Chapter 1 SDB521 Instrument Introduction

The SDB521 Full-Spectrum Direct-Reading Spectrometer, independently developed by YUKE Instruments, is a novel atomic emission spectrometer. It determines material composition through analyzing characteristic spectral emissions of elemental atoms or ions generated by thermal or electrical excitation, enabling both qualitative and quantitative elemental analysis. Primarily used for detecting alloy components and impurity levels in metallic materials, this instrument finds extensive applications across industries including metallurgical casting machinery, laboratory testing, automotive manufacturing, aviation and power sectors, shipbuilding and nuclear energy, as well as ferrous and non-ferrous metal smelting, processing, recycling, and industrial quality control. Its capabilities cover pre-furnace inspections, incoming material testing, quality control, and final product inspection for elemental composition analysis.

The instrument's testing performance has reached the advanced level of international counterparts, featuring rapid analysis speed, high precision, user-friendly operation, convenient sample placement, and argon gas conservation. With a novel design and stable reliability, it boasts a fully Chinese-language interface and integrates Germany's cutting-edge spectroscopic detection technology with domestic advancements. The product demonstrates the following technical advantages:

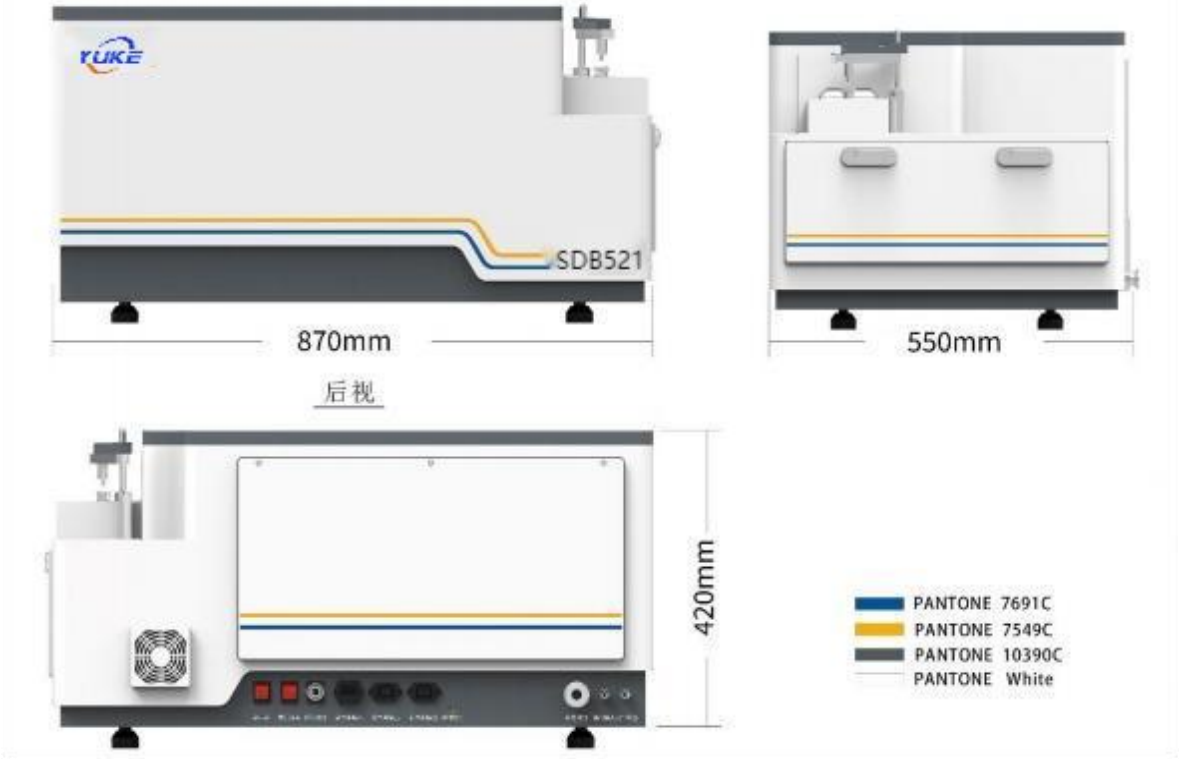
1. Intelligent operation and interaction system: automatic pixel correction, automatic plate number identification, Chinese-English convertible simple operation interface.

2. The spectrum data is accurate, using dark current deduction + resolution digital enhancement technology.

3. The detection operation is simple, and the detection data can be obtained in 15-40s with one click.

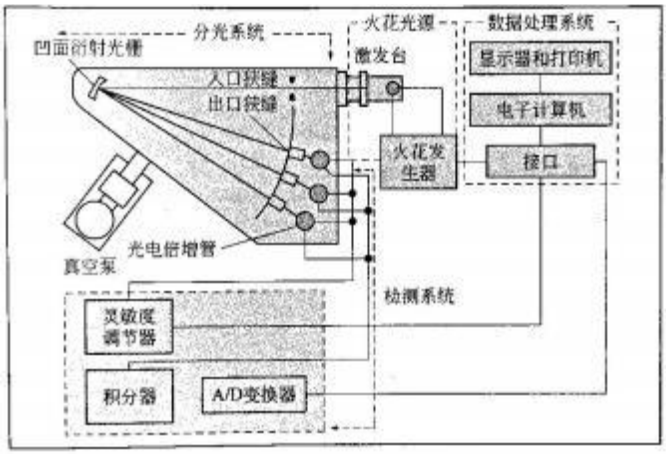
4. Automatic monitoring and reminder of instrument hardware: temperature and vacuum monitoring, maintenance record monitoring, etc.

5. Remote transmission of communication protocol, two-way interactive operation, and technical support.



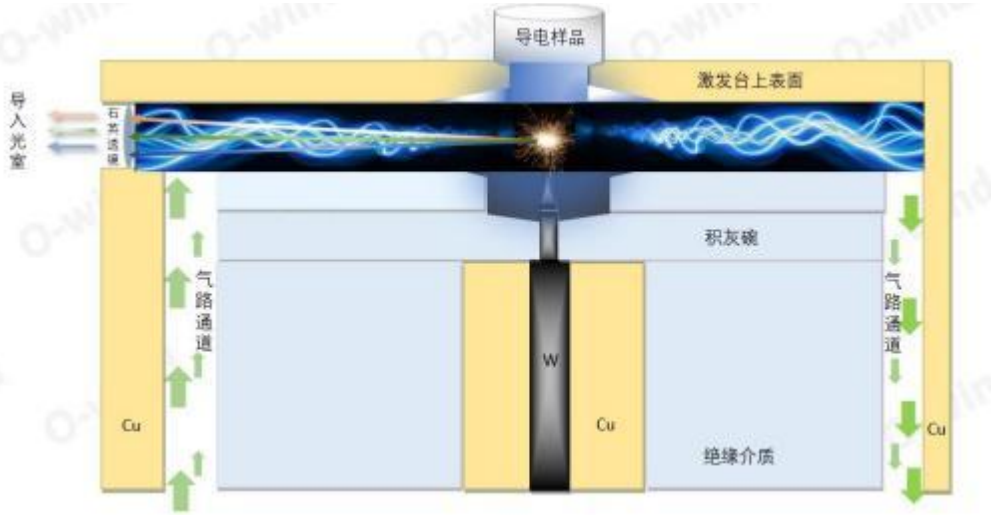
Chapter 2 Working principle of the instrument

The SDB521 Full-Spectrum Direct-Reading Spectrometer, through the integration of microelectronics and computer technology, has achieved highly automated analytical capabilities in precision, sensitivity, rapid operation, and instrument performance. Its core architecture consists of five key components: an excitation light source (spark lamp), electrode holder, spectroscopic system, detection system, and data processing unit. Both the electrical control system and data processing system are programmatically controlled by a computer for real-time monitoring and data management. The typical multi-channel instrument configuration is illustrated in the diagram below.



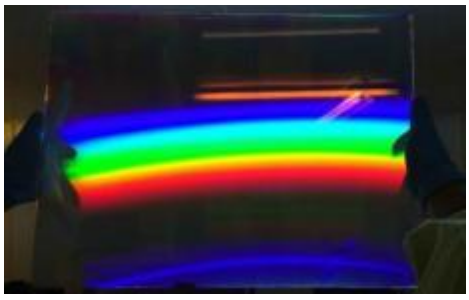
Common structure of full spectrum direct reading spectrometer

The SDB521 Full-Spectrum Direct-Reading Spectrometer employs an innovative excitation method where metal samples are processed into sample blocks. These blocks themselves serve as electrodes, while another sample or tungsten wire acts as the counter electrode. Positioned on the excitation platform, the instrument activates the digital excitation circuit according to preset parameters. The emitted light is dispersed by a spectroscopic system, with photoelectric sensors measuring spectral line intensities at specific wavelengths. The data processing system directly outputs results, enabling quantitative analysis of target elements in samples. For operational convenience, the excitation platform incorporates a built-in tungsten needle electrode system.



Chapter 3. Technical features

3.1 Paschen-Runge Optical Structure



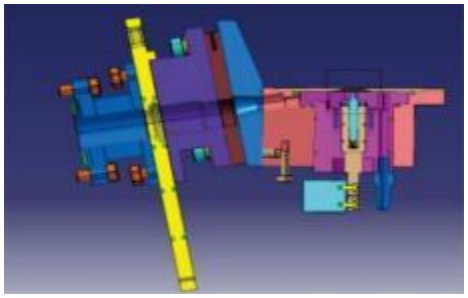
✓Parabolic-Longer concave grating device, using Paschen-Runge structure, the optical chamber structure is processed with integral profile to reduce the instrument with ambient temperature, improve the accuracy and stability of the instrument.

✓The wavelength range can reach (150-600) nm, and can analyze C, S, P and other elements as well as conventional elements, meeting the needs of various matrix materials for the test elements.

✓6-10 high performance CCD detectors imported from Japan

✓Light chamber cast aluminum profile integrated processing technology, precision processing, high vacuum sealing (patent number: ZL 202121923296.6)

3.2 15° Precision excitation system

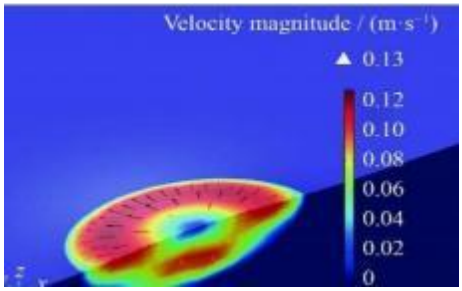


✓It has a patented structure design with independent intellectual property rights, and a 15 °tilted angle design, which has less spectral line interference and accurate spectrum reception.

✓Single-layer thin plate electrode plate, greatly reducing the cost of exciter plate replacement.

✓High purity tungsten electrode is adopted. High purity tungsten electrode has the advantages of high strength, corrosion resistance and high temperature oxidation, which reduces the influence of parameters on test data during use.

3.3 Optical thermostatic system



✓(Patent No: ZL 202121923296.6, Patent No: ZL 202121923346.0)

✓ The light chamber is a constant temperature cavity, equipped with feedback heating device, which can effectively ensure the constant

temperature of the light chamber, thereby suppressing temperature changes and reducing the slight changes of mechanical parts caused by temperature, which leads to light path drift.

✓ Optical components work in a constant temperature environment, which helps to ensure the short-term stability and long-term stability of instrument test results.

3.4 Intermittent argon charging system

✓The intermittent argon filling effectively ensures the stability of the environment inside the light chamber.

✓Intermittent inflation greatly reduces the consumption of argon.

✓The design of slightly higher than atmospheric pressure can ensure the stability of the light room environment.

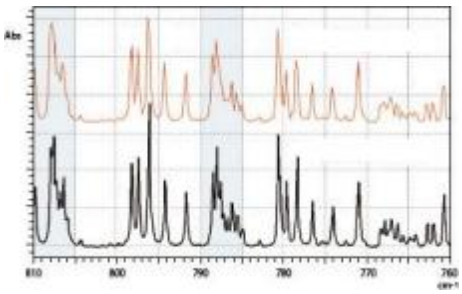
✓The argon system will not produce noise interference in the process of use, improving the comfort of use.

✓Set the dynamic and static argon flow rate, so that the instrument has excellent argon saving technology, reduce the user's cost.

✓Intelligent advanced gas path monitoring: Before excitation, the monitoring system ensures that the spark chamber is sealed and not leaking; after excitation, pulse argon blow is used to improve the dust removal effect and ensure the short-term and long-term performance of the instrument

Period stability.

3.5 High energy pre-combustion HEPS technology



3.6 Import SUS high and low standard

✓New adjustable digital light source, high energy pre-ignition technology (HEPS), to meet the measurement of vacuum ultraviolet spectrum below 180nm, grating radius 402nm, to obtain the best high resolution

✓Long-term stability is excellent, and the procedure is standardized for 1-3 months per time;

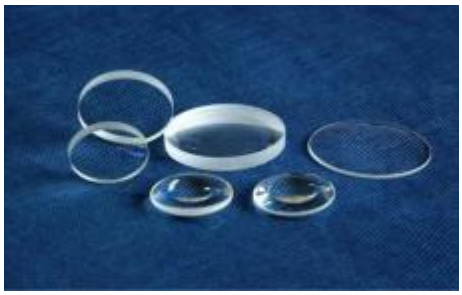
✓(Patent No.: 2021SR0146134)

✓Germany SUS imported high and low standard spectral samples.

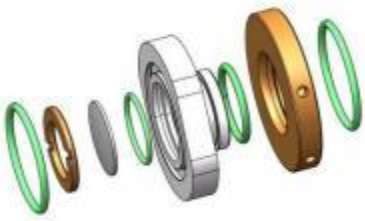
✓The world's leading technology ensures the best uniformity of sample composition and the best value of calibration parameters.

✓It can realize the global standardization of the matrix, and for customers' various sample testing requirements, it can simply and quickly achieve all the instrument program calibration at one time.

3.7 Optical lens system design



optical lens



Fitted lens design

✓The quartz glass material MgF2 coating is adopted to ensure that the light intensity of ultraviolet wavelengths such as C, N, P and S passes through the lens is the strongest, so that the ultraviolet short wave measurement results are more accurate.

✓The plug-in lens seat structure effectively isolates the dust in the excitation table, prevents the contamination of the light chamber, and facilitates the regular maintenance and cleaning of the instrument.

✓The design of the pressed ring embedded lens effectively isolates the gas exchange between the light chamber and the outside world, ensuring the stability of the internal environment of the light chamber.

✓Easy to assemble and disassemble.

3.8 Intelligent detection system

✓Intelligent operation and interaction system: automatic pixel correction, automatic plate number identification, Chinese and English can be converted to a simple operation interface.

✓The spectrum data is accurate, using dark current deduction + resolution digital enhancement technology, and differential timing collection of multiple CCD detectors.

✓Instrument hardware monitoring reminder: temperature and vacuum automatic monitoring, maintenance record monitoring, etc.

✓Communication protocol remote automated transmission, two-way interactive operation, remote technical service support.

✓(Patent numbers: 2020SR1651417,20210146134)

✓Software Product Certification (No.: Su RC-2021-E0485, Su RC-2021-E0485)

3.9 List of core components

Serial number	part name	origin	brand	Serial number part name origin brand
1	CCD sensor	Japan	Toshiba, East Japan	
2	raster	France	HORIBA JY	
3	mains filter	America	Astrodyne	
4	Standard samples (high and low standard)	Germany	SUS	
5	electromagnetic valve	Taiwan, China	Airtac	
6	Bose vacuum pump	China	Bosch Group	
7	FPGA slug	America	Altera	
8	Ignition pulse transformer	Britain	OEP	
9	Switching Mode Power Supply	China	Meanwell	
10	Transmission fiber	America	Avago Technologies	

Chapter 4 Technical parameters

project	parameter
Instrument type	SDB521
Detectable matrix	Fe,Al, Cu, Zn matrix detection
Optical structure	Type P-Longgrande round full spectrum vacuum/non-vacuum optical system
prober	7-16 Block CCD, containing a measurement deep ultraviolet CCD
wavelength coverage	139-800nm, wavelength range measurable C, S, P, N
Gigantism focal length	HORIBA Jobin Y Concave Holographic Grating (2400g/mm)
Optical focal length	402mm
Source type	New adjustable digital light source, high energy pre-ignition technology (HEPS)
discharge frequency	100-1000Hz
discharge current	Max 100A
Ignition voltage	1-15KV
Standby average power	80VA
Stimulate maximum power	1000VA
working power supply	AC (220+20) V, (50+1) Hz, protective earthed single-phase power supply
Time of detection	15-40s (depending on sample type)
working temperature	(10-30) ℃
Humidity at work	(20-50) %
Vacuum range of light room	1-15Pa
Argon gas purity requirements	99.999%
Argon inlet pressure	0.2MPa
Argon gas flow	Standby flow rate 0.1 L/min, excitation flow rate 6 L/min
instruments weight	About 70kg
Instrument dimensions	Long 870mm * wide 550mm * high 420mm

Chapter 5 Analytical functions

The full-spectrum direct-reading spectrometer features a user-friendly interface with streamlined software operations. Optimized for different user preferences, the system reduces technical requirements while ensuring intuitive operation. The main menu bar displays four primary sections: [Daily Analysis], [System Maintenance], [Data Management], and [Help], each containing dedicated submenus. Key navigation options are conveniently located in the upper-right corner, including [User Switch], [Minimize], and [Exit] buttons.

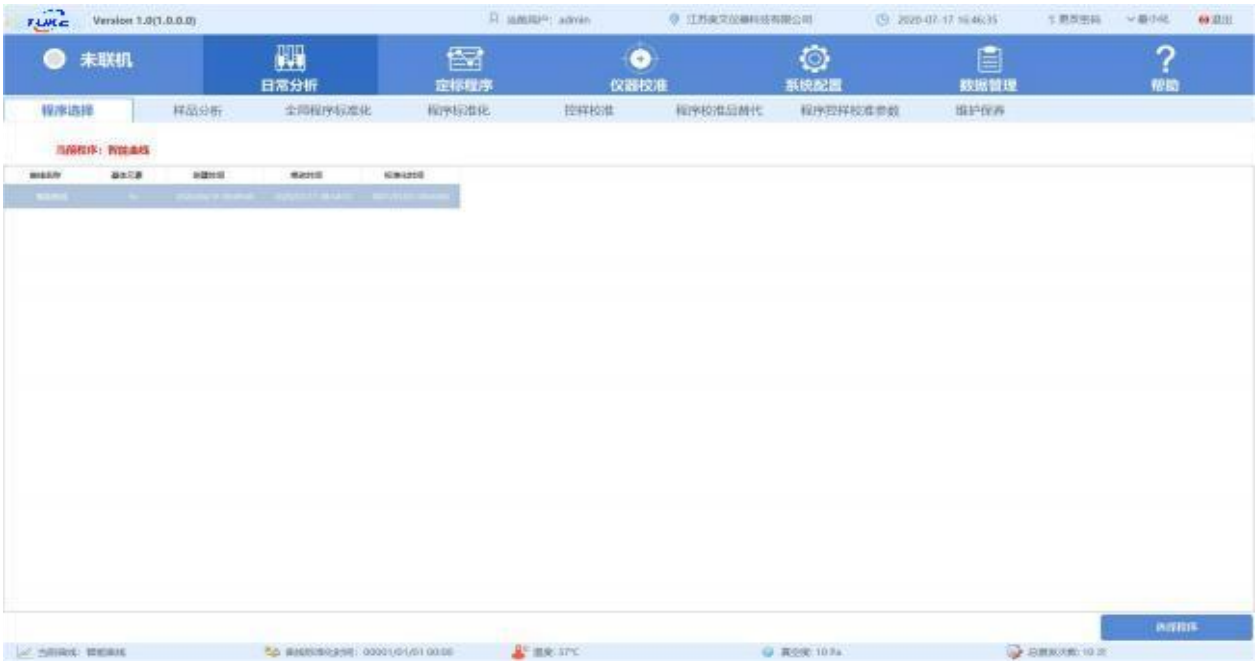
The software version, current program, curve standardization time are displayed in the upper left corner of the main interface, and the current user, company name, light room temperature, instrument vacuum degree, and total excitation times are displayed at the bottom of the main interface.

➢ **Intelligent curve**

Intelligent computing function can meet the analysis needs of in-body materials.

Intelligent link to the appropriate curve model to obtain more accurate analysis results.

The analysis of unknown samples can be realized without worrying about model selection and the operation is more simple.



➢ **Intelligent quality control**

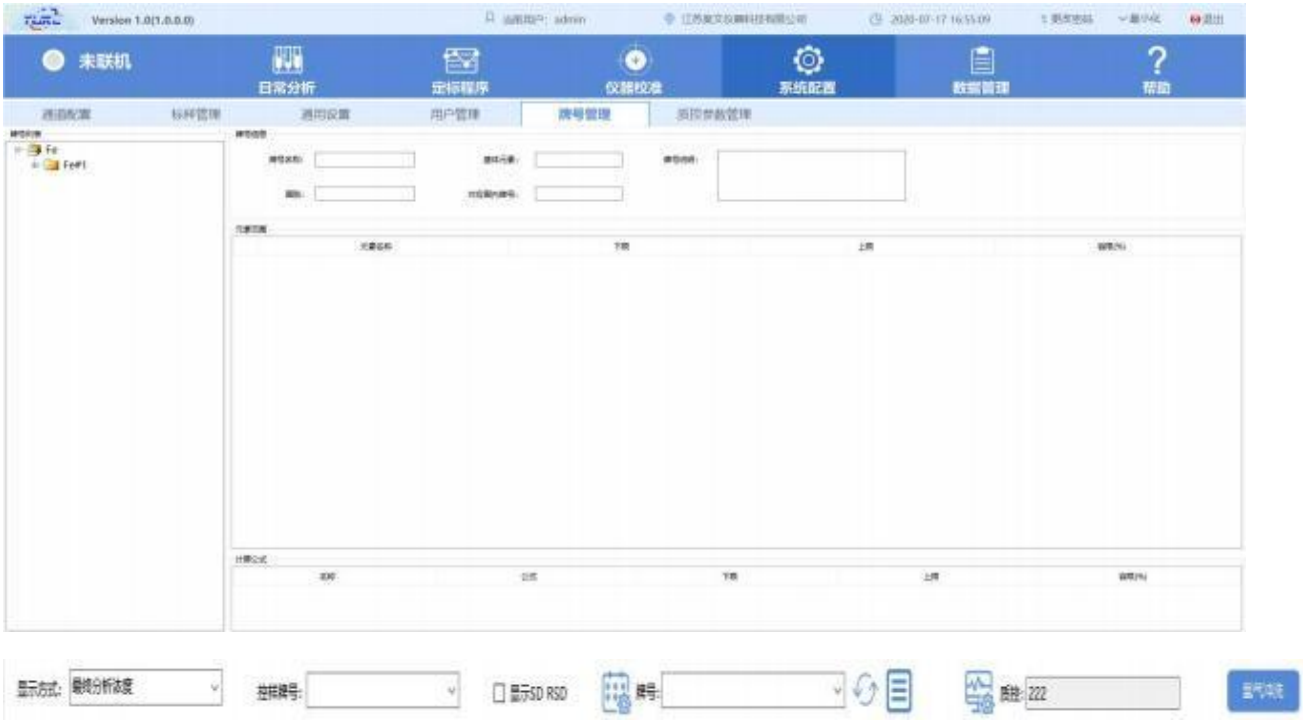
According to the measurement standard of users, the upper and lower limits of element composition quality control can be freely set, the sample composition can be automatically judged whether it exceeds the standard, and the results are clear at a glance.

➢ **Intelligent quality control**

According to the measurement standard of users, the upper and lower limits of element composition quality control can be freely set, and the sample composition can be automatically judged whether it exceeds the standard or not, and the results are clear at a glance.

➢ **Intelligent brand identification**

It can classify unknown materials, help users quickly identify sample brands and numbers, and intelligent housekeeping service.

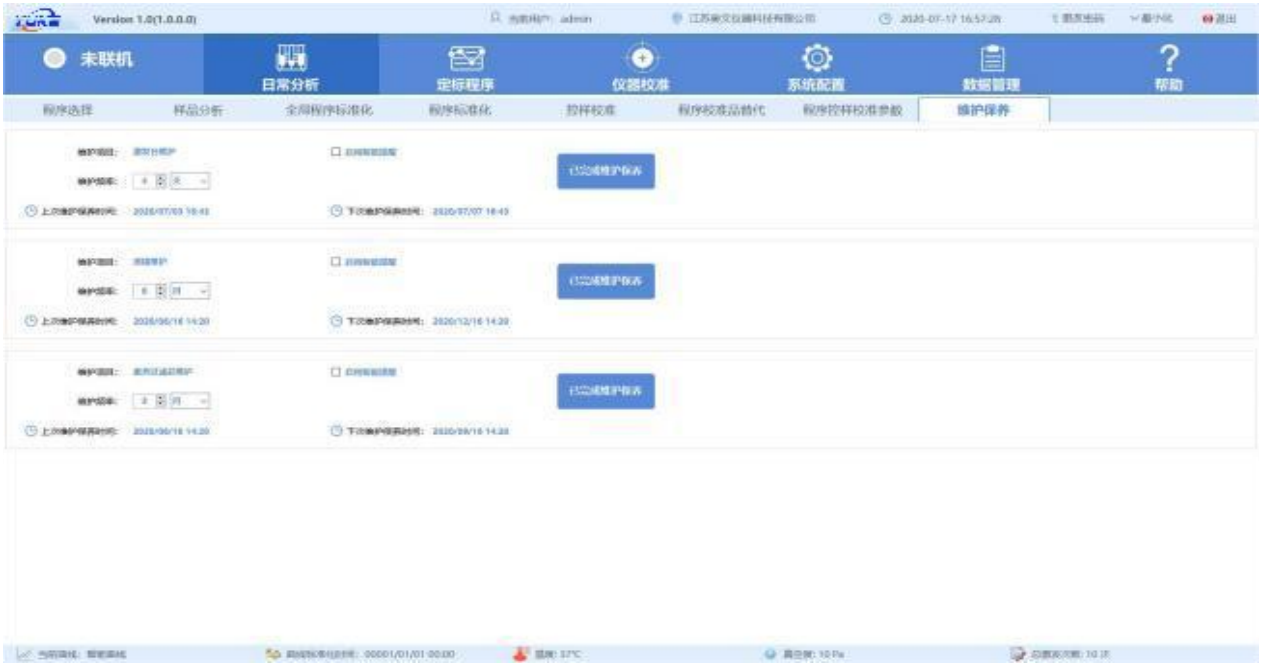


➢ **Intelligent equivalent calculation**

The carbon equivalent and corrosion resistance equivalent formulas can be freely edited to control material properties and improve product performance.

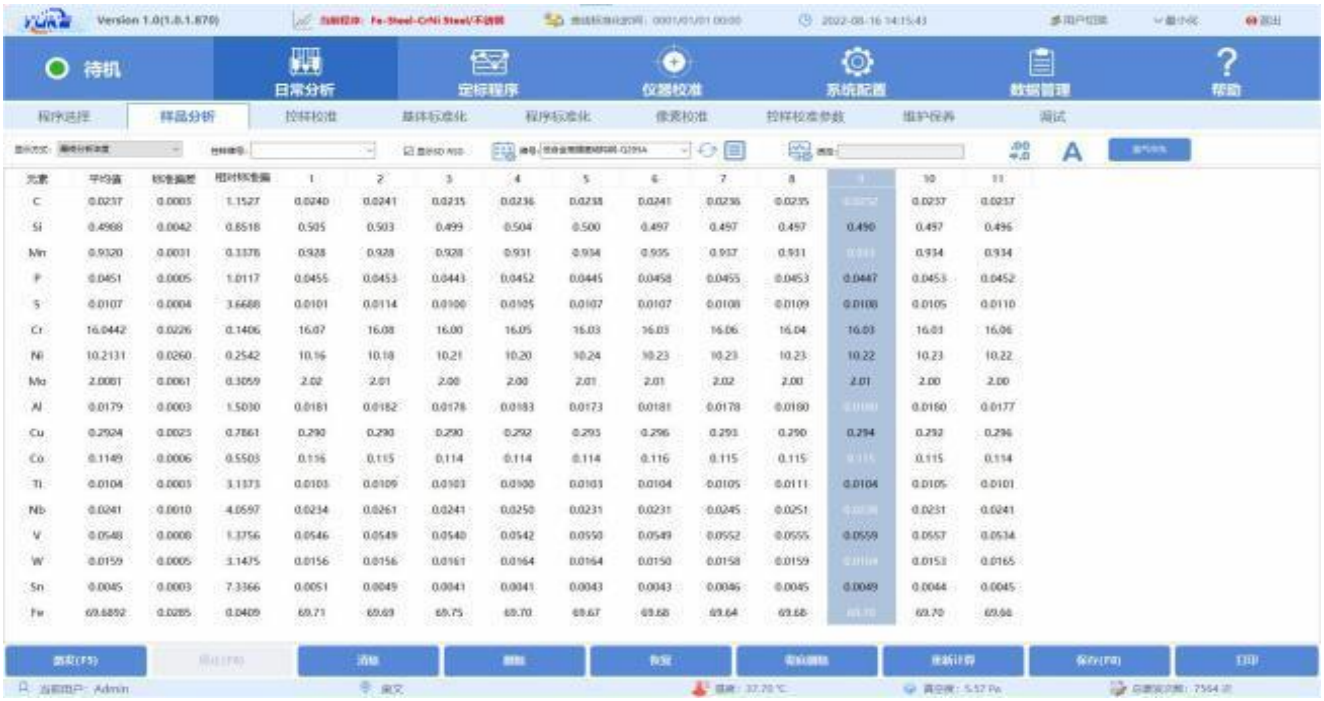
➢ **Smart system housekeeping service**

The software interface presents the operating status of the instrument in real time. The maintenance and cleaning time of the instrument is timely reminded.

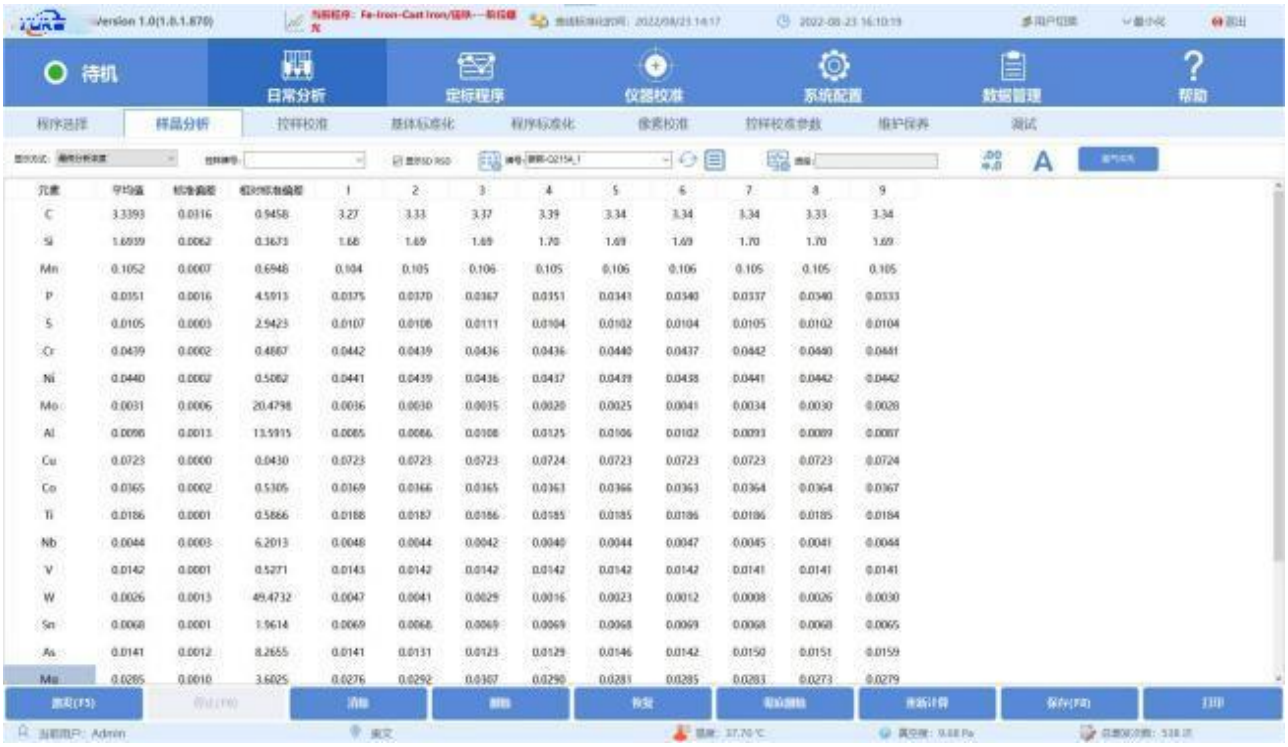


Chapter 6 Experimental data display (part)

➢ **Matrix: Iron based (Fe) Analytical procedure: Stainless steel**



➢ **Matrix: iron base (Fe) Analysis procedure: cast iron**



Chapter 7. Instrumental matrix, optional range of analytical procedures

The standard working curves for the instrument are calibrated using reference samples developed by Jiangsu YUKE Instrument Technology Co., Ltd. For special alloys and elements, users must provide either standard samples or pre-calibrated control samples, which YUKE will then calibrate. However, these calibration curves shall not be used as acceptance criteria for the instrument. [Selection is based on the matrix curve content range table established by the Technical Service Department. The SDB521 Full-Spectrum Direct-Read Spectrometer is a single-matrix instrument.]

1. The instrument analysis program is calibrated by the buyer using domestic and foreign certified standard samples, which can meet almost all common grades.

2. The buyer's testing requirements are special (such as rare alloy grades, elements, content ranges, etc.), which may lead to the lack of corresponding certification standard samples.

3. If the buyer can provide an applicable sample, YUKE engineers can make a special analysis program for the user.

4. The content of matrix elements is the total minus the content of other elements (100% -∑ other elements)

5. Cast iron test specimens must undergo thorough whitening treatment to ensure accurate testing. For molten metal (hot metal) tests, sampling molds must meet rapid cooling requirements (e.g., stamp-shaped or coin-shaped configurations) to maintain whitened surfaces. When testing cast iron products (typically non-whitened specimens), the material should be remelted and poured into rapid cooling molds to achieve proper whitening.

6. Each analysis program needs to be configured with multiple standardized samples for instrument calibration. When multiple analysis programs are configured, the same standardized samples will not be configured repeatedly.

7. The size of the typical sample is 15-80mm in diameter. If the size is too small or too thin, appropriate fixture should be configured and feasibility should be confirmed with engineers.

Matrix analysis program table

Serial number	Iron base (Fe) analysis program	Aluminum base (Al) analysis program	Serial number	Iron base (Fe) analysis program	Aluminum base (Al) analysis program
1					
2	Medium and low alloy steel	Aluminum, silicon and copper series			
3	chromium nickel stainless steel	Aluminum-silicon series			
4	high manganese stainless steel	Aluminum and zinc series			
5	chromium steel	Aluminium and copper series			
6	plain cast iron	Aluminum magnesium series			
7	nodular cast iron	Aluminum-manganese series			
8					
9					

Hadfield's manganese steel	Low alloy aluminum series
high-speed steel	Pure aluminum series
high-chromium iron	

Range table of iron base analysis procedures

	NO.		常用程序													
		Program 分析曲线	Fe-Low alloy 中低合金钢		Fe-CrNi steel 不锈钢		Fe-Cr steel铬钢		Fe-Cast iron 铸铁		Fe-Cr-hard Cast 高铬铸铁		Fe-Mn Steel 高锰钢		Fe-Tool Steel工具钢	
		Elements 元素	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
常规元素及范围	1	C	0.001	0.91	0.001	0.5	0.001	2.2	2	4.1	2	3.4	0.001	2.2	0.001	1.5
	2	Si	0.001	4	0.001	2.5	0.001	1.5	0.001	3.5	0.001	2.5	0.001	2	0.001	2
	3	Mn	0.003	2.1	0.003	19	0.003	1.5	0.003	1.7	0.003	1.6	2	30	0.003	1.1
	4	P	0.002	0.055	0.002	0.055	0.002	0.05	0.002	0.7	0.002	0.5	0.002	0.18	0.002	0.06
	5	S	0.002	0.06	0.002	0.05	0.002	0.1	0.002	0.18	0.002	0.15	0.002	0.06	0.002	0.06
	6	Cr	0.002	5	4	30	1	24	0.002	2.5	2	31	0.002	3	2	7.5
	7	Ni	0.002	5	1	25	0.01	4.2	0.003	2.4	0.001	2.5	0.001	2.5	0.02	0.3
	8	Mo	0.0005	1	0.002	3.2	0.002	2	0.002	1.2	0.002	3	0.04	1	0.05	9.5
	9	Al	0.002	1.3	0.002	1.7	0.002	1.7	0.002	0.6	0.002	0.6	0.002	0.5		
	10	Cu	0.003	0.5	0.003	4.5	0.003	0.5	0.003	1.8	0.003	1.5	0.003	0.55	0.003	0.47
	11	Co	0.003	0.5	0.003	0.2	0.003	0.5	0.003	0.03	0.003	0.2			1	15
	12	Ti	0.002	1.2	0.002	0.7	0.002	0.4	0.002	0.4	0.002	0.3	0.002	0.2		
	13	Nb	0.002	0.3	0.002	2.4	0.002	1.5	0.002	0.6	0.01	0.18	0.009	0.1		
	14	V	0.001	1	0.001	0.55	0.001	1	0.001	0.7	0.001	1	0.001	0.5	0.03	12
	15	W	0.002	2	0.002	3	0.002	1	0.002	0.6	0.002	2	0.002	0.3	0.1	20
	16	Pb	0.002	0.05					0.002	0.07						
	17	Mg							0.0005	0.1						
	18	B	0.001	0.016	0.001	0.01			0.002	0.05	0.002	0.05				
	19	Sn			0.0003	0.1			0.003	0.3						
	20	As			0.005	0.03			0.005	0.1						
	21	La							0.005	0.06						
	22	Ce							0.003	0.2						
	23	Sb	0.005	0.1	0.005	0.1			0.005	0.2						
基体元素	24	Fe	余量		余量		余量		余量		余量		余量		余量	

Aluminum base program range table

SDA400 Al基标准范围

	No.	Program 分析程序	Al-SiCu alloy铝基-铝硅铜系		Al-Si alloy铝基-铝硅系		Al-Zn alloy铝基-铝锌系		Al-Cu alloy 铝基-铝铜系		Al-Mg alloy 铝基-铝镁系		Al-Mn alloy 铝基-铝锰系		Al-low alloy 铝基-低合金铝系		Pure-Al alloy 铝基-纯铝系	
		Elements元素	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
常规元素以及基本范围	1	Si	1	15	1	15	0.01	0.52	0.01	1.1	0.002	0.51	0.005	0.94	0.001	0.75	0.001	1.1
	2	Fe	0.003	1.5	0.003	1.5	0.003	0.8	0.003	0.8	0.003	0.8	0.003	1	0.003	4	0.002	1.2
	3	Cu	0.1	9.5	0.005	0.34	0.01	0.78	0.01	5.8	0.007	0.2	0.02	0.42	0.002	0.18	0.002	0.06
	4	Mn	0.001	1.3	0.001	1.3	0.001	1.3	0.001	1.3	0.001	1.3	0.1	1.8	0.001	1.3	0.001	0.06
	5	Mg	0.001	3	0.001	3	0.01	5	0.001	3	1	10	0.001	3	0.001	3	0.001	0.05
	6	Cr	0.004	0.26	0.004	0.2	0.01	0.25	0.01	0.3	0.002	0.34	0.01	0.2	0.001	0.15	0.001	0.03
	7	Ni	0.002	2	0.002	2	0.002	0.3	0.002	2	0.002	0.3	0.004	0.15	0.002	0.3	0.001	0.03
	8	Zn	0.002	4	0.002	4	1	8.5	0.002	1	0.01	1	0.01	1	0.002	1	0.002	0.06
	9	Ti	0.001	0.25	0.001	0.25	0.001	0.25	0.001	0.25	0.001	0.25	0.001	0.25	0.001	0.001	0.002	0.06
	10	Be	0.002	0.08	0.002	0.08												
	11	Ca	0.0015	0.03	0.0015	0.03												
	12	Cr	0.0020	0.37	0.0020	0.37	0.0020	0.37	0.0020	0.14	0.0020	0.37	0.0020	0.27	0.0020	0.27	0.0020	0.27
	13	Co	0.003	0.05	0.003	0.05												
	14	Ga	0.001	0.03	0.001	0.03	0.001	0.03			0.001	0.03			0.001	0.03		
	15	Pb	0.002	0.2	0.002	0.2	0.002	0.1	0.002	0.1	0.002	0.1	0.002	0.1	0.002	0.2		
	16	Sn	0.001	0.2	0.001	0.2	0.001	0.2	0.001	0.2	0.001	0.2	0.001	0.2	0.001	0.2		
	17	Sr	0.001	0.08	0.001	0.08												
	18	V	0.001	0.06	0.001	0.06	0.001	0.06	0.001	0.06	0.001	0.06	0.001	0.06	0.001	0.06	0.001	0.06
	19	Zr	0.01	0.25	0.01	0.25	0.01	0.25	0.01	0.25	0.01	0.1	0.01	0.25	0.01	0.25	0.01	0.1
基体元素	20	Al	余量		余量		余量		余量		余量		余量		余量		余量	

Chapter 8. Scope of supply

8.1 Host list

No. Item specification model quantity				No. Item specification model quantity			No. Item specification model quantity		
1	**Full spectrum direct reading spectrometer**		SDB521		1 unit				
	Analytical matrix: Details: Based on customer choice		SDB521		1				
	Analysis procedure: Details: Based on customer choice		SDB521		** twig				
	High and low standard blocks: configured according to the product matrix and analysis program		enter port SUS		** block				
2	YUKE direct reading spectrometer CCD data acquisition system embedded software V1.0		embedded software		1 set				
3	YUKE full spectrum direct reading spectrometer analysis software V1.0		Application analysis software		1 set				
4	Communication parameter voltage regulator		CWY-11-1KVA		1 unit				
5	compression release valve		/		1				
6	Consumables and spare parts		YUKE		1 set				
7	Instrumentation manual, product qualification certificate, warranty card, etc		YUKE		1 set				
8	Packaging and transportation		/		1 Next				

8.2 Consumables and spare parts

order number	name of material	Specifications and quantity Specification number quantity	
	Tubular purple copper	6mm*4mm	3m
1	Double card joint nut	304/KF16	2pcs
2	inner hexagon spanner	/	1pcs
3	Tool kit	/	1pcs
4	PTFE TAPE	/	1pcs
5	Stimulate the electrode cleaning brush	/	2pcs
6	fuse	5A	1pcs
7	earth wire	/	1pcs
8	Serial cable	/	1pcs
9			

10	Filter bottle and filter tube	10*6.5	1pcs
11	power line	Input 1, output 1	2pcs
12	Phillips screwdriver	/	1pcs
13	PU air tube		1.5m
14	fastening screw		2pcs
15	Type O sealing ring assembly	Supporting specifications	2pcs

Special statement: Due to technical progress, product upgrade, market changes and other reasons caused by the above instrument parts, spare parts and other production and supply manufacturers change, the actual shipment is subject to.

Chapter 9 Installation and maintenance of instruments

9.1 Installation of the instrument

Full spectrum direct reading spectrometer is a kind of precision optical instrument, which needs careful maintenance and care to maintain its stable analytical performance and make the instrument work normally. When installing the instrument, it must meet the installation conditions of the instrument. Generally, the following matters should be paid attention to:

1. The instrument should be installed in a laboratory with less dust and no corrosive gas. The instrument should avoid direct sunlight.

2. The temperature and humidity in the laboratory should meet the requirements specified by the instrument. The temperature of the laboratory is required to be 10-30℃ and the relative humidity is less than 50%.

3. The spectrometer should be installed in a place with as little vibration as possible, and there should be no strong vibration source near the instrument to avoid the influence of vibration. There should be no strong AC interference around the instrument, no strong airflow and corrosive gases such as acid and alkali.

4. The power supply to the instrument should be connected to the voltage stabilizer, so that the power supply variation is kept within ±1%, and the frequency variation is as small as possible. It should also have a good grounding.

5. In order to make the instrument work stably and reduce harmful interference to other equipment, special grounding equipment must be set up according to the requirements of the instrument.

6. The environment needs to be able to discharge the gas from the vacuum pump (referring to the vacuum instrument) and the light source electrode frame part outside.

The seller is responsible for the installation and debugging, and the buyer shall provide the site, power supply, gas source and other facilities that meet the laboratory installation conditions. The installation is free during the warranty period.

Upon completion of instrument installation preparations, the buyer may notify the seller to dispatch technical service engineers to the site for installation. The seller shall confirm an installation schedule within 24 hours of receiving the notice and notify the buyer accordingly. Technical service engineers will arrive at the site within the agreed timeframe. Following an inspection process, they will verify the buyer's site preparations and the instrument's basic condition before commencing installation. The equipment can only be delivered for use after passing acceptance verification through normal operation.

The buyer shall keep the instrument properly before installation and shall not open the box without permission of the seller. If the instrument is damaged due to the buyer's carelessness after delivery, the buyer shall bear the corresponding responsibility by himself.

9.2 Auxiliary equipment and gas supply

In order to make a full spectrum direct reading spectrometer work effectively, in addition to a good performance of the main instrument, it also needs auxiliary equipment to form a complete spectrum automatic analysis system. These auxiliary equipment include:

The voltage stabilizer power supply —— ensures the stable power supply of the instrument, which can be configured according to the requirements of the instrument manual.

The gas supply system —— argon source, pressure and flow stabilizing device and regulating instrument are provided to ensure the requirements of argon during the operation of the instrument and during the analysis process.

The equipment for sample preparation and sampling —— including grinding wheels and small lathes, which are used for surface polishing or turning of samples, should be configured according to the specific analytical tasks and requirements. High-speed cutting machines, sandpaper grinding discs, belt sanders, and grinding wheels must be installed in safety zones equipped with dust collection systems.

9.3 Pre-installation preparations for users

1. Laboratories

A dedicated laboratory should be established for equipment configuration. The spectroscopy room must be separated from the sample preparation area, with designated spaces for instrument placement. As the SDB521 is a benchtop instrument, an experimental table approximately 60-70cm high should be prepared to accommodate it. For operational convenience, leave about half a meter of space behind and on both sides of the spectrometer. Additionally, install a computer desk beside the instrument for workspace organization.

2. High-purity argon

Prepare 2-3 bottles of high purity argon gas with a purity greater than 99.999%.

3. Air conditioning

According to the size of the spectroscopy laboratory room, one air conditioner should be configured, and the air conditioner should not blow directly on the instrument.

4. Grind sample machine or small lathe:

If used for steel sample analysis, it is necessary to configure a grinding machine with a grinding pan diameter greater than Φ300mm (it is recommended to use Jinan Jinguang GM series spectral grinding machine); for aluminum, copper, lead and other non-ferrous metal samples surface, small lathe is used.

5. AC parameter voltage regulator

Prepare an AC parameter voltage regulator (specification 1KVA, single-phase 220V), voltage stabilization accuracy less than 3%, adjustment time less than 40ms, it is recommended to use:

a. Iron Tower brand voltage regulator (magnetic saturation voltage regulator) produced by Luoding Radio Technology Co., LTD., Guangdong Province;

b. Century Star single-phase AC parameter regulated power supply produced by Dongguan Aoxis Electric Appliance Technology Co., LTD.;

6. Dedicated lines for independent use

When the soil resistivity is below 4Ω, use copper rods with diameters of 38-50mm for grounding, with a length of 2.5m. Generally, the grounding wire should be buried at a depth of no less than 2m. In special locations where installing grounding electrodes is required, if the depth fails to reach 2m, place 8kg of industrial salt and approximately 30kg of coke around the electrode along with water to reduce ground resistance.

Other non-essential annexes

The access end of the spectrometer should be equipped with power failure protection and overcurrent 5A protection; the diameter of the power line should be more than 1.5 square millimeters;

A micro vacuum cleaner for cleaning the spark test bench; a temperature and humidity meter to monitor the laboratory environment; and a power strip;

For humid areas, dehumidifier is required (not necessary)

In some areas, if the output of high-purity argon gas cannot meet the analysis requirements, an argon purifier should be configured (the purity of argon gas is greater than 99.999%), and the user prepares it (not essential)

A cutting machine for the treatment of samples that are not suitable for spectrometer analysis (not essential)

8. Notes

The power supply system of the spectrometer should be separated from the high-power electrical equipment (such as medium frequency electric furnace and other electrical equipment with frequent start and stop);

Keep away from high power electrical appliances at least 50m or so;

The dustproof effect of the spectroscopic laboratory is better;

Avoid single side heating or direct sunlight on the spectrometer;

Laboratory technical requirements

Serial number	Project requirements	Serial number	Project requirements	Serial number	Project requirements
1	temperature	(20-30) ℃, maximum allowable temperature change: ±2℃/h			
2	relative humidity	(20-80)%, no water condensation			
3	Seismic protection requirements	The instrument working place should prevent vibration, if there is a large vibration around, it is advisable to take vibration reduction measures;			
4	Cleanliness requirements	Keep the laboratory clean and avoid contact with corrosive substances such as acids and alkalis			
5	Shielding requirements	To prevent electromagnetic interference, when there is a strong electromagnetic field in the environment, the laboratory should take shielding measures			
6	Argon gas requirements	≥99.999%, oxygen content not more than 2mg/L			
7	power requirement	220V (±10%), current 10A, single phase 50Hz			
8	earthing resistance	<4Ω			
9	power stabilizer	1KVA			
10	Spectrometer grinding machine	380V			
11	Small lathes	380V or 220V			
12	vacuum cleaner	220V			
13	Instrument placement table	800*2000mm			
14	Argon purifier	220V			

9.4 Maintenance of equipment

Full spectrum direct reading spectrometer is usually a desktop laboratory instrument, which needs to operate under certain conditions. Especially for the instrument used in front of metallurgical furnace, its use and maintenance can ensure that the instrument is in normal operation for a long time and provide accurate and reliable measurement performance.

1. Circuit connection line switch

The electrical circuit of the instrument must be well connected, and the voltage is kept stable by the voltage regulator. There is switch protection, and the internal circuit must be grounded. The argon gas interface connector of the working gas should be kept tightly connected to ensure the use of gas during the entire analysis process.

2. Argon flow regulation

The instrument is equipped with a pressure regulator (pressure reducing valve), which can be adjusted to obtain the appropriate argon flow rate and observe the remaining argon in the bottle.

3. Exciter maintenance

When analyzing approximately 200 samples, the spark stage requires cleaning. The cleaning diagram is shown below. Typically, particles in the excitation chamber grooves can be removed using an excitation chamber brush, argon gas purging, or a compact vacuum cleaner (recommended for its convenience and effectiveness). During routine analysis, after each sample excitation, clean the electrode through the excitation port with an electrode brush to prevent dust accumulation from affecting excitation performance. Note: Keep samples on the spark stage when not performing experiments or using the instrument to avoid unintended excitation that could damage it. Avoid using wet cloths during cleaning.

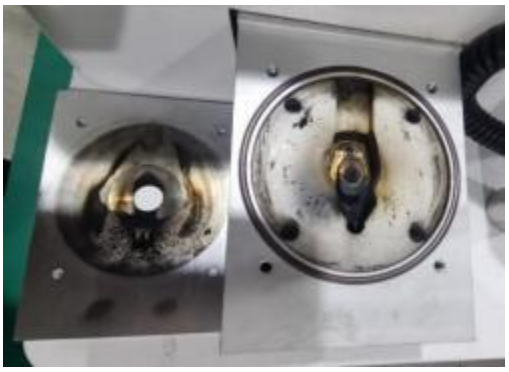


Figure 1 Before clearing

Figure 2 cleaned up

4. Vacuum pump (vacuum instrument)

After prolonged operation, perform regular oil level checks in the oil pump's reservoir. When the oil level drops below recommended levels, refill the tank. Open the tank valve to add oil until it's completely filled, then close the valve. Verify the oil level by checking that both the pump-to-light chamber passage and the float valve are closed simultaneously, while ensuring normal pump operation. During refilling, ensure the oil level remains within the visible scale range through the glass sight window. Conduct periodic inspections. If the oil temperature falls below 12℃, the system should not be activated.

5. Other matters needing attention

During routine cleaning of excitation units and filters, the power supply must be turned off. When performing instrument maintenance or repairs, follow the shutdown procedure for extended inactivity. In areas with frequent power outages, ensure vacuum pump valves are properly closed when not in use to prevent vacuum oil from backflow into the optical chamber and contamination. After prolonged operation, regularly check the vacuum oil level through the glass window on the pump's side – low levels require oil replenishment. Maintain optimal operating conditions by strictly adhering to standard procedures and protocols to maximize equipment longevity.