Supporting Information

Battery-Operated Portable High-Throughput Solution Cathode Glow Discharge Optical Emission Spectrometry for Environmental Metal Detection

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1. Sample introduction mode

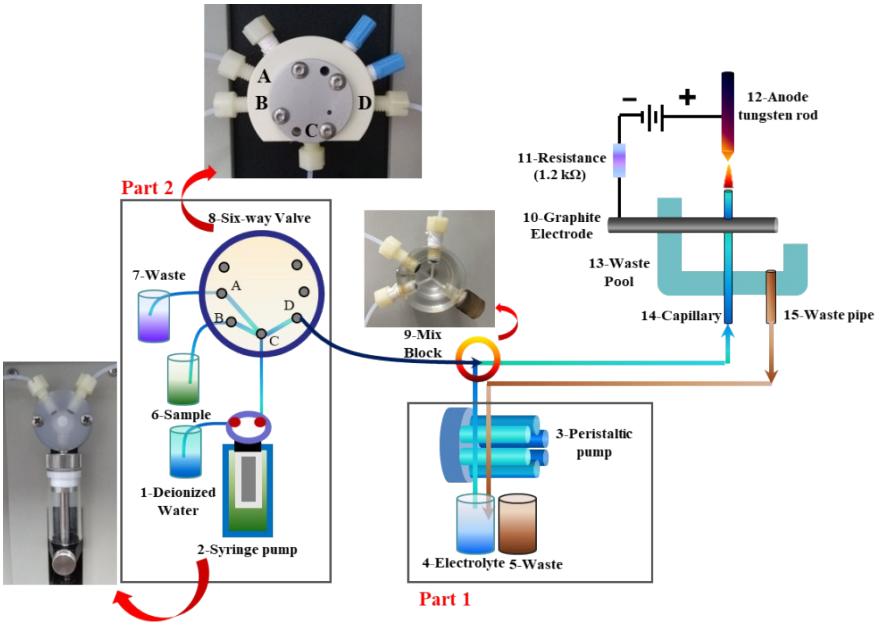

Figure. S1 Schematic diagram of sample introduction system for portable SCGD-OES

The battery-operated portable high-throughput SCGD-OES allows two sample introduction modes according to the need of the analysis process. Under the same analytical conditions, the continuous flow mode can reach lower DLs than the flow injection mode, but requires more sample volume.

Continuous flow mode: The process of continuous injection is shown in Part 1 of Fig. S1. The electrolyte is removed, and the sample solution acidified to pH=1 by nitric acid is transferred as electrolyte to the cathode capillary through a peristaltic pump. In this mode, the six-way valve is kept off, blocking the communication between Part 1 and Part 2.

Flow injection mode: The process of flow injection is shown in part 2 of Fig. S1. The sample solution is drawn into the syringe pump through the B-C channel of the six-way valve. Then the B port is closed, and the sample is injected into the mix block via the C-D channel. The sample is mixed with the electrolyte in the mix block and then transferred together to the radiation system via the cathode quartz capillary. In this mode, samples are taken only once for each analysis. The injection volume of the sample and the injection rate can be set in the software, as described in Section 3.

2. Instrument operation and analysis software

The interface of the instrument operation software is shown in Fig. S2, and it allows the instrument to be turned on and off. Moreover, the instrument's detection parameters can be debugged, such as the discharge voltage, integration time, signal recording delay

time, and so on.

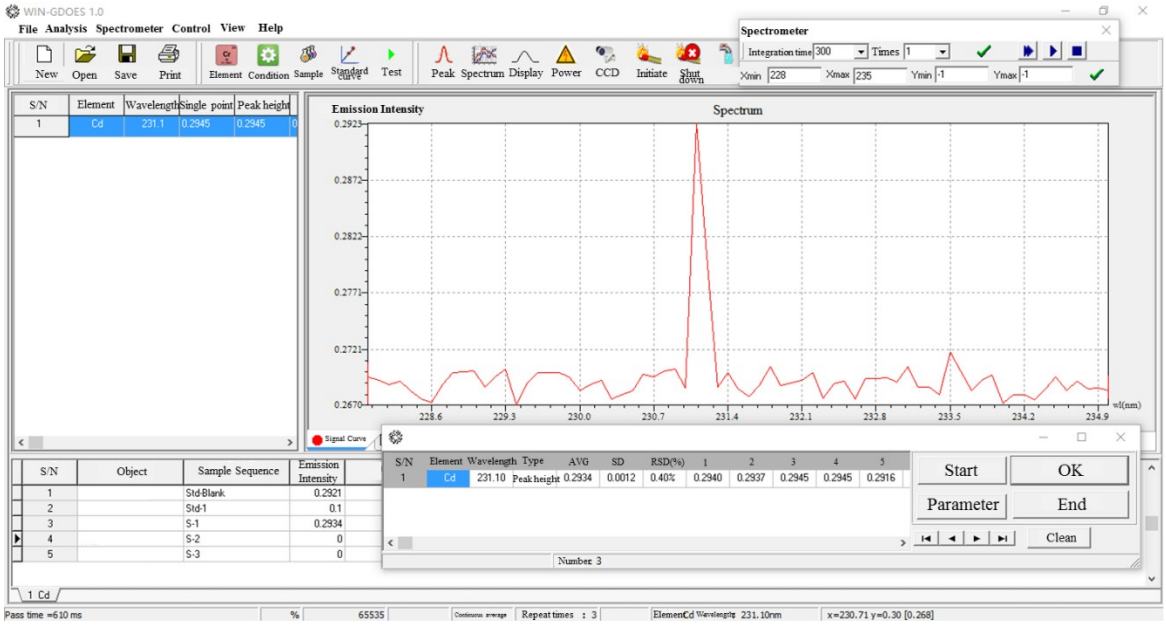

Figure. S2 Instrument operation and analysis software interface

3. Instrument operation parameter debugging interface

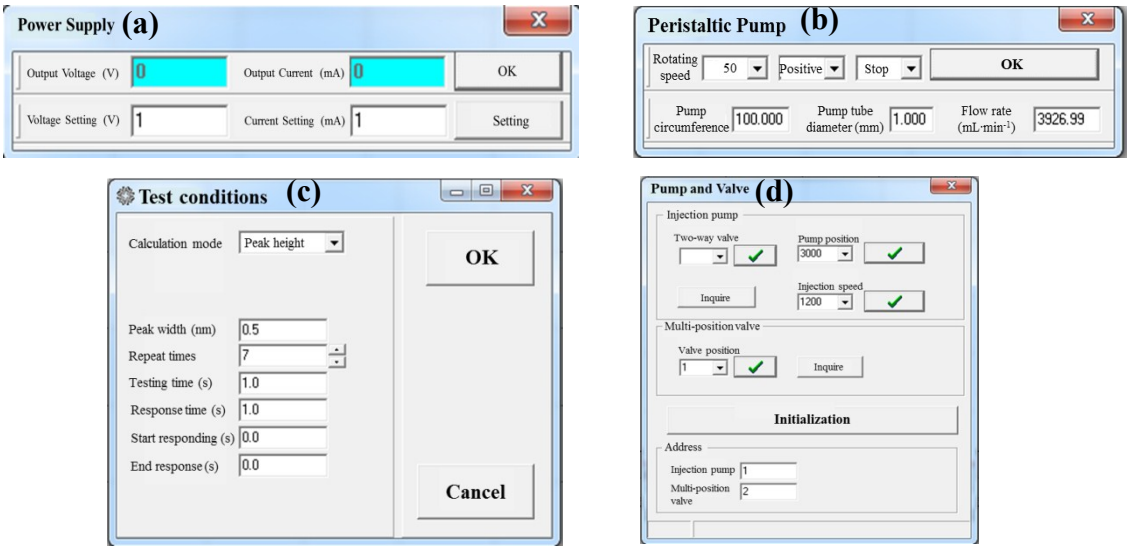

Figure. S3 Instrument operation parameter debugging interface for (a) discharge voltage, (b) electrolyte flow rate, (c) signal recording delay time, and (d) sample injection parameters

(1) The applied voltage is set in the Power Supply interface.

(2) The electrolyte flow rate is set in the Peristaltic Pump interface.

(3) The signal recording delay time and the testing times are set in the Test Condition interface. The signal recording delay time is referred to the time from the start of the

sample introduction to the start of signal recording by the spectrometer.
(4) The injection volume and the injection rate of the syringe pump are set in the Pump and Valve interface. The injection volume refers to volume of the sample taken by the syringe pump. The injection rate refers to the rate at which the sample solution enters or leaves the syringe pump under the action of a syringe pump.

4. Analyzable element range

The target element and its characteristic detection wavelength need to be selected before the analysis. The range of analyzable elements by this instrument is shown in Fig. S4.

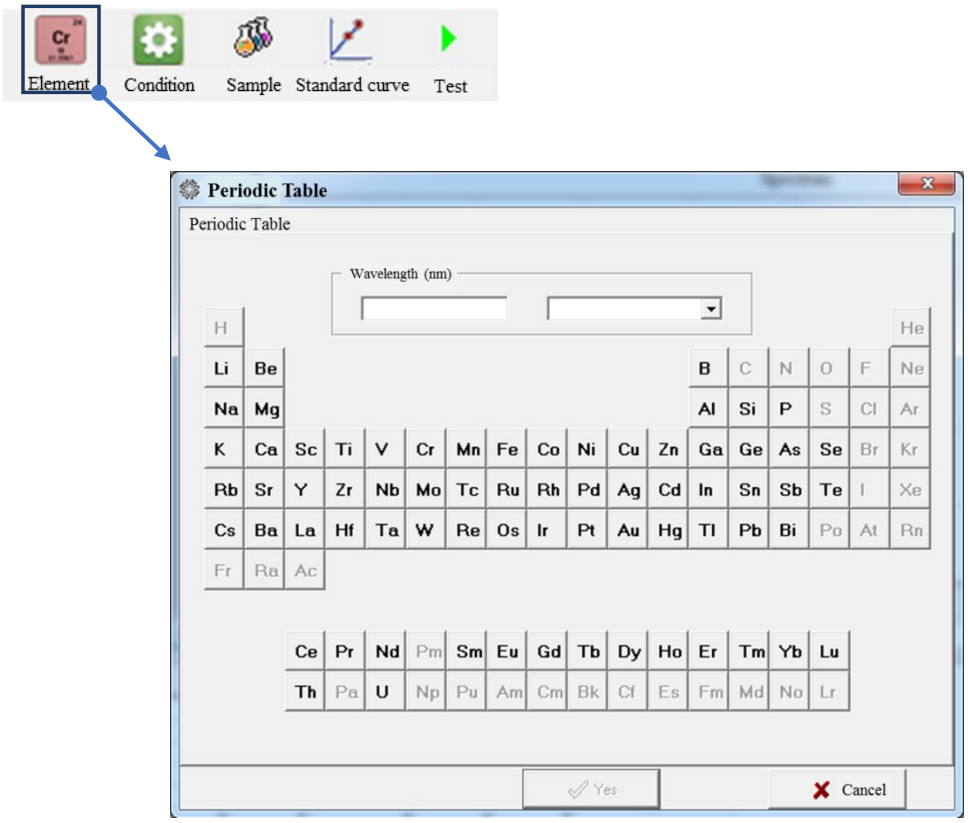

Figure. S4 Analysis element selection interface

5. Sample analysis sequence

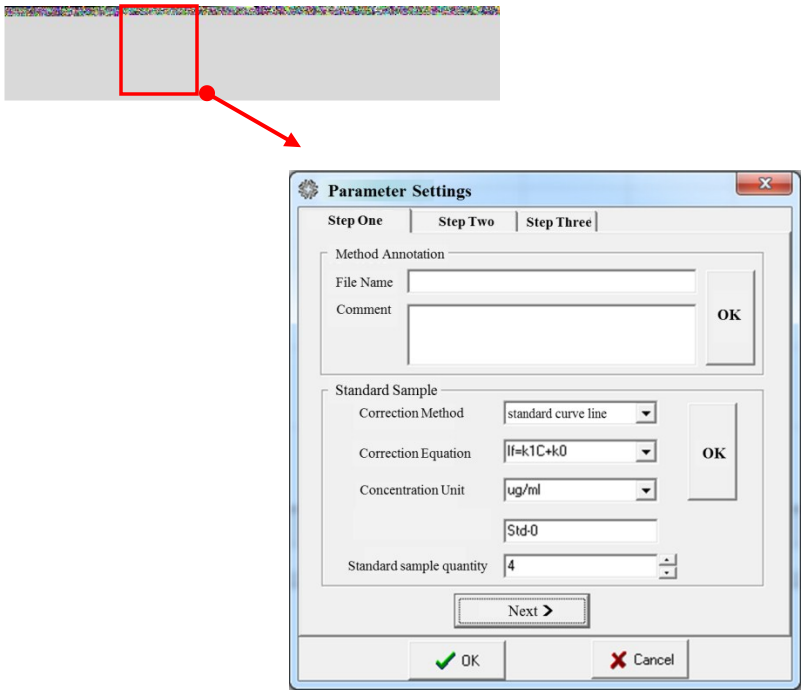

Figure. S5 Interface for establishing the sample and standard analysis sequence

The established standard and sample analysis sequence is displayed on the software operation interface, as shown in Fig. S6.

S/N	Object	Sample Sequence	If	Concentration (μg·L⁻¹)	Actual concentration (μg·L⁻¹)	SD	RSD(%)	Date	Time
1	Standard sample	Std-Blank	0	0	0	0	0		
2	Standard sample	Std-1	0.1	1	0	0	0		
3	Standard sample	Std-2	0.2	5	0	0	0		
4	Standard sample	Std-3	0.3	10	0	0	0		
5	Sample	S-1	0	0	0	0	0		
6	Sample	S-2	0	0	0	0	0		
7	Sample	S-3	0	0	0	0	0		

Figure. S6 Established standard and sample analysis sequence

6. Sample detection

After running the detection program, the instrument will detect the standard samples and samples according to the established sample sequence.

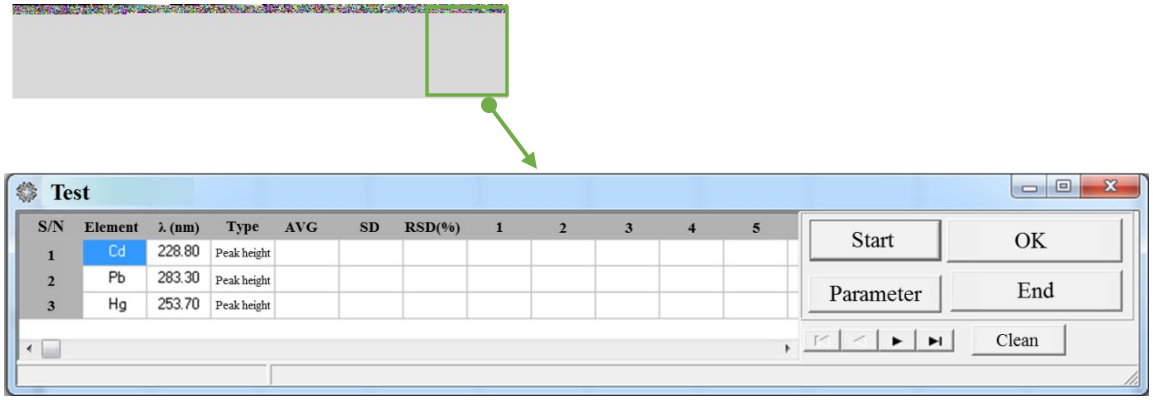

Figure. S7 Instrument element analysis interface