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XRF-B210

X RAY FLUORESCENCE SPECTROMETER OPERATION MANUAL

PLEASE SCAN QR CODE TO WATCH THE OPERATION VIDEO OF PRODUCTS.

VIDEO

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Security Guidance

This manual including the precautions that should be observed, in order to ensure personal safety and equipment from damage. These considerations are used respectively, obvious warning USES [note], [tip], users in the process of reading, please pay attention to the Suggestions.

Pay attention to these followings:

1. XRF-B210 is characteristic by analyzing the samples X ray method to qualitative quantitative analysis instrument. To human safety and the normal use of equipment customers are strictly prohibited to remove the instrument secretly, otherwise, the company will not be warranty.
2. In the maintenance of different parts, please be sure to cut off the main power supply.
3. The instrument has carried on the strict inspection before leaving the factory, allows users to rest assured to use, but after all, hard to avoid has a problem, in this, please be understanding; If in the process of use of abnormal, please contact us, we will solve for you as soon as possible.
4. The instrument factory is equipped with computer and printer, in the event of failure caused by instrument can't use, is not in the company within the service, users directly to computer manufacturers or printer, please contact maintenance, please be understanding here.
5. The instrument shall be operated with the specialized personnel, other irrelevant personnel shall not move or operate, otherwise the consequence is proud.

Preface

With the progress of society, Precision instrument industry has the high speed development. X-ray fluorescence spectrometer, as is a new nondestructive testing instrument is widely used in metallurgy, geology, chemical industry, machinery, petroleum, building materials industries. Also widely used in food detection, the RoHS testing, test, zero halogen element composition detection, harmful element analysis, analysis of alloy coating and the determination of the thickness of the metal film, etc.
Our company 's XRF-B210 analyzer is better to cope with alloy and coating analysis can satisfy the customer at the same time on the analysis of the RoHS and halogen free environmental directives, equipped with high-performance Si pin detector and digital multi-channel analysis system, at the same time as a result of the vacuum type test, for testing the light effect is greatly increased, expanded the scope element test and test accuracy, especially increases the content of alloy elements in low light, the detection effect of other elements in the test of RoHS directive of repeatability and stability also has improved significantly.

Split open a case to check

Check boxes if there are any destruction in transit, confirmed after no abnormalities, open the packing cases, control instrument packing list one by one, check the host, accessories, spare parts, certificate of approval, such as whether is complete, if you find any missing or damaged, please contact our company immediately. Don't return the instrument without our permission.

The instrument connection

Place the XRF-B210 on the table, according to the requirements shown in figure 2-1 to instrument all wiring port connected to the power supply, vacuum pump and PC USB one by one in place. Open the instrument power switch and PC power supplies after the connection is verified, instruments at the back of the fan rotation and positive power indicator.

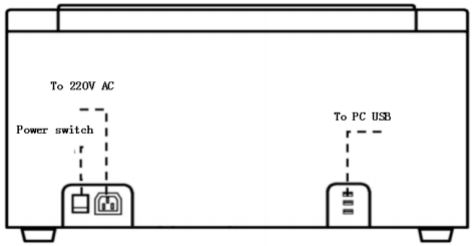


Figure 2-1

Install driver

After electrify, right-click the "computer" icon on the screen, as shown in figure 3-1,Click on the"manager

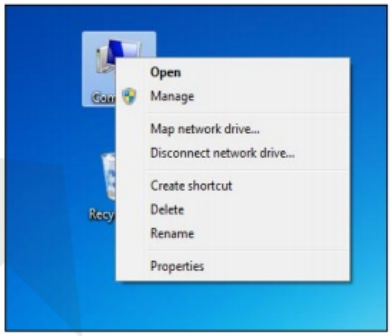


Figure 3-1

Click on the "device manager" icon, as shown in figure 3-2

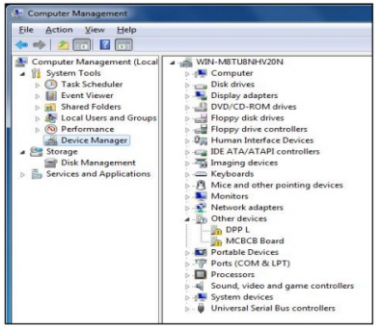


Figure 3-2

Right click on the "DPP L" icon, as shown in figure 3-3

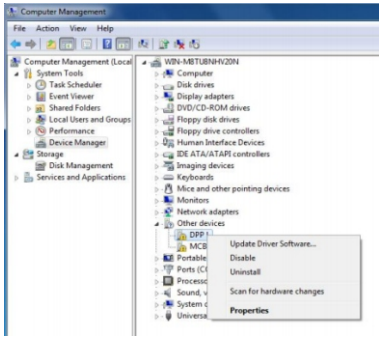


Figure 3-3

Click "Update Driver software",

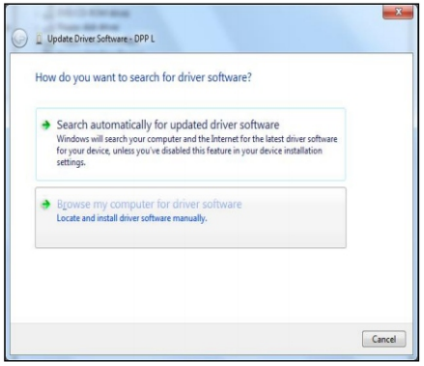


Figure 3-4

As shown in figure 3-4 , Click on the "browse computer for Driver software" ®, choose "E: /Driver/DPP L Driver" folder, as shown in figure 3-5:

Figure 3-5

Click on the "OK," as shown in figure 3-6

Figure 3-6

Click on the " Install this driver software alway ", the system will jump out have been successfully installed the driver file, as shown in figure 3-7

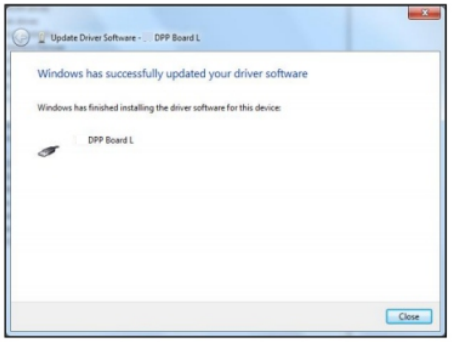


Figure 3-7

Open the device manager , you will see "USB Serial Port" as shown in figure 3-8

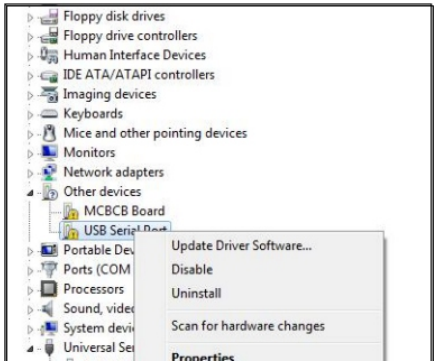


Figure 3-8

Then according to the above "DPP L" to install again. When users open the "device manager", under "Universal serial bus controllers" see "DPP Board L", If without the icon, you need to reinstall the driver. As shown in figure 3 -9

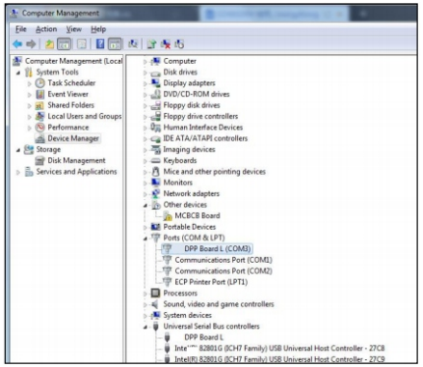


Figure 3-9

Click on the "Device manager" button, as shown in figure 3 -10

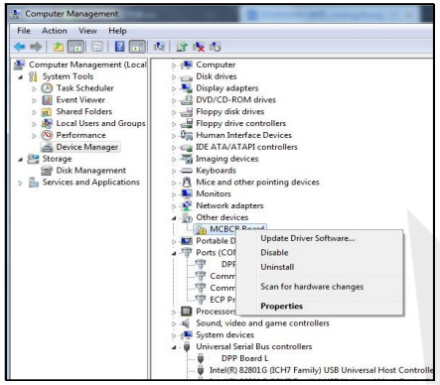


Figure 3-10

Right click on the "MCBCB Board", as shown in figure 3 -11

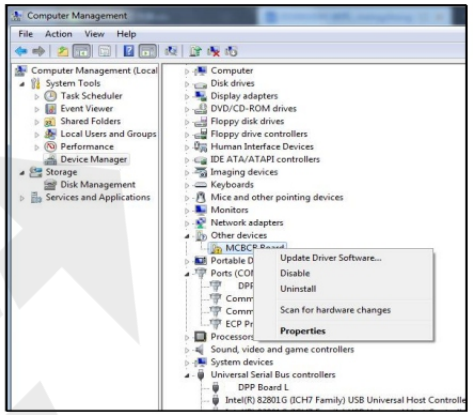


Figure 3-11

Click "Update Driver software", as shown in figure 3-12

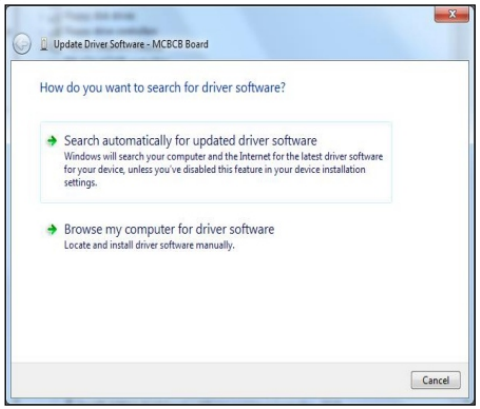


Figure 3-12

As shown in figure 3-12,Click on the "browse computer for Driver software" (R), choose "E: /Driver/XRF Driver" folder, as shown in figure 3 - 13:

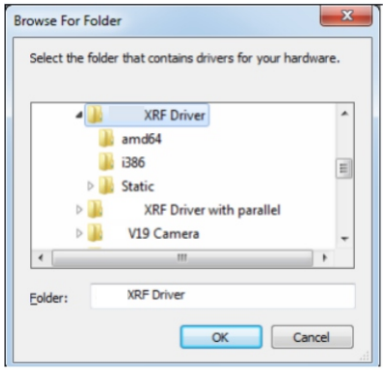


Figure 3-13

Click on the "XRF Driver" icon, as shown in figure 3-14

Figure 3-14

Click on the "Always install the driver software (I)", the system will jump out that you have been successfully installed the driver file, as shown in figure 3-15.

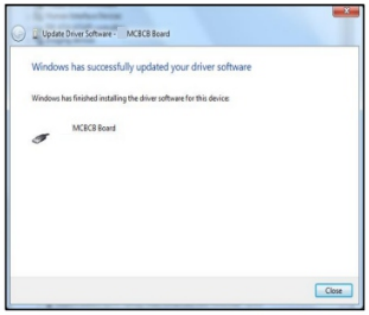


Figure 3-15

Open the device manager, you will see "USB Serial Port" as shown in figure 3-16 :

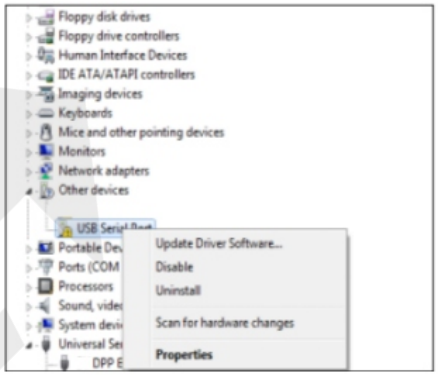


Figure 3-16

Then according to the above installation "MCBCB Board" steps to install again.

When the user to open the "device manager", under "Universal serial bus controller" see "MCBCB Board", If without the icon, you need to reinstall the driver. As shown in figure 3-17

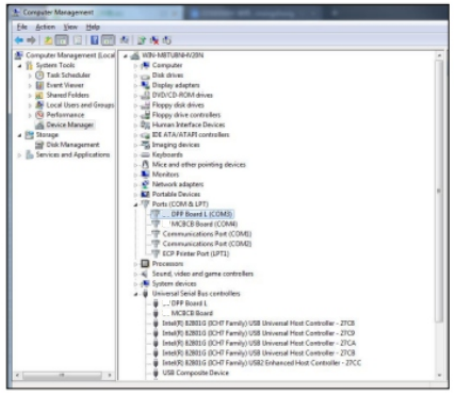


Figure 3-17

The use of clock dog

Clock dog binding mode is binding and interface board, the clock dogs need to be plugged into the computer, and otherwise, the software can't normal open, lead to can't test.

Usually the state pattern of clock dog can be divided into two kinds: one for installment payment mode; another for full payment mode.

Installment payment mode: general use time limit, when reached the set time, the clock dogs will stop working, and need to activate the rear can normal use. Software comes with system time clock a dog, has nothing to do with the computer system time.

Full payment mode: clock dogs without time limit.

The activation of the clock dog

Open the test software: if the instrument hardware is not boot, the system will prompt "would you please check whether the device is connected, connect the instrument can be good at this time. As shown in figure 4-1:

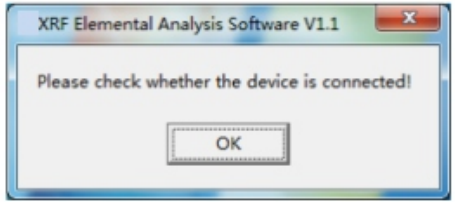


Figure 4-1

If the instrument is normal connection, and software is overdue, the system will prompt "software has expired, please activate", as shown in figure 4-2:

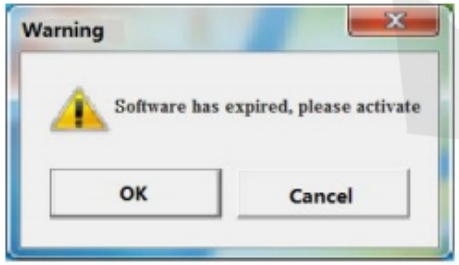


Figure 4-2

Click "OK", the software will automatically generate a serial number: XXXXXXXXXXX, enter the activation code, Click the "activate" as shown in figure 4-3, wait a few seconds, the system will automatically activate the software, software can be used normally after activation.

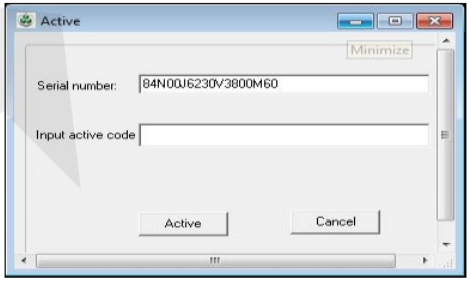


Figure 4-3

Install the software

1. Open E: / Software/harmful element detection Software installation package/ harmful element detection software setup file. The system will pop up as shown in figure 5-1 interface:

Figure 5-1

2. Click "Next"appears as shown in figure 5- 2 interface.

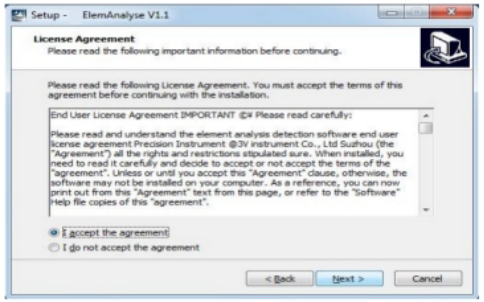


Figure 5-2

3. Select "I accept the agreement" , click "Next", as shown in figure 5- 3 interface.

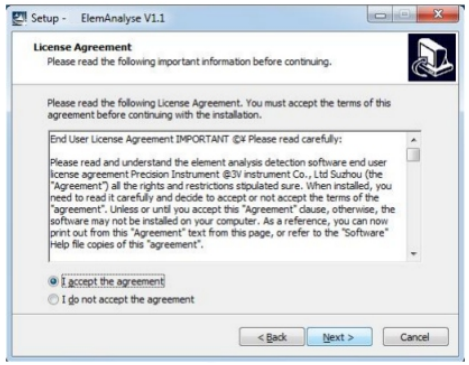


Figure 5-3

4. Appears as shown in figure 5- 4 interface:

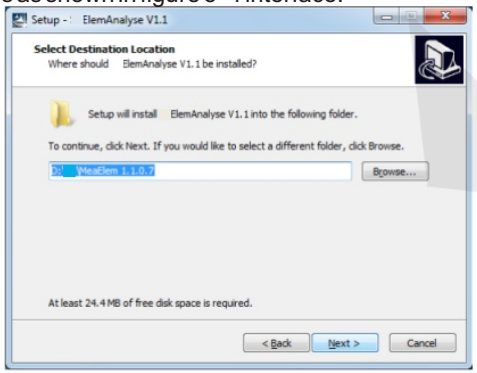


Figure 5-4

Note: the current step is mainly used to modify the software installation path, is installed by default on disk D. If keep the default, click “next"; If need to modify the installation path, please choose you need to install path, and then click "next”

5. ear as shown in figure5- 5 interface, click the "next" :

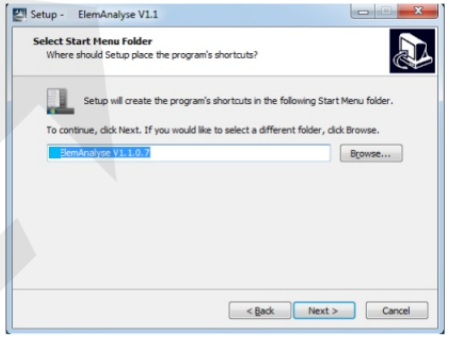


Figure 5-5

6. As shown in figure 5- 6 interface, select "create a desktop icon” then click "next”

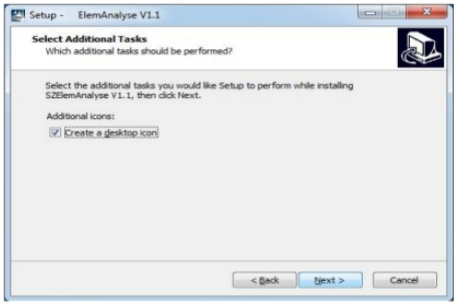


Figure 5-6

7. As shown in figure 5- 7 interface, click the "Install", the system will begin to install the software

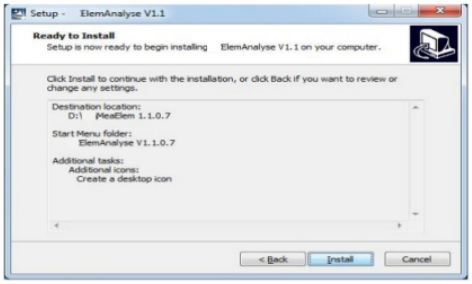


Figure 5-7

8. After completing the installation, the icon and Completing the SZElemAnalyse" will show on the interface. shown in figure 5- 8

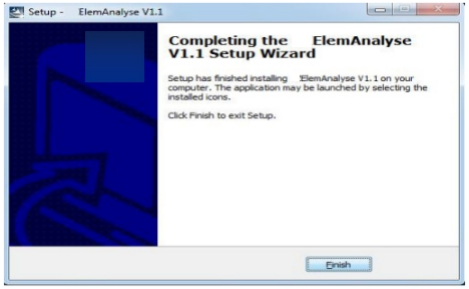


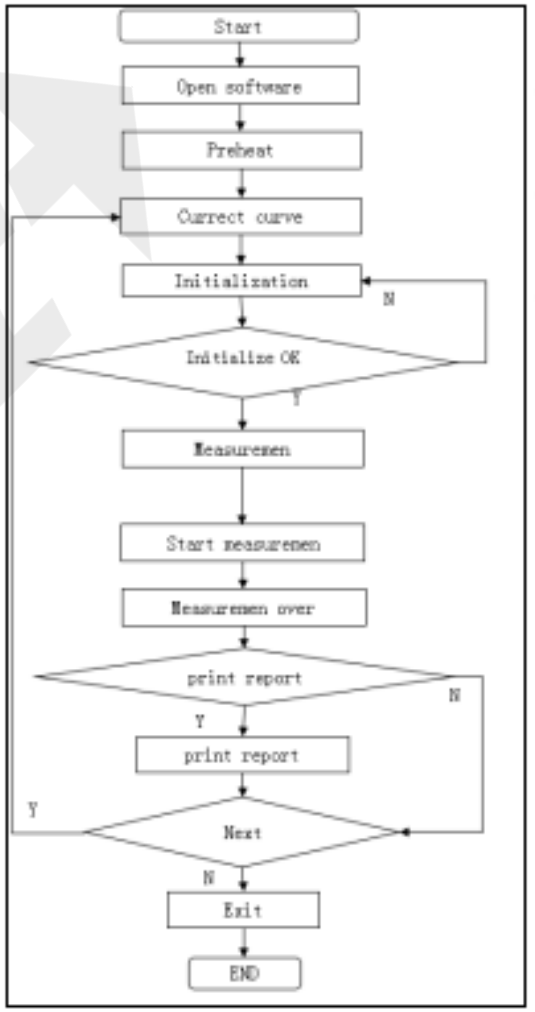
Figure 5-8

9. . Click "Flinish", at this moment, you can see software shortcut icon on the desktop.

Figure 5-9

Quick to use

The sample flow chart of measurement:



1 Preheating equipment

Boot, put the instrument on standby for 2-3 minutes, and click on the "warm up" button. After preheating, the instrument can work. Instrument preheating is the necessary step before every test preparation, if the instrument shutdown beyond half an hour, we suggest to advance it.

2 Initialization

Customers must have the initialize settings before using it. Click the initialize button, the system prompts in sterling silver (Ag) sample, click the "OK", the system began to initialize the instrument

Remark:

1. Initialization is a very important step before measuring samples; initialization allows instrument set all the recovery is in place, and the elements are returned to the right channel.
2. Measurement for the first time in a day, it is recommended the user to initialize more than two or three times.
3. Initialization time: initialization is for 10 seconds general.
4. Failed to initialize the maximum allowed number of 10 times. If more than the number of times, then stop the initialization, and set up the device initialization failed.

3 Measurement of the samples

Click on "start" button in the toolbar, will pop up as shown in figure 6- 1 window as follows

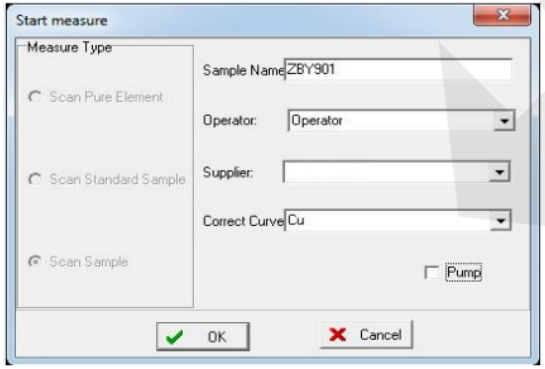


Figure 6-1

Please input the sample name,operator name and choice the suitable curve, According to the actual sample choose whether to need to vacuum.Finally,click"OK" to start measurement.

4 Save the report

At the end of the measurement, the pop-up as shown in figure 6-2 window, select "save report" or "print report" (note: two options, the system will save the spectrum).

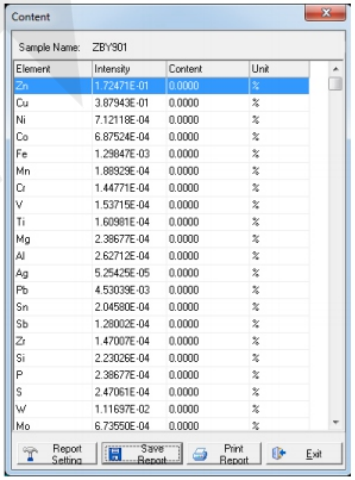


Figure 6-2

Tip

If the user in the "Settings" menu item chose "automatically saved report", the software will automatically save the report at the end of the each measure, save the file format from software default format (BMP, PDF or HTML format one). Save path is stored in the "[software install directory] \ \" Report], such as "D: \ MeaElem1.1 \ Report". Or print the report

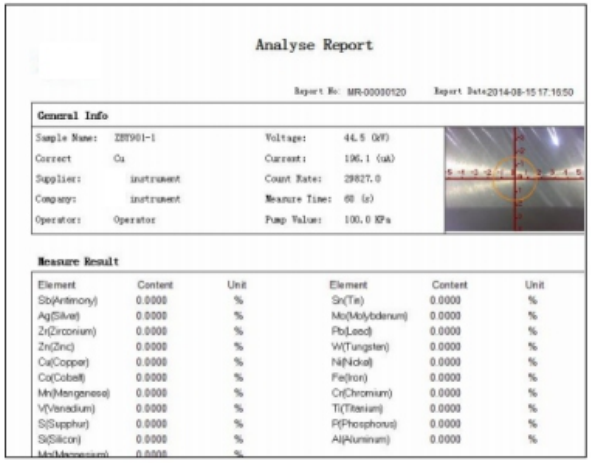


Figure 6-2

Introduction of software

After installation of the software, run the program, the user sees as shown in figure7-1 software main interface:

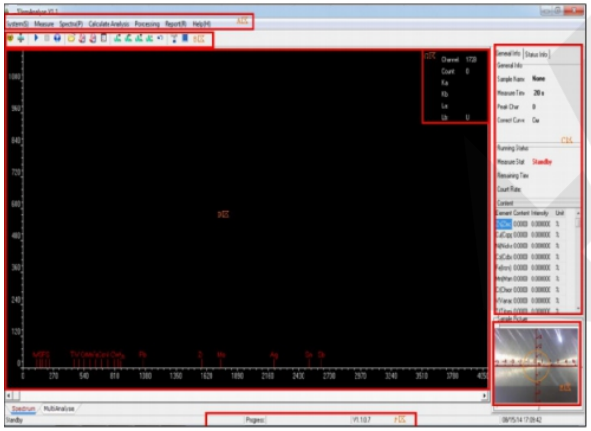


Figure 7-1

Above the main interface is divided into six parts altogether
A, The menu bar: system Settings and setting up the working curve
B, Toolbar: instrument measuring and spectrogram shortcut operation Progress bar:
C, Information display measurement, the system time, software version information
D, Spectrum drawing area: spectral data from the graphics display
E,The status bar: display spectrum of basic information, current status and test condition.
F,Sample display: display test samples and the position of the sample.
G,Spectral information: display the current focus on peak channel information.

1 The menu bar

1.1 System Settings
1.1.1 System Settings

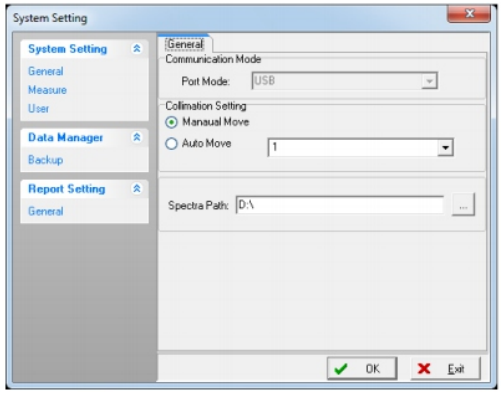


Figure 7-2

System settings, including three parts: General, Measure,User.
General: Communication, collimator settings, spectral path The main communication way set computer and instrument communication interface mode, generally is USB (the default interface). Collimator settings: set the collimator, ,generally do not do any changes. Path: the path to ave the spectrum measuredsample spectrum. The software will automatically save in "[software installation driectory]\Spectra\ [the current system time]\" By clicking the button to the right of therevision.

Measure:whether the vacuum, energy calibration, parameter nitialization, parameter measurement

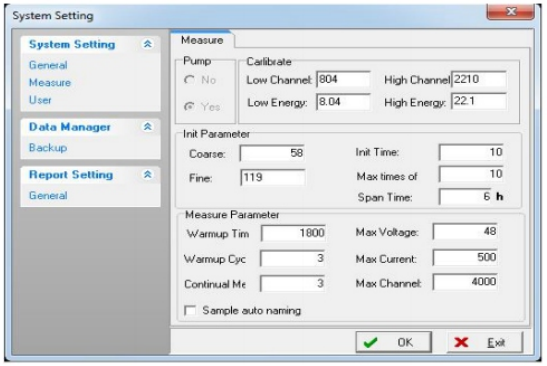


Figure 7-3

Whether the vacuum according to the actual needs of vacuum instrument set. Energy correction is used to set the correction element channel value and energy value; used to correct the elements are Cu, Ag.

The initialization parameter is used to set the initialconditions, coarse adjustment, fine adjustment of users do not modify, lest cause testabnormal. Measurement parameters are used to set the preheating time, preheatingperiod, even measured frequency, maximum pressure, maximum flow, the maximum peak channel, the user can be modified according to the actual need.Select this optionto system software will automatically named time of sample sample automatic naming.

User

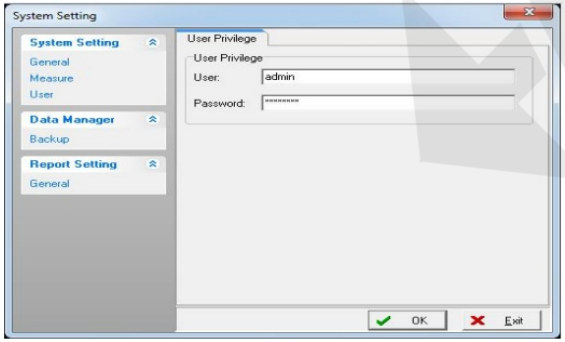


Figure 7-4

Enter the administrator user name and password. This function is mainly used for the debug instrumentation engineer.

1.1.2 Data mangerment

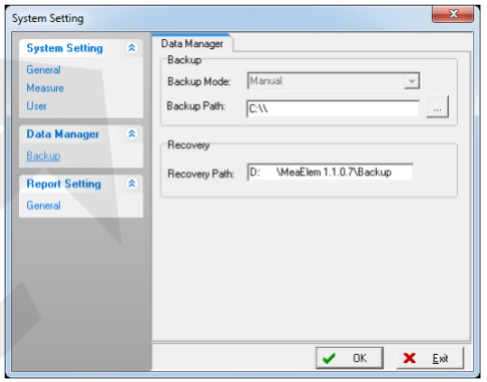


Figure 7-5

The backup path: backup path set according to the need for.

The reduction path: the backup data reduction, can choose according to the need ofreducing path.

1.1.3 Report setting

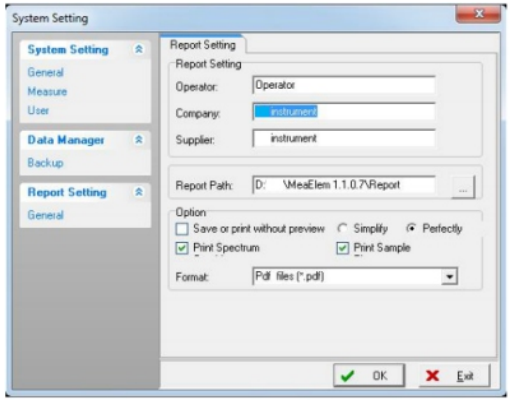


Figure 7-6

Report settings: modify the print or report and analysis report of operator, the inspection department and sample source information

Report path setting: analysis report default save path. The user can click on the right side of the"..." Button to change the path
Options: the user to select options. Save format altogether has three kinds: Html file,Pdf file, Bmp file.

1.2 collimator settings

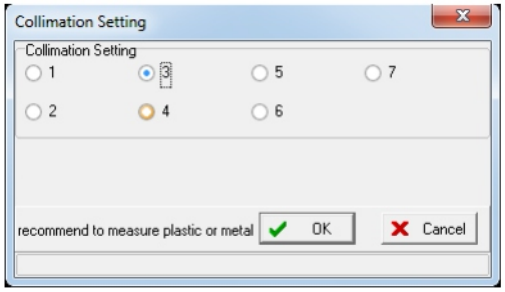


Figure 7-7

If the user needs to use to manually adjust the motor, you can choose from 1 to 7 in front of the box, Then click the "OK" button, the instrument will be reset motor, then move to the designated location , and then the window will automatically close the interface.

Note
Instruments and motor in the process of moving, the user can hear the sound of the motor rotation.

1.3 Import Motor data

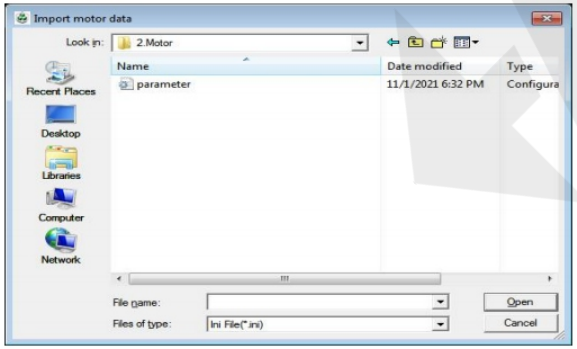


Figure 7-8

The factory will be the motor data into the program, do not arbitrarily change the settings.

1.4 . Data Backup
Automatic data backup, usually the default saved to the D drive, you can also change the save path from the system settings.
1.5. Data Recovery
Automatic Data Recovery, generally read the D drive, you can also change the system settings to restore the default path.
1.7 Exit
Exit Software

2 Measurement sample 2 (M)

Measuring in a sample, including starting stopping preheating initiali zation . Measuring in a sample, including starting, stopping, preheating, initiali zation
Start: start detecting customer sample pieces
Stop: stop detection halfway during measurement.
Preheat: Preheat instruments. In order to make the measurement sample data accurate and stable. Initialization: Initialize the instrument, the purpose is to let the elements return to the correct channel

3 Spectroscopy (P)

3.1 open spectrum

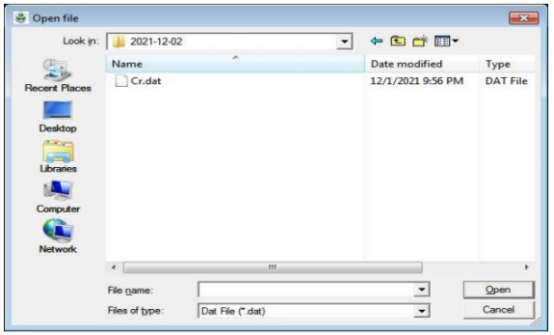


Figure 7-9

Click "open spectrum", jump out of the Open file tab. Users can open arbitrary sample spectrum. Spectrum will open to the light blue spectrum display.

3.2 Load imaginary spectrum
Click "Load imaginary spectrum", the user can open any sample spectrum imaginary spectrum, so easy to compare different sample spectra.

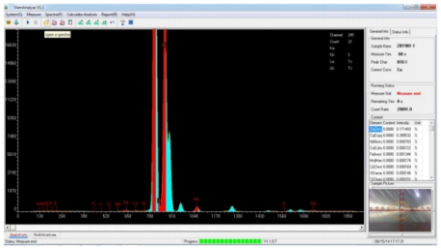


Figure 7-10

3.3 Delete all imaginary spectrum Click the "Delete all empty spectrum", remove the empty spectrum.

3.4 Spectral list

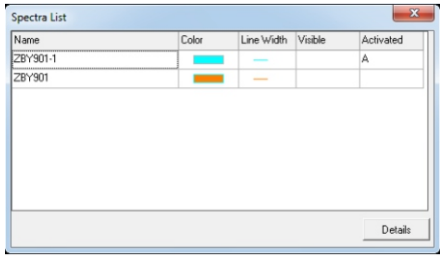


Figure 7-11

Click the "spectral List", out of the spectral List tab, as shown in Figure 8-10. Displays the status of the software interface of the spectrum, there are the name of the spectrum, (does not require the detection of elements) colors, (crest edge) width, visible, active state. Visible state is divided into True and False.

When Ture state spectrum is complete. When False state spectrum is incomplete, only to be detected waveform elements. The software interface is a real spectral spectrum, shown in an active state A, the spectrum is the imaginary spectrum, not shown in the active state. In the software interface, can only have a real spectrum, but can have multiple virtual spectrum.

4 Calculation analysis

4.1Display content The pop-up "display content" form, display the current spectrum of the element content.

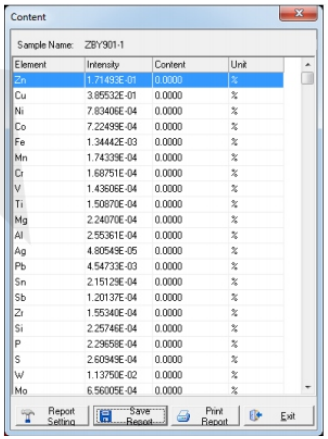


Figure 7-12

4.2 Peak parameter
The pop-up "qualitative parameter" form. Used to determine the parameters settingeffective peak

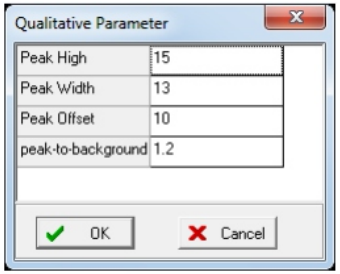


Figure 7-13

4.3 Qualitative analysis The qualitative analysis of the spectra, and peak detection is shown in the spectrum dispaly bar.

4.4Calibration curve

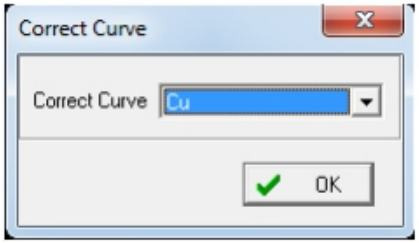
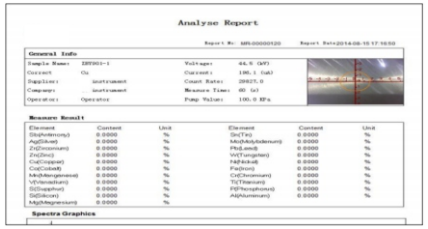


Figure 7-14

5 Analysis Report

5.1 Print Report



If you do not choose the "Report Settings" inside "skip Preview" will pop up like WORD print preview Print window click on the "Print Report", the user can view the report style, and through the buttons on the toolbar to print or save appropriate format.

5.2 Save Report

Save the report in the software installation directory folderof""report.

6 language

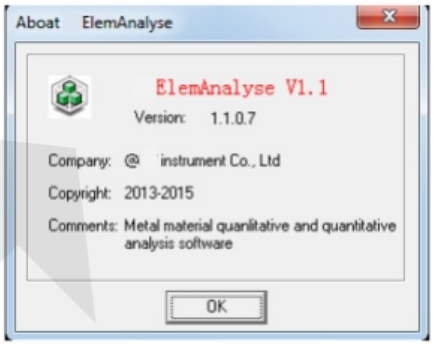
I nterface languages have two choices: Chinese, English. Users according to their needs to select the appropriate language.

7 help

7.1. help topics Users can get help of some software operating problems through this project.

7.2 . About

"Completing the ElemAnalyse software" version information.



The toolbar

Tool in the toolbar from left to right in turn for preheating, initialize, start, stop, open, open the virtual spectroscopy, close all virtual spectroscopy, display list, horizontal zoom spectroscopy, horizontal, vertical narrow spectrum amplification, vertical narrow spectrum, spectral according to restore the default.、System setting, Calibration curve

preheating: click button preheating, instrument start preheating, pipe pressure from 20 kv up to 45 kv in turn

- Start: start measuring the samples.
- Stop: midway stop measurement.
- Open spectrum: open a spectrum file
- Open virtual spectrum: open spectrum file in virtual spectrum form.
- Close all virtual spectrum: close all current open virtual spectrum file
- Display spectrum list: display all current spectra
- Level zoom spectrum: the current spectrum lateral magnification.
- Level to reduce the spectrum: the current horizontal narrow spectrum.
- Vertical zoom spectrum: the current spectrum longitudinal magnification.
- Vertical narrow spectrum: the current longitudinal narrow spectrum.
- Spectrum according to restore the default: the current spectrum check back up to the default state.
- System setting: Set system parameters。
- Calibration curve: Select the test calibration curve

Information bar

Information bar has two parts: basic information,Instrument status
The basic information Include: basic information,working condition,content information,sample photos

1 The basic information

Including: measuring time, spectral peak channel, material name, the calibration curve

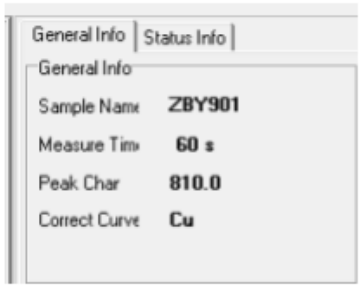


Figure 8-1

Sample name: the name of the currentcurrent s measured samples.
Measuring time: the time required to measure the current sample.
Peak pass way: indicates the pectrum corresponding to the highest peak in the abscissa, namely: the peak.
Calibration curve: shows the curve of the test samples with the name

2 The working state

Include: measuring state, residual time, counting rate, dead time and the current baseline

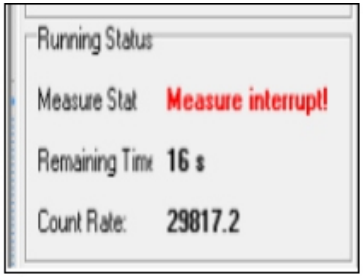


Figure 8-2

Measuring Status: Description instruments to measure the current situation.
Start measuring tips: are measuring ...
Measuring End Tip: End Measurement
Other tips can see actual feedback.
Time remaining: Description remaining time to detect the end of the current sample. Count rate: The number of photoelectrons collected per second, the detector unit is cps.

3 Content information

Display sample contained element and its content

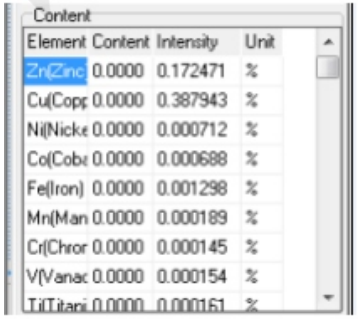


Figure 8-3

3 Sample photos

Display test sample and the sample position. If you don't show the samples, in the position of the sample right click, select Hide samples

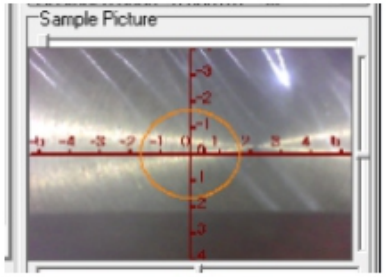


Figure 8-4

5 Instrument status

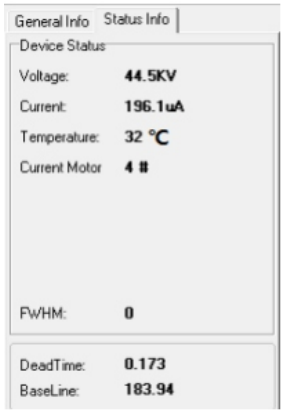


Figure 8-5

Instrument status: Voltage, Current, Temperature, Current moto, Pump value

- Voltage: High Voltage need to test samples
- Current: Current need to test sample.
- Temperature: Detection of the instrument internal temperature, when the temperature is higher than35 degrees in the status bar "software will prompt high instrument temperature, pleaselet the instrument to rest for a while!" ; if the temperature is above 45 degrees, the software will stop their measurement, and would prevent customers continue to test, so as not to affect the normal use of equipment spare parts.
- Current moto: current use Motor position

NOTE

Temperature parameters are a very important parameter monitoring instruments. When the temperature is higher than 40 ℃above will have some impact on the result of the test, so suggest instrument using the environment to be equipped with air conditioning, had better not put the instrument is in more than 40 ℃environment for long-term use.

Spectral region

Spectral : Display the current open Spectral

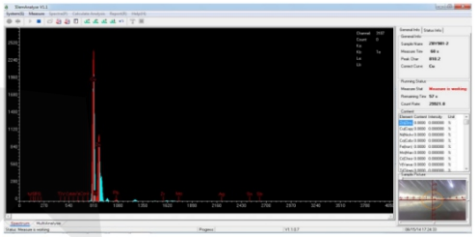
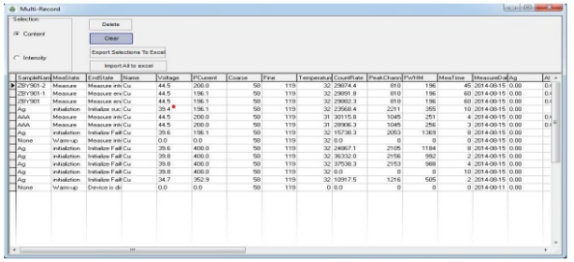


Figure 9-1

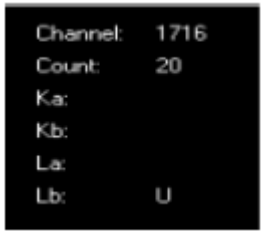
Diversity analysis: themain elements content testing of samples of various parts ofvalue, can analyze multiple samples simultaneously. Select the "content" and "energyintensity", can according to need to get samples for further information. Can choose toremove a sample information or empty the entire list information according to the needs of. Multiple tables can be directly exported to Excel.

Attention

Spectra and diversity analysis can be switched by spectrum below two controls



Spectral information area

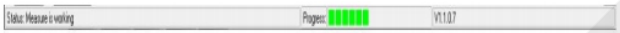


Spectral information area displays information about the current mouse position where the spectrum, the horizontal axis is the channel value, the vertical axis is the count value

Note

Move the mouse to the spectral region, press and hold the left mouse button and move around, spectrum area on the upper right corner will display the corresponding channel number, According the channel number calculate the corresponding elements.

The status



Status main display measurement , progress, software version, the current operator and the current time of the system..
Ameasuring instrument status: the current test status
Progress status: the form of a progress bar display.
Operator: shows the report Settings set of names.
The current time is shown in the current date

Common troubleshooting

1、No count rate or calculation rate is below 10
Possible reasons:
（1)Check whether the software temperature display is normal, if normal,check whether high pressure indicator is light
（2)If high voltage indicator is not on, then check whether instruments cover close to normal
2、 The high-voltage indicator light does not illuminate during the measuring
Possible reasons
（1)On the instrument power didn't open
Instrument on the power does not open, it can't work,so high pressure is not light.
（2) High-voltage protection switch disconnect.
Open the instrument cover, holding down the "high pressure protection switch by hand, then open the software, click on the" start measuring ", Check the yellow light ‘condition.
（3) If the high voltage indicator is not on, may be there is something wrong with the hardware connection, please contact us to solve.
3、Time to stop or too quickly
Possible reasons:
（1) Instrument and computer are not normal connection
Please correct instrumentation and computer USB cable
（2) surrounded by strong interference
When surrounded by strong interference, hardware and software can not work normally. It could make the time stop
Solution: when the other possible causes are ruled out, after carefully check around the presence of strong electromagnetic interference, such as the high tension line, towers, earthquake, etc., such as welcome transformation instrument working position.
\4、the measurement data is not accurate
Possible reasons:
(1) Instrument is not preheating
(2) Instrument is not initialization
(3) The test window film or contaminated is pollution
(4) Samples are mixture, not homogeneous material
(5) The sample is too thin or too little, counting rate is less than 1000
If the problem still not solved, please feedback the problem to our company, we will solve for you as soon as possible.

Maintenance

When the instrument is not used for a long time, please use shield cover the instrument, in order to prevent dust into the instrument.
Use the instrument, it is best to instrument equipped with stabilized voltage supply.
The plateform of place instrument need to as level as possible, and firm does not shake.
Regularly to the sides of the instrument and testing platform is clean, use cotton with a little alcohol wipe gently.
Test platform of film if damaged or contaminated, please use the random distribution of the test membrane replacement.
Replace the test film, cannot by hand or other items contact instrument detector etc.
Without permission, Disassembly only be done by the engineer of my company. otherwise no warranty

The status

Status main display measurement , progress, software version, the current operator and the current time of the system..
Ameasuring instrument status: the current test status
Progress status: the form of a progress bar display.
Operator: shows the report Settings set of names.
The current time is shown in the current date

Appendix 1

X ray fluorescence analysis with the characteristics of each element of X ray energy meter (K, L line energy)

Atomic number	Symbol	Element		Kα	Kβ	Lα	Lβ	Lγ	Ll
1	H	氢	1.008						
2	He	氦	4.008						
3	Li	锂	6.94	0.052					
4	Be	铍	9.012	0.110					
5	B	硼	10.81	0.185					
6	C	碳	12.01	0.282					
7	N	氮	14.01	0.392					
8	O	氧	15.99	0.523					
9	F	氟	18.99	0.677					
10	Ne	氖	20.17	0.861					
11	Na	钠	22.99	1.041	1.067				
12	Mg	镁	24.31	1.25	1.3				
13	Al	铝	26.99	1.49	1.55				
14	Si	硅	28.09	1.74	1.838				
15	P	磷	30.97	2.02	2.14				
16	S	硫	32.06	2.31	2.468				
17	Cl	氯	35.45	2.62	2.82				
18	Ar	氩	39.94	2.96	3.19				
19	K	钾	39.1	3.31	3.59				
20	Ca	钙	40.08	3.69	4.01				
21	Sc	钪	44.96	4.09	4.46				
22	Ti	钛	47.9	4.51	4.93				
23	V	钒	60.94	4.95	5.43				
24	Cr	铬	51.99	5.41	5.95				
25	Mn	锰	54.94	5.895	6.49				
26	Fe	铁	55.84	6.4	7.06				
27	Co	钴	58.93	6.925	7.65				
28	Ni	镍	58.7	7.47	8.265				
29	Cu	铜	63.54	8.04	8.907				
30	Zn	锌	65.38	8.63	9.572				
31	Ga	镓	69.72	9.24	10.263				
32	Ge	锗	72.5	9.876	10.984				
33	As	砷	74.92	10.532	11.729				
34	Se	硒	78.9	11.21	12.501	1.38	1.42	—	—
35	Br	溴	79.9	11.91	13.296	1.48	1.53	—	—
36	Kr	氪	83.8	12.63	14.12	1.59	1.64	—	—
37	Rb	铷	85.47	13.375	14.971	1.69	1.75	—	—
38	Sr	锶	87.82	14.142	15.849	1.81	1.87	—	—
39	Y	钇	88.91	14.933	16.754	1.92	2	—	—
40	Zr	锆	91.22	15.746	17.687	2.04	2.124	2.3	1.792
41	Nb	铌	92.91	16.6584	18.647	2.17	2.257	2.46	1.902
42	Mo	钼	95.94	17.443	19.633	2.29	2.395	2.62	2.015

43	Tc	锝	99	18.327	20.647	2.42	2.538	2.79	2.122
44	Ru	钌	101	19.235	21.687	2.56	2.683	2.96	2.252
45	Rh	铑	102.9	20.167	22.759	2.7	2.834	3.14	2.376
46	Pd	钯	106.4	21.123	23.859	2.84	2.99	3.33	2.503
47	Ag	银	107.9	22.1	24.987	2.98	3.151	3.52	2.633
48	Cd	镉	112.4	23.109	26.143	3.13	3.316	3.72	2.767
49	Tn	铟	114.8	24.139	27.382	3.29	3.487	3.92	2.904
50	Sn	锡	118.6	25.193	28.601	3.44	3.662	4.13	3.044
51	Sb	锑	121.7	26.274	29.851	3.605	3.843	4.35	3.188
52	Te	蹄	127.6	27.38	31.128	3.77	4.029	4.57	3.335
53	I	碘	126.9	28.512	32.437	3.94	4.22	4.8	3.484
54	Xe	氙	131.3	29.669	33.777	4.11	4.422	5.04	3.636
55	Cs	铯	137.3	30.854	35.149	4.286	4.62	5.28	3.794
56	Ba	钡	137.3	32.065	36.553	4.47	4.828	5.53	3.953
57	La	镧	138.9	33.3	37.986	4.65	5.043	5.79	4.124
58	Ce	铈	140.1	34.569	39.453	4.84	5.262	6.05	4.287
59	Pr	镨	140.9	35.864	40.953	5.034	5.489	6.32	4.452
60	Nd	钕	44.2	37.185	42.484	5.23	5.722	6.6	4.632
61	Pm	钜	147	38.535	44.049	5.431	5.956	6.89	4.816
62	Sm	钐	150.4	39.914	45.649	5.636	6.206	7.18	4.994
63	Eu	铕	152	41.323	47.283	5.846	6.456	7.48	5.176
64	Gd	钆	157.2	42.761	48.949	6.059	6.714	7.79	5.361
65	Tb	铽				6.275	6.979	8.1	5.546
66	Dy	镝				6.495	7.249	8.42	5.742
67	Ho	钬				6.72	7.528	8.75	5.942
68	Er	铒				6.948	7.81	9.09	6.152
69	Tm	铥				7.18	8.103	9.42	6.341
70	Yb	镱				7.41	8.401	9.78	6.544
71	Lu	镏				7.65	8.708	10.1	6.752
72	Hf	铪				7.898	9.021	10.5	6.958
73	Ta	钽				8.145	9.341	10.9	7.172
74	W	钨				8.396	9.67	11.3	7.386
75	Re	铼				8.651	10.008	11.7	7.602
76	Os	锇				8.91	10.354	12.1	7.821
77	Ir	铱				9.17	10.706	12.5	8.04
78	Pt	铂				9.441	11.069	12.9	8.267
79	Au	金				9.711	11.439	13.4	8.493
80	Hg	汞				9.987	11.823	13.8	8.72
81	Tl	铊				10.266	12.21	14.3	8.952
82	Pb	铅				10.549	12.61	14.8	9.183
83	Bi	铋				10.84	13.021	15.2	9.419
84	Po	钋				11.13	13.441	15.7	9.662
85	At	砹				11.42	13.87	16.2	
86	Rn	氡				11.72	14.316	16.8	
87	Fr	钫				12.03	14.77	17.3	
88	Ra	镭				12.34	15.233	17.8	10.62
89	Ac	锕				12.65	15.712	18.4	
90	Th	钍				12.97	16.2	19	11.117
91	Pa	镤				13.29	16.7	19.6	11.364

92	U	铀				13.61	17.218	20.2	11.616
93	Np	镎		99.69	114.7	13.95	17.74	20.774	11.89
94	Pu	钚		102.3	117.7	14.28	18.28	21.401	12.12
95	Am	镅		104.9	120.8	14.62	18.83	22.042	12.38
96	Cm	钜		107.7	123.9	14.96	19.39	22.699	
97	Bk	锫（pei）		110.5	127.1	15.31	19.97	23.37	
98	Cf	锎（kai）		113.3	130.4	15.66	20.56	24.056	
99	Es	锿		116.2	133.7	16.02	21.17	24.758	
100	Fm	镄		119.2	137.2	16.38	21.79	25.475	