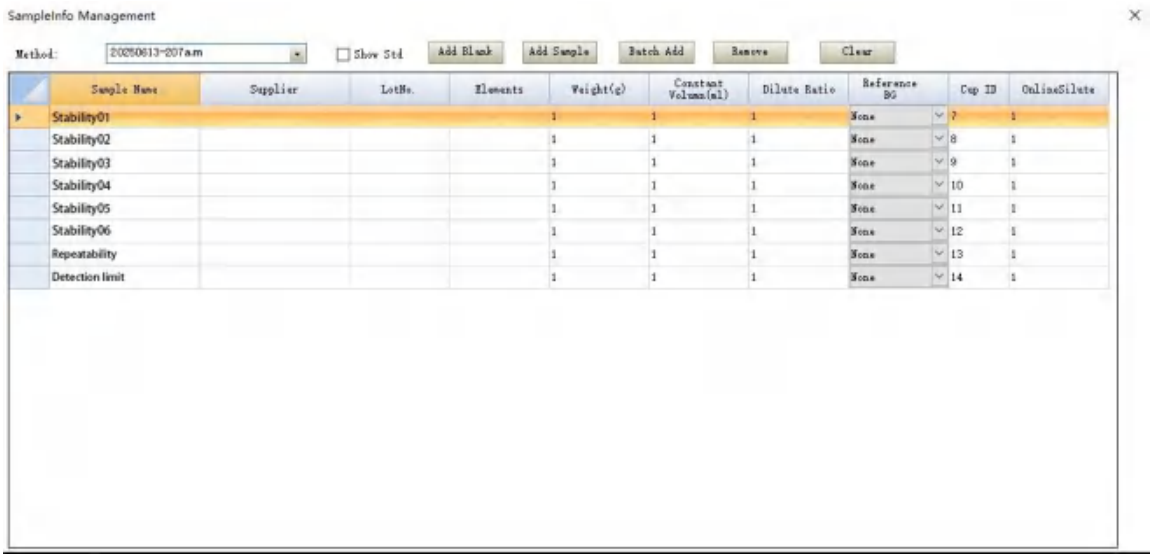


Figure 19 Sample information management interface diagram

After editing, all sample names will be displayed in the "Sample Name" drop-down box.You can select the sample to be measured, click "Analysis Measurement ->Measure Sample" to start the measurement, or click the icon " 

" .After the measurement is completed, the measurement results will be displayed in the result display box, as shown in figure 20:

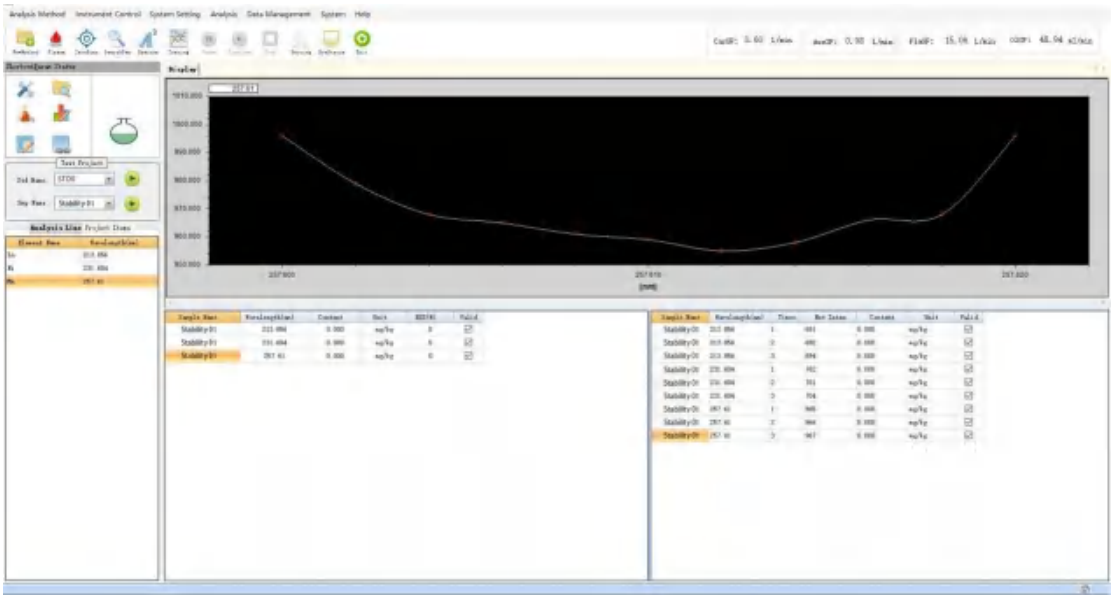


Figure 20 Test result display interface diagram

Click on "Data Management ->Historical Records" to enter the historical data report page.Click on "Query" to preview and analyze the information of

the measured samples.As shown in figure 21:

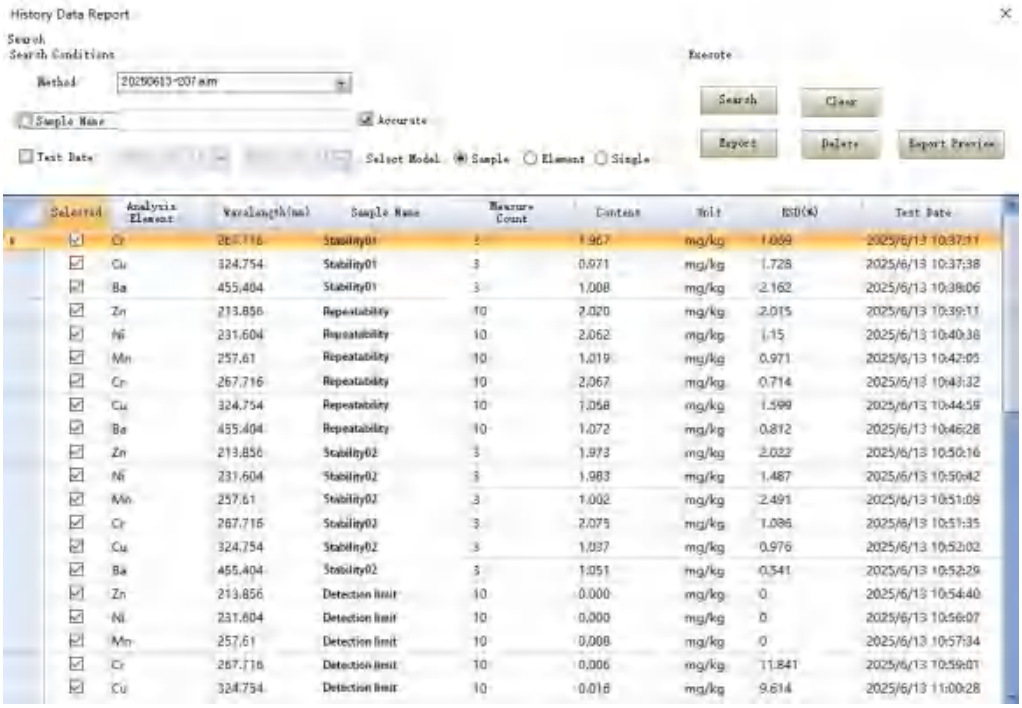


Figure 21 Query interface

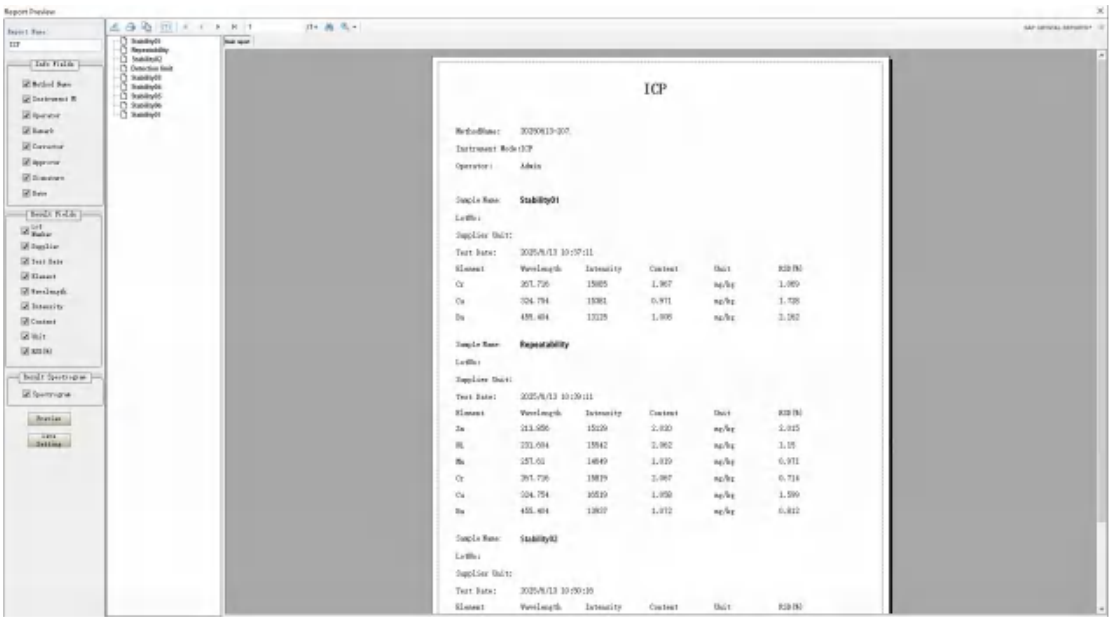


Figure 22 Report preview image

You can also set the name of the analysis report and the content displayed in the report (including information fields and result fields).After setting， you can click "Save Settings"to save the settings.Click"Preview"to preview the generated analysis report again according to the current report content settings.Click " " can save

report、click “ ” can directly print the current report.

5.5.4 Interval tracing

Click on “Analysis and Measurement ->Spectral Line Tracing” to pop up a dialog box as shown in figure 23.Select the sample name that needs to be traced， and then click start tracing to perform sample tracing testing：

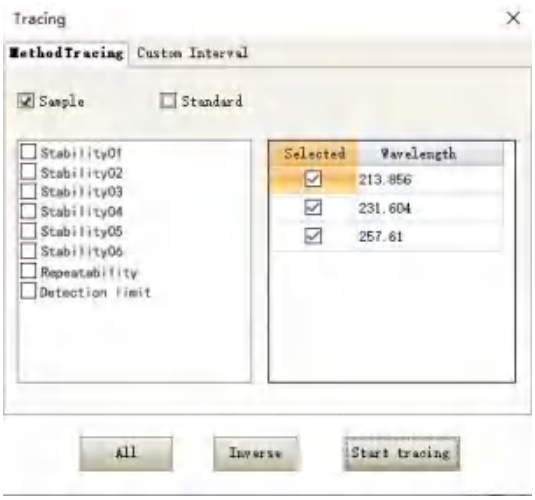


Figure 23 Interval tracing method editing interface

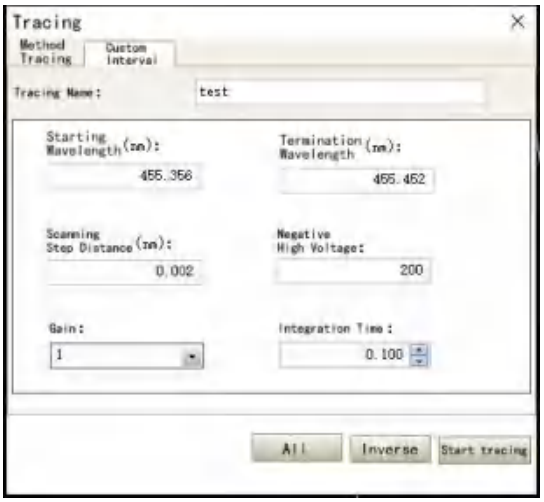
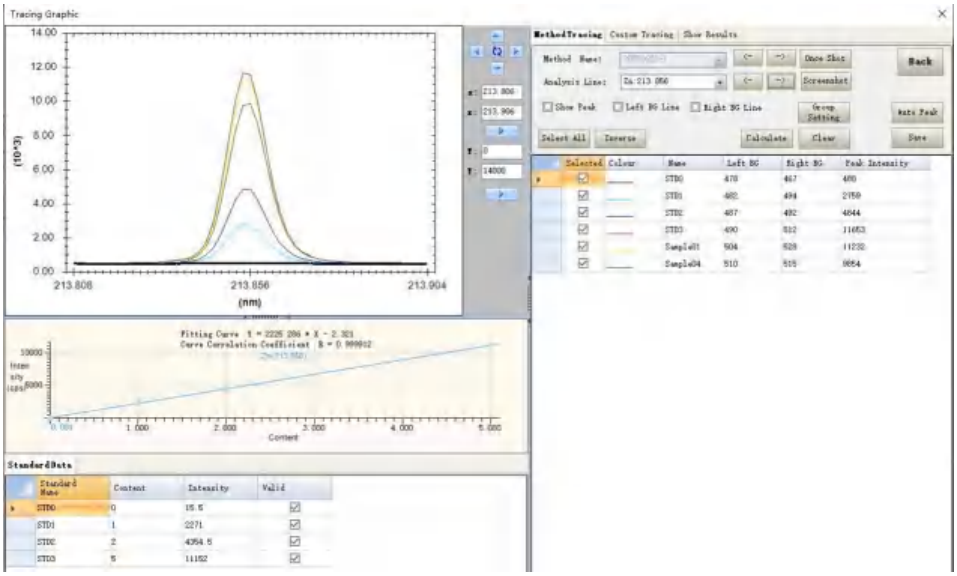


Figure 24 Interval tracing custom tracing interval editing interface

In the method tracing， selecting the sample or standard to trace can trace all the spectral lines in the currently open method.You can also customize the trace interval and set its trace parameters (negative high voltage，gain，integration time)，enter the trace name，and click “OK”to start tracing.After the trace is completed，the software automatically saves the information of the trace.You can view trace information through “Data Management ->Trace Diagram”.



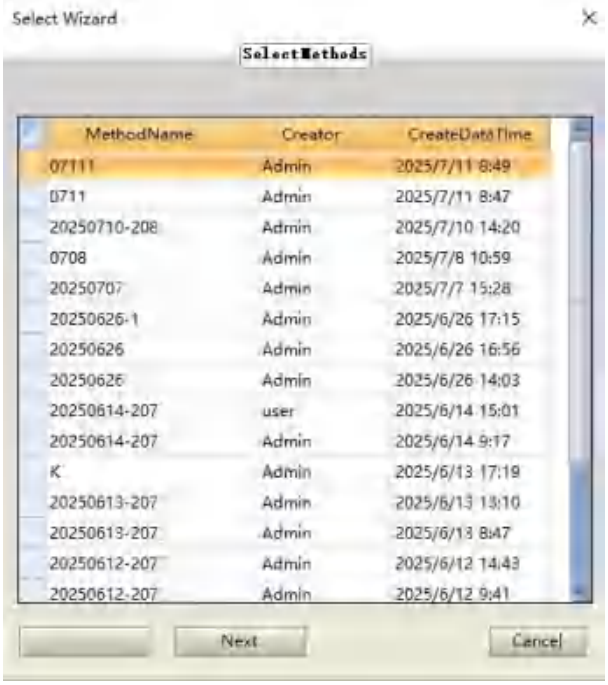
5.6 Shutdown

Step: Click “ ” enter the plasma control interface，click “Shut Down”，wait for 2 minutes， wait for the torch tube to cool down， close all gas valves and peristaltic pumps， and finally cut off the air switch (black) of the solid-state power supply， and then turn off the main control power switch (red) to complete the shutdown.

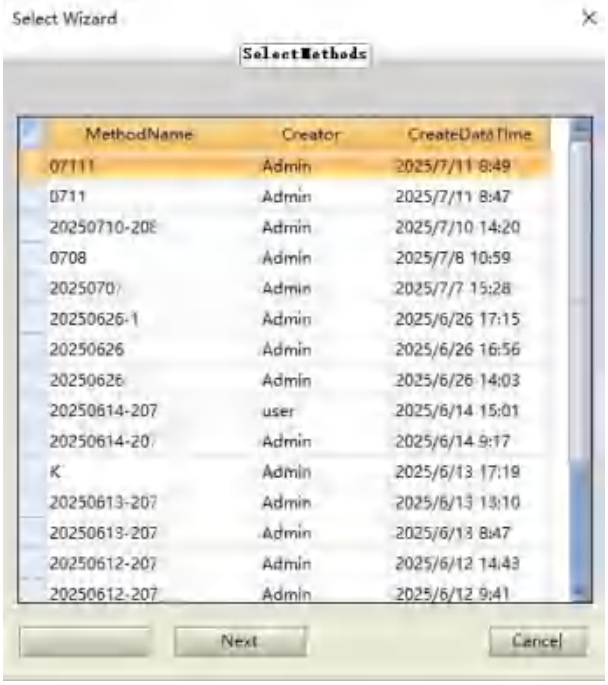
5.7 Data management

5.7.1 Trace diagram

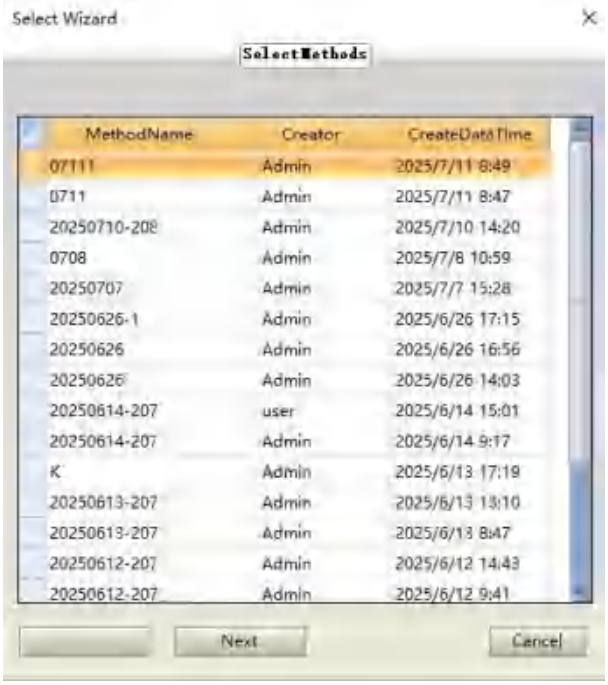
Click on “ Data Management ->Trace Diagram ” to pop up the trace diagram window，as shown in figure 25.Select the corresponding testing method to record and click“Next”：



After selecting the sample name to be viewed，choose next：



After selecting the icon of the element you want to view，click next：



After selecting the corresponding element，you will enter the tracing diagram of the sample shown in figure 26：

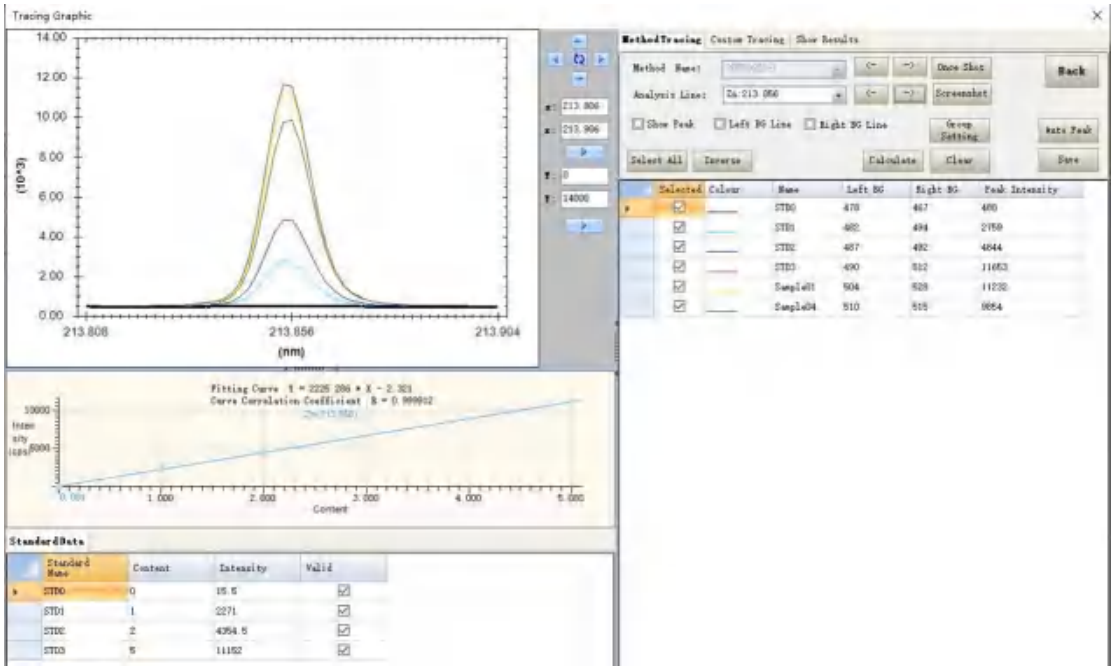


Figure 26 Trace diagram interface diagram

5.7.2 Sample information management

As shown in figure 27，operations such as adding，deleting，clearing，and saving can be performed.For the three column information of sample weigh，v olumetric capacity，and dilution ratio，you can fill all sample rows with the sa me values as the first row of samples by double clicking on their correspondin

g column heads.

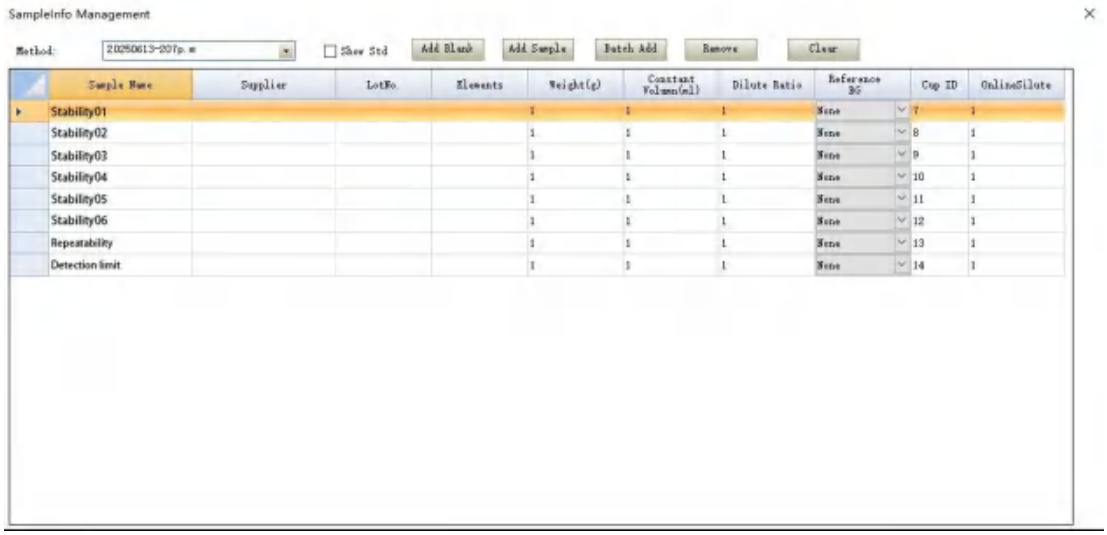


Figure 27 Sample management interface diagram

5.7.3 Wavelength library

As shown in figure 28，new wavelengths can be added or the currently se lected wavelength can be deleted (adding a unique wavelength value cannot del ete wavelengths already selected in the method).

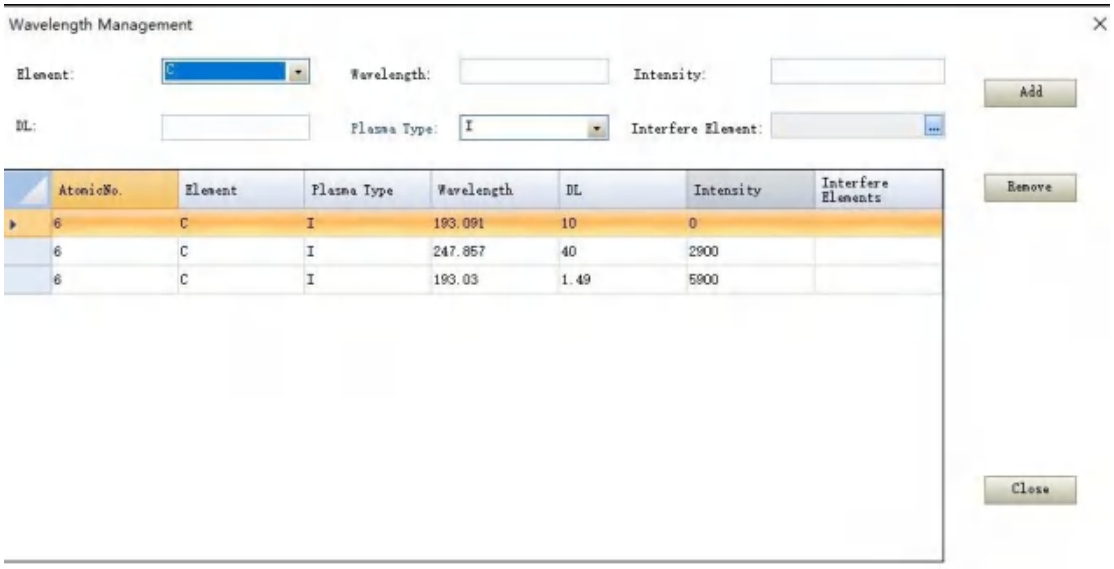


Figure 28 Wavelength library maintenance interface diagram

5.7.4 Measurement records

“Data Management ->Historical Records”allows you to select analysis methods，sample names (exact matching and fuzzy matching)，measurement date queries，and export to Excel for saving.

Figure 29 Measurement record query and display interface

Select one or more historical records and click “Report Preview” to view the historical report.As shown in figure 30：

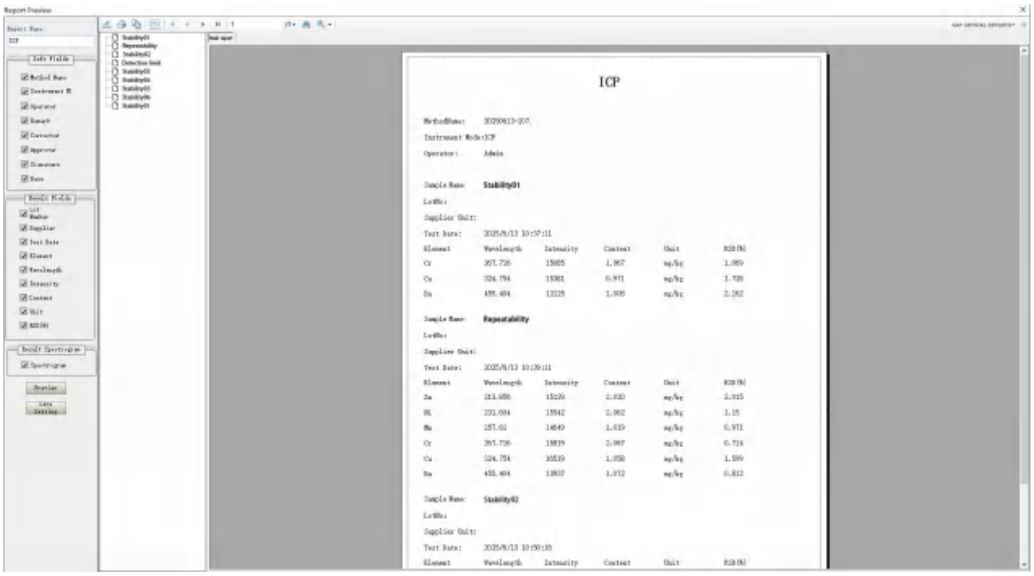


Figure 30 Report preview interface diagram

5.7.5 Analysis method

5.7.5.1 Delete method

Click on “File ->Delete Method” to pop up a dialog box as shown in figure 31.Select one of the methods (which cannot be the currently open method)，and click “Delete” to delete the method.

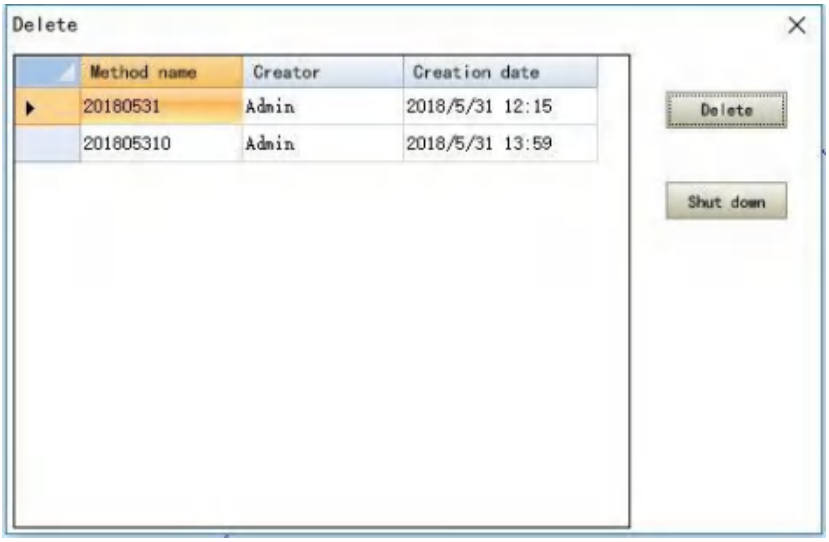


Figure 31 Method management interface diagram

5.8 User management

5.8.1 Authority management

As shown in figure 32，permissions are divided into three levels: Administrator，Expert，and Operator，and different operation permissions can be set for each level of user.This operation is only owned by Admin.

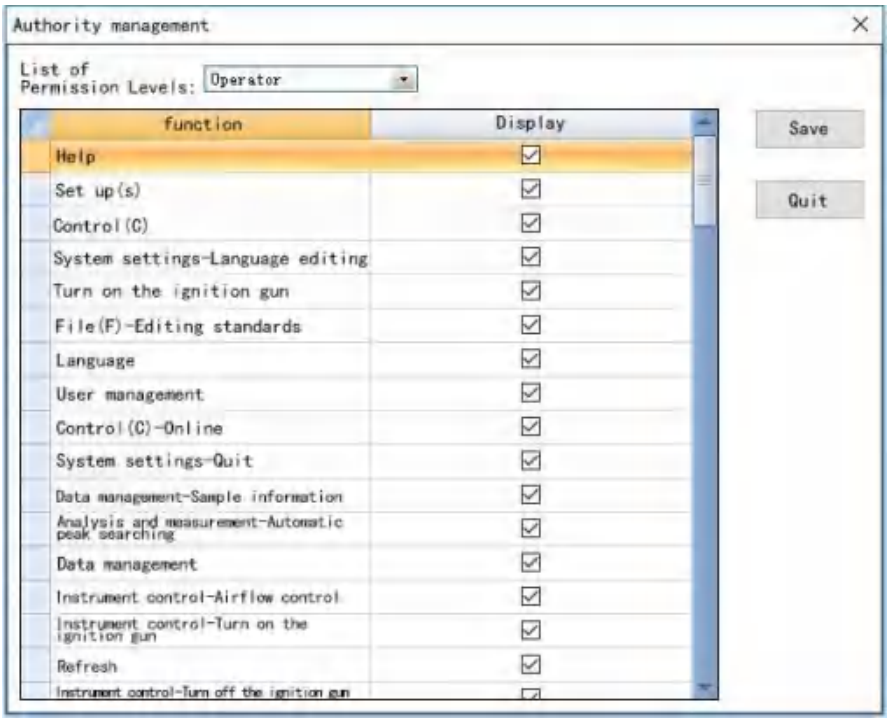


Figure 32 Authority management interface diagram

5.8.2 User management

Figure 33 User management interface diagram

Administrators（Admin）have operational privileges such as adding，deleting users，changing user permissions，and changing passwords，while other levels of users only have password change privileges.As shown in figure 34：

Figure 34 User management password modification interface diagram

5.8.3 User switching

As shown in figure 35， select the account you want to log in to， enter its corresponding password，and click “Login”to switch users.

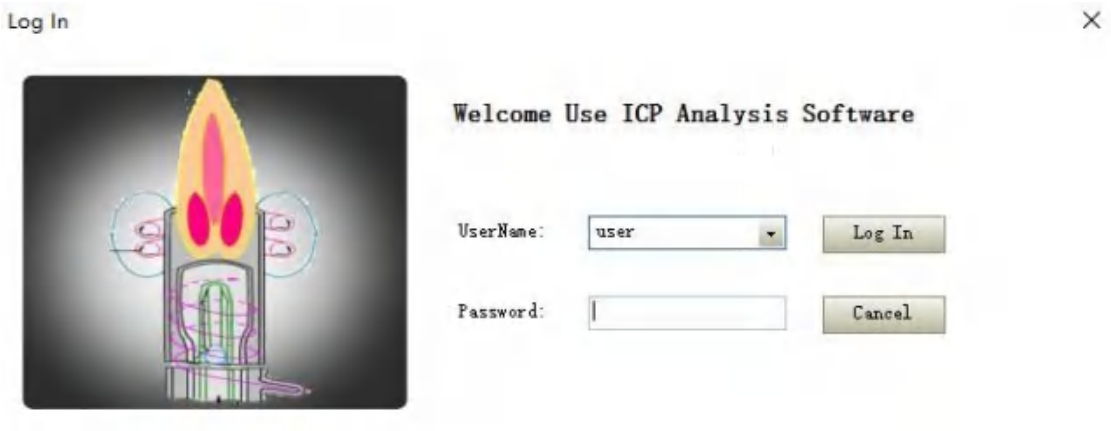


Figure 35 User login interface diagram

5.9 Language

5.9.1 Language editing

As shown in figure 36，operations such as adding，deleting，and modifying UI display language can be performed.

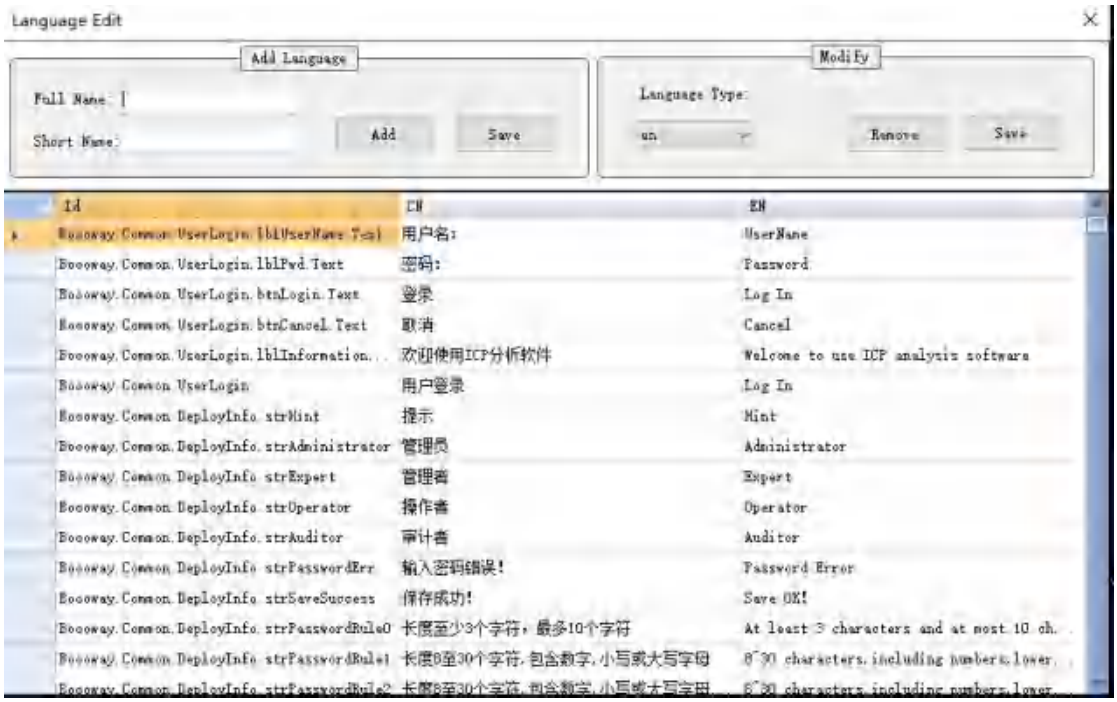


Figure 36 Language editing interface diagram

5.9.2 Language switching

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

5.10 Auxiliary functions

5.10.1 Instrument parameters

Click on “System Parameters ->Instrument Parameters” to pop up a dialog box as shown in figure 37， where you can set instrument related parameters (these parameters are set by the instrument at the factory and do not need to be changed by the user).

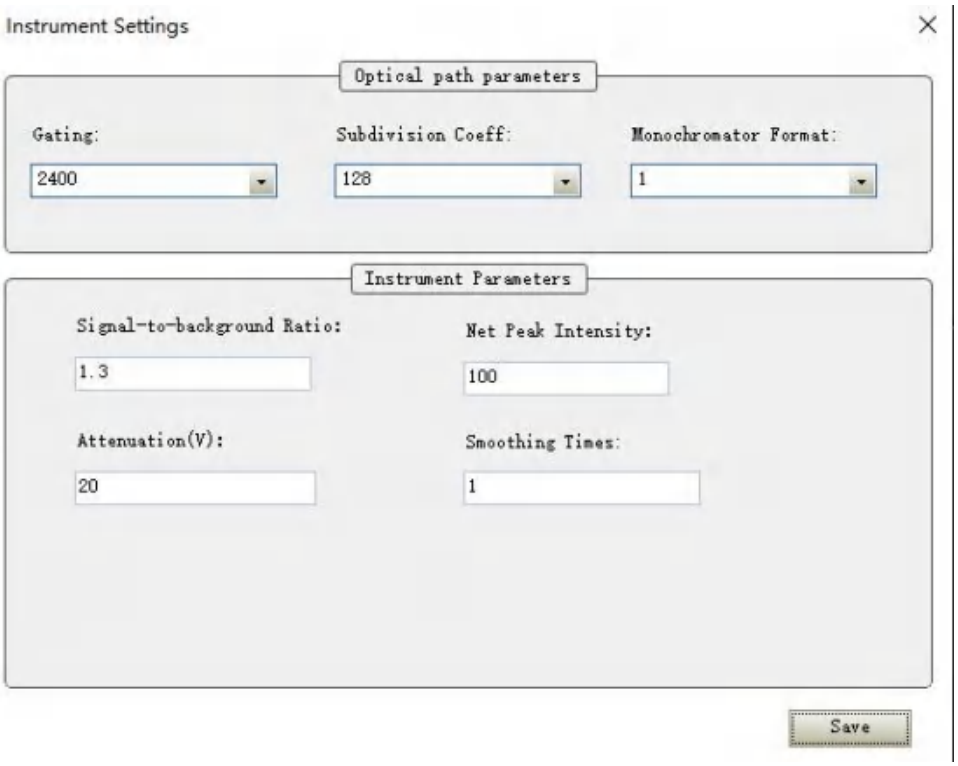


Figure 37 Instrument parameter setting diagram

5.10.2 Flame position adjustment

As shown in figure 38，the observation height adjustment range is 0-20mm，and the flame observation height position is adjusted by controlling the torch motor.

Figure 38 Observe the height adjustment interface diagram

5.11 Help

5.11.1 Concerning

Display relevant information such as software version and ownership.As shown in figure 39：

Figure 39 Software version information interface diagram

5.12 Accompanying drawing

5.12.1 Software operation flowchart

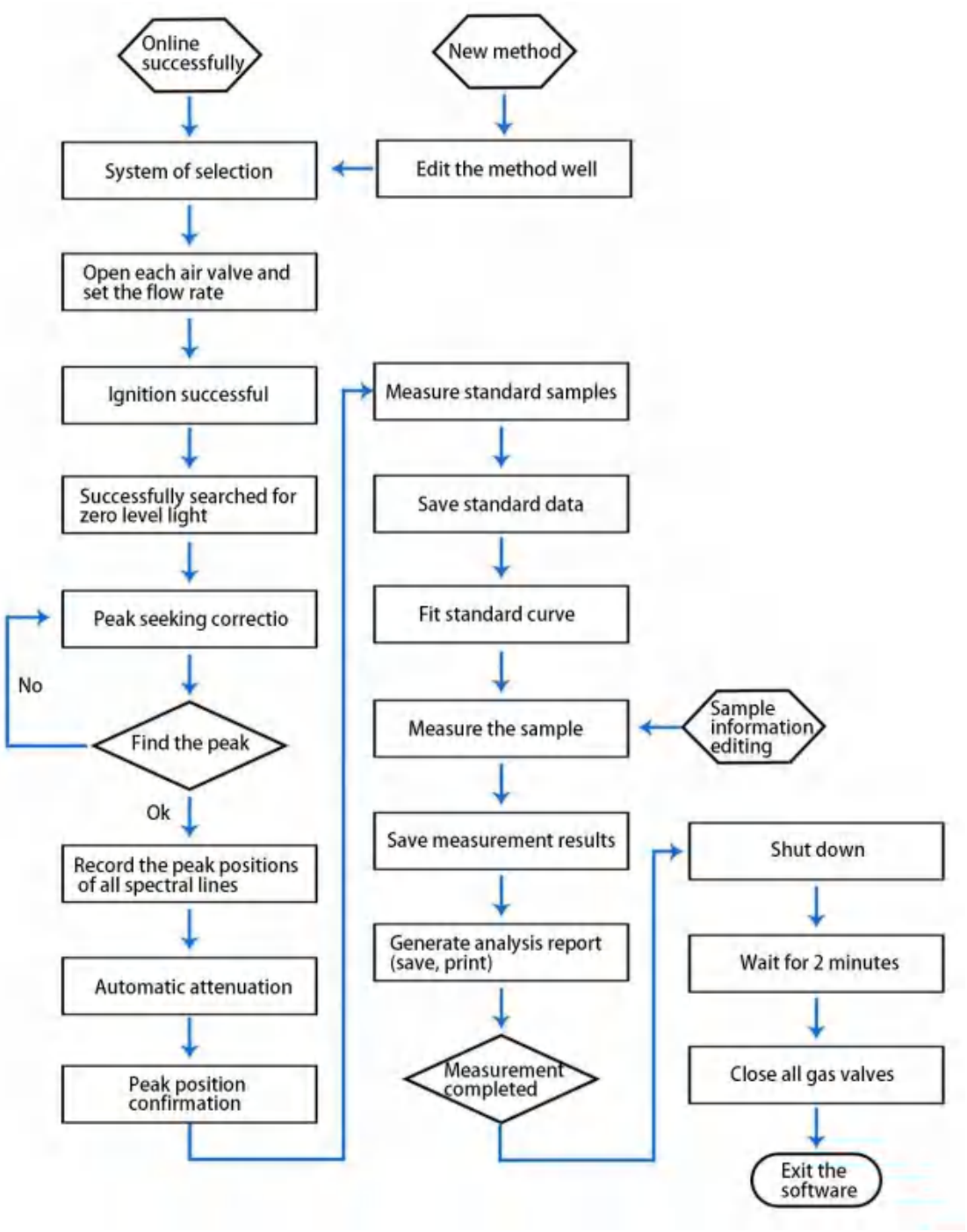


Figure 40 Software flow chart

Chapter VI Product maintenance and upkeep

Inductively coupled plasma emission spectrometer capable of analyzing sample concentrations ranging from a few ppb to several percent or even tens of percent.If the environmental conditions for analysis are not strictly controlled，it will inevitably lead to inaccurate experiments； It is also required to strictly maintain and upkeep the instrument during use in order to achieve strict control of analysis quality and extend the lifespan of the instrument.

6.1 Cleaning of laboratory vessels

Common laboratory vessels，such as beakers and volumetric flasks，need to be cleaned before use.Polytetrafluoroethylene（PTFE）and borosilicate glassware can be cleaned with soap or detergent first，rinsed with water，and then（1+1）HNO3 soak 24 hour（Or boil）.Wash with water，wash with deionized water (three times).Some glassware has severe oil stains， which can be washed with a washing solution (prepared by adding concentrated sulfuric acid and potassium dichromate)，and then thoroughly rinsed with water.

6.2 Usage and maintenance

6.2.1 Environment

This instrument requires a fixed temperature of 20-25 degrees celsius to be maintained at room temperature，and the temperature change should be less than ± 1 degree Celsius.The indoor humidity should be less than 70%，preferably controlled between 45% and 60%，and equipped with an air purification device.

6.2.2 Power supply line

In order to ensure the safe operation of ICP，the power supply line must have sufficient capacity，otherwise the voltage of the line will be too high duri ng instrument operation，affecting the lifespan of the instrument.Please refer to the《Instrument Installation Conditions》for specific requirements of the circuit environment.

6.2.3 Dustproof

When exhaust fans are needed in the laboratory to remove the heat from

the instruments and toxic gases generated during operation, a pressure differenc e is formed between the laboratory and the outside, creating negative pressure in the laboratory.Outdoor air containing a large amount of dust flows into the room through the gaps in doors and windows, accumulating in various parts of the instruments, which can easily cause high-voltage components or joints to i gnite, short circuits, leakage, and other faults in circuit boards, wiring, socket s, etc..Therefore, frequent dust removal is necessary.Especially for computers, e lectronic control circuits, high-frequency generators, displays, printers, etc., th ey should be regularly disassembled or opened, cleaned with a small brush, an d at the same time, a vacuum cleaner should be used to remove dust from va rious parts.For the negative high voltage power line of the photomultiplier tube and the high voltage line and connector of the computer monitor, it is also n ecessary to carefully remove carbon deposits and dust with a small amount of anhydrous alcohol dipped in gauze.For instrument dust removal, it is general ly assisted by professionals in electronics, instrument maintenance, or computer science.If the instrument users or managers do not understand electronic know ledge or the structure of the instrument, they should not easily touch it to avoi d accidents.Dust removal should be stopped and the power supply should be tu rned off before proceeding.

6.2.4 Maintenance of atomizer

Atomizer is the most fragile and critical part of the injection system, requ iring good maintenance and use.Regular cleaning is necessary, especially after measuring high salt solutions.The top of the atomizer and the nozzle of the tor ch tube may accumulate salt, causing poor aerosol channels and often reflectin g a decrease in measurement intensity and an increase in instrument reflection power.Dust or carbon accumulation on the torch tube can affect the ignition and stability of the plasma torch, as well as the reflected power.Therefore, it is necessary to regularly wash it with acid and water, and finally, rinse it wit h anhydrous ethanol and blow dry it, while keeping the injection system and t orch tube clean.

6.2.5 Try to minimize the number of on-off cycles during use

Before starting up for testing，it is necessary to make arrangements and pr epare in advance.It is important to avoid frequent opening of the instrument at the same time，as frequent opening can easily cause damage.This is because t he instantaneous current of the instrument is much higher than that during nor mal operation，and the instantaneous pulse impact can easily cause damage to t he power transistor，vacuum capacitor，and other chips.

6.2.6 Other matters need attention

1、Inspection of the sample system before injection；

2、Inspection and cleaning of the sample system after measurement；

3、The waste liquid in the waste liquid tank should be cleaned regularly；

4、Cleaning of torch tubes，atomizers，and mist chambers；

5、Regular replacement of cooling water；

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

7、After the instrument is ignited，the flow meter and pressure gauge of the plasma gas cannot be adjusted casually，otherwise it will burn out the quartz torch tube；

8、After igniting the instrument，the sample capillary must be placed in the solution.When replacing the solution，the capillary should not leave the liquid (air) for more than 10 seconds, otherwise it will cause flameout；

9、If you find that the quartz torch tube is very dirty, please clean it in time；

10、Take care when disassembling the torch tube, spray and fog chamber (quartz glass products are fragile).

Chapter VII Fault analysis and troubleshooting

Common fault phenomena and related solutions：

7.1 Ignition failed

1）According to the software prompt，check if there is any indication of

insufficient airflow.If prompted，please check the gas circuit according to the prompts and replace the gas cylinder if necessary；

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

3）Check if the ignition gun wire is connected to the torch tube；

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

7.2 Click sample injection preparation fire extinguishing

1)Check if the capillary injection tube is not placed in the solution，causing air to enter；

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

7.3 Software connection failed

1） Check if the network cable is in good contact；

2） Check if the instrument is powered on.

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