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See the world more clearly, let it be less mysterious

Real Qualitative Analysis Solution Expert

ICP 3200
Vertical Torch Dual–view Inductively Coupled Plasma Optical Emission Spectrometer

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Version No.: TRSJ 202401

So far, more than 140 countries and regions worldwide have chosen Skyray Instrument

www.yukelab.com

ICP 3200

Sensitive, precise, stable, swift, and convenient in perfect harmony...

As the long-awaited flagship product of Skyray Instrument, the ICP3200 series has finally emerged, fulfilling the expectations of many after years of anticipation. With a sleek and practical design featuring a vertical torch for dual view, seamless switching between radial and axial modes at the touch of a button, and a novel combustion chamber airflow design coupled with a sealed ventilation system, the accumulated heat dissipates imperceptibly. Its patented three-dimensional distributed constant temperature system, equipped with multi-point temperature monitoring, effortlessly achieves long-term thermal equilibrium. Additionally, the compact and optimized RF generation system, integrated control system with multiple control boards merged into one for higher integration, comprehensive integration of independently developed high-precision mass flow controllers, and more intelligent, user-friendly, and streamlined analysis software, ensure that your analytical work is carried out with ease and proficiency.

Superfast Testing Speed

Rapid testing velocity endowed with intelligent integration

Bidirectional observation

Robust bidirectional observation functionality

Research–grade Detector

High-performance large-format research-grade detector

Qualitative Analysis

Unique qualitative analysis methodology

Wavelength Calibration

Practical wavelength calibration functionality

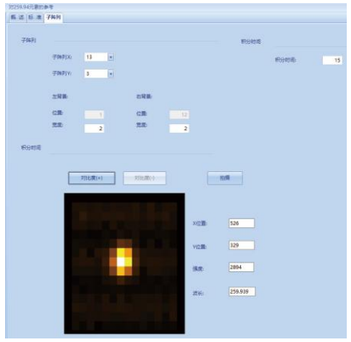
Software Analysis

Powerful software analysis features

Performance Advantages

Rapid testing velocity endowed with intelligent integration

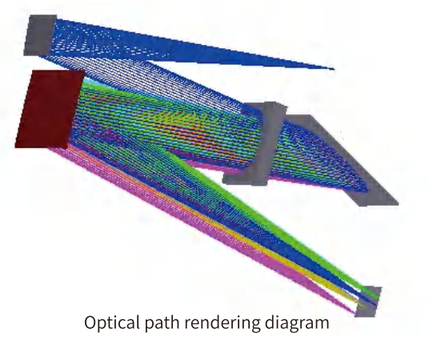
Full spectrum analysis can be completed in a single exposure, eliminating the need for multiple exposure optimizations while still achieving excellent detection limits and linear dynamic range. Analysis of all elements can be completed within 15 seconds of a single exposure. Each analysis spectral line can be optimized for measurement by setting arbitrary suitable integration periods within the exposure time. All spectral line intensities can be read out in a single exposure to expedite analysis speed, or individual spectral lines can be specified for independent readout with a reading time not exceeding 2 milliseconds.



Intelligent scoring function

Precision and stable spectrophotometer system

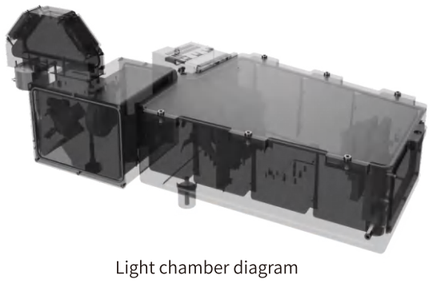
The precision and stability of the spectrophotometric system have been achieved through special temperature control and heat dissipation treatments along the axial forward illumination path, ensuring precise temperature stability of the entire optical path and minimizing thermal drift of spectral lines. The entire intermediate optical system features no moving parts and is well insulated from the combustion chamber, with all optical components sealed within a constant temperature chamber maintained at 35°C. This meticulous and stable temperature control (±/0.1°C), along with multi-point temperature control, ensures minimal detection limits and outstanding long-term stability.



Optical path rendering diagram

Blow-scan type optical chamber

For wavelength measurements below 189nm, the option to use either argon or nitrogen gas for purging the optical path is available. This significantly reduces air absorption in the ultraviolet range, thereby enhancing the detection capability of ultraviolet spectral lines. Normal testing does not require purging of the chamber. However, when measuring deep ultraviolet spectral lines, purging gas flow can be controlled via software. The purging gas flow rate in the normal mode is set at 2.0 L/min, while in the fast mode, it is increased to 4.0 L/min.



Light chamber diagram

Robust bidirectional observation functionality

The utilization of intelligent positioning vertical torch dual-view technology, in conjunction with an intermediate step grating-prism cross-dispersion optical structure, enables measurement over a broad wavelength range without sacrificing light flux or sensitivity. The optical mirror positions automatically initialize upon startup, allowing for seamless one-click switching between radial and axial modes without the need for cumbersome optical adjustments. This effortlessly meets the requirements for precise qualitative and quantitative measurements.

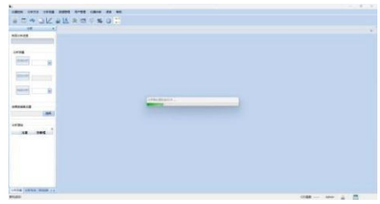


Diagram for automatic optical mirror position initialization upon startup

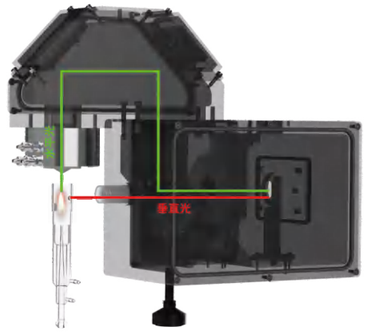


Diagram for bidirectional observation

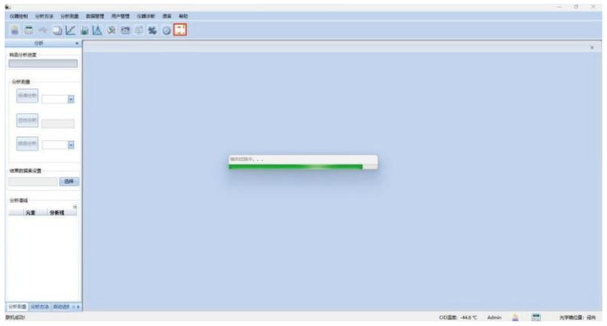


Diagram for one-button switch between radial and axial modes

High-performance large-format research-grade detector

The imported large-format research-grade Charge Injection Device (CID) detector features a million-pixel resolution, boasting the largest target surface size and single pixel area among similar products. With an effective detection area of 28mm × 28mm, it allows for the addition of spectral line measurements as needed. Each pixel is equipped with anti-saturation overflow protection, effectively eliminating issues related to spectral line saturation overflow. This ensures that spectral lines of varying intensities can be measured and analyzed within a single exposure.

Detector diagram

Stable and reliable solid–state RF power supply

The instrument features a solid-state generator operating at 27.12MHz, with water cooling, automatic tuning, and built-in protections against overload and overheating. Operating at a fixed frequency provided by an external crystal oscillator, the excitation frequency remains stable and unaffected by internal oscillations. With advantages including small size, high efficiency, stable output power, and various protective features, the generator incorporates fully automatic matching technology to further enhance instrument stability and safety.

RF power supply diagram

Highly adaptable sample introduction system

The standard configuration includes a Scott nebulizer, glass concentric nebulizer, and integrated torch. Additionally, various other types of nebulizers, nebulizer chambers, and torches are available as options, such as cyclonic nebulizer chambers, high-salt resistance nebulizers, and HF-resistant nebulizers. Various sizes of central channel in the torch are also available for selection. Equipped with a four-channel peristaltic pump, the speed is continuously and automatically adjustable, controlled entirely by the computer. It features a quick-pump function and stable, pulse-free sample introduction.

Sample introduction system diagram

Peristaltic pump diagram

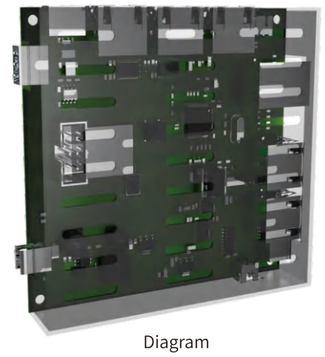
Combustion chamber with a completely new air duct design

The combustion chamber features a new airflow design in combination with a patented torch extension sleeve, to mitigate the impact of heat accumulation on the optical path and nebulizer chamber, thereby effectively enhancing the long-term stability of the instrument.

Combustion chamber

Combustion chamber diagram

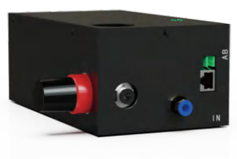
The new main control board integrates the matching box interface board, power interface board, and main control board into one, with high integration effectively enhancing anti-interference capability, reducing the number of circuit boards, and bringing advantages to later maintenance and production costs. All external interfaces are changed to Ethernet ports, facilitating wiring and improving signal anti-interference capability. Integrated bus-type RS485 module facilitates communication with other bus-type peripherals and is compatible with newly developed flow meter devices. All new architecture components can communicate with the main control chip via RS485 bus for data transmission, thereby interacting with the host computer.



Diagram

High–precision mass flow controller

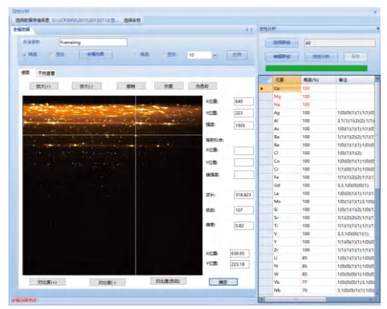
The independently developed mass flow controller features a high-performance proportional valve combined with a high-precision flow sensor and equipped with intelligent algorithms to better adapt to the pneumatic characteristics of instruments. It complies with the highest accuracy level (0.5) of the general technical standard for mass flow controllers (SJ/T 10583-2016), offering lower repeatability (0.5% F.S) and shorter response time (achieving the set flow rate within 0.85 seconds). It supports digital signal control, intelligent online software adjustment, and boasts strong anti-interference capabilities, resulting in lower errors.



Flow meter diagram

Unique qualitative analysis methodology

The truly comprehensive qualitative analysis gathers a vast amount of spectral information and interference controls. Tailored for complex matrices, it effectively distinguishes between major and trace elements while identifying potential interfering elements, thereby minimizing misinterpretation. The operation is simple and expedient, requiring no preparation of standard solutions. Merely dissolve a portion of the sample, initiate spectral information collection with a single click, and complete data compilation, retrieval, comparison, and evaluation with another click. Instantaneously, probabilistic qualitative results are provided, ensuring accuracy and speed.



Software diagram

Intelligent nitrogen monitoring function and multiple purge modes

This feature enables timed nitrogen purging and alerts for nitrogen supply, effectively reducing the occurrence of CID damage due to insufficient nitrogen purging time. Multiple purging modes are available, including the cold cone purging mode, which effectively cuts off the plasma tail, reduces element self-absorption effects, and enhances plasma torch stability. Both normal and fast purging modes of the chamber can be used for testing deep ultraviolet elemental spectral lines. Rapidly converting the entire chamber into an inert gas atmosphere greatly reduces air absorption of UV short waves, thus enhancing the sensitivity and detection capability of deep ultraviolet elemental spectral lines.

Nitrogen monitoring function diagram

Gas purge mode diagram

Practical wavelength calibration functionality

Carbon emission spectral lines are utilized for preliminary wavelength calibration. After each ignition during startup, the software automatically calculates the optical offset. Based on the magnitude of the offset, the software decides whether optical initialization calibration is required, eliminating the need for preheating and consumables associated with mercury or neon lamp calibration. Furthermore, the software features built-in functions for calibrating characteristic spectral line positions and spectral peak positions. Users can perform peak calibration for single or multiple elements using standard solutions at any time, ensuring the accuracy of analytical wavelength measurements.

Diagram for optical initialization and wavelength calibration upon startup

Diagram for feature spectral line position calibration function

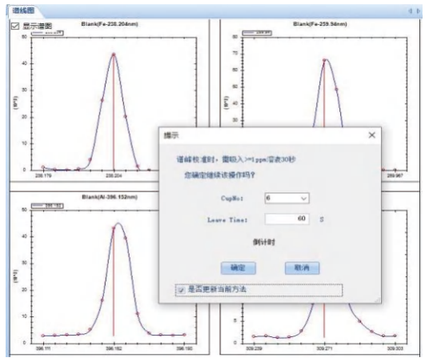
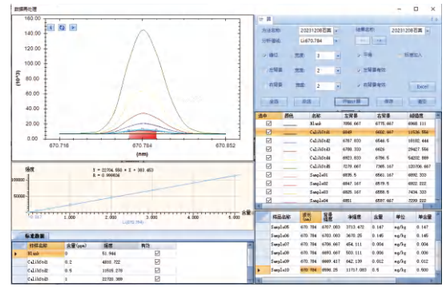


Diagram for spectral peak calibration function

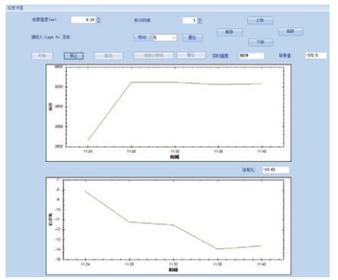
Powerful Software Analysis Features

The software features a wizard-style interface, which is intuitively designed, user-friendly, and allows users to easily understand functions at a glance, making your testing work seamlessly. With practical functions such as automatic torch alignment, one-click ignition, and safety state monitoring, as well as a vast spectral line library, users can freely select and add secondary sensitive lines for different elements. The software also includes professional optical path debugging functions, qualitative, semi-quantitative, and quantitative analysis capabilities, instrument diagnostic optimization functions, flexible full-spectrum research capabilities, powerful offline reprocessing functions, and method - multiple sample result set management functions. Additionally, it incorporates scientifically intelligent background correction and interference removal algorithms, enhancing the professionalism and accuracy of testing.

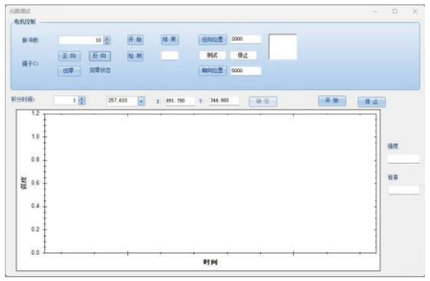


Offline reprocessing function diagram

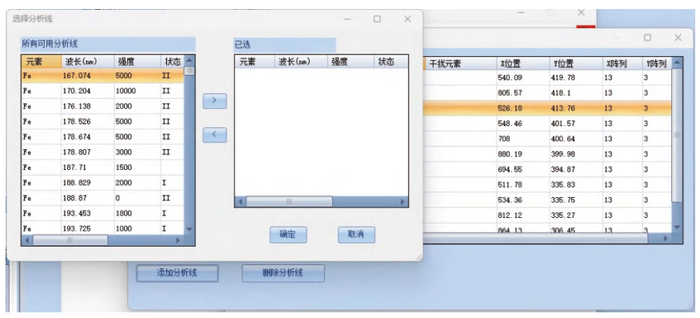
Interference factor database diagram



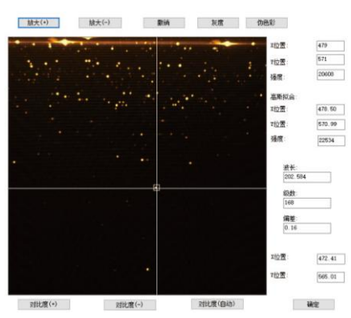
Instrument diagnostic optimization function diagram



Optical path debugging function diagram



Spectral line library calling diagram



Full spectrum research mode diagram

Sample Inspection

Using the Application of ICP3200 in the Lithium Battery Industry as an Example:

Abstract: Lithium cobaltate (LiCoO2) and lithium nickel cobalt manganese oxide (LiNiCoMnO2) were dissolved in aqua regia on an electric hotplate. Twenty metal elements including iron, nickel, copper, titanium, and lanthanum were simultaneously determined by a dual view inductively coupled plasma emission spectrometer (ICP-3200). The method achieved a lithium cobaltate recovery rate of 86.5% to 108.5% and a lithium nickel cobalt manganese oxide recovery rate of 88.0% to 109.5%. The linear correlation coefficient was greater than 0.999. The relative standard deviation for lithium cobaltate was between 0.31% and 1.79%, and for lithium nickel cobalt manganese oxide, it was between 0.39% and 2.29%. The method is simple to operate, fast in analysis, highly sensitive, and suitable for the detection requirements of positive electrode materials in the lithium battery industry.

Table 1: Instrument Operating Conditions

Observation Direction	Plasma Gas Flow Rate (L/min)	Auxiliary Gas Flow Rate (L/min)	Carrier Gas Flow Rate (L/min)	High Frequency (MHz)	High-Frequency Output Power (KW)
Axial	12	0.6	0.6	27.12	1.0

Table 2: Detection Limits and Precision

Element Name	Mg	Na	Ca	Fe	Zn	Cu
Spectral Line (nm)	279.553	588.995	393.366	259.94	206.2	324.754
Detection Limit (mg/L)	0.00004	0.004	0.00003	0.001	0.002	0.001
Lithium Cobaltate RSD (%)	0.38	1.35	0.69	1.52	1.01	0.65
Lithium Nickel Cobalt Manganese Oxide RSD (%)	0.71	2.29	0.85	1.32	0.47	1.06

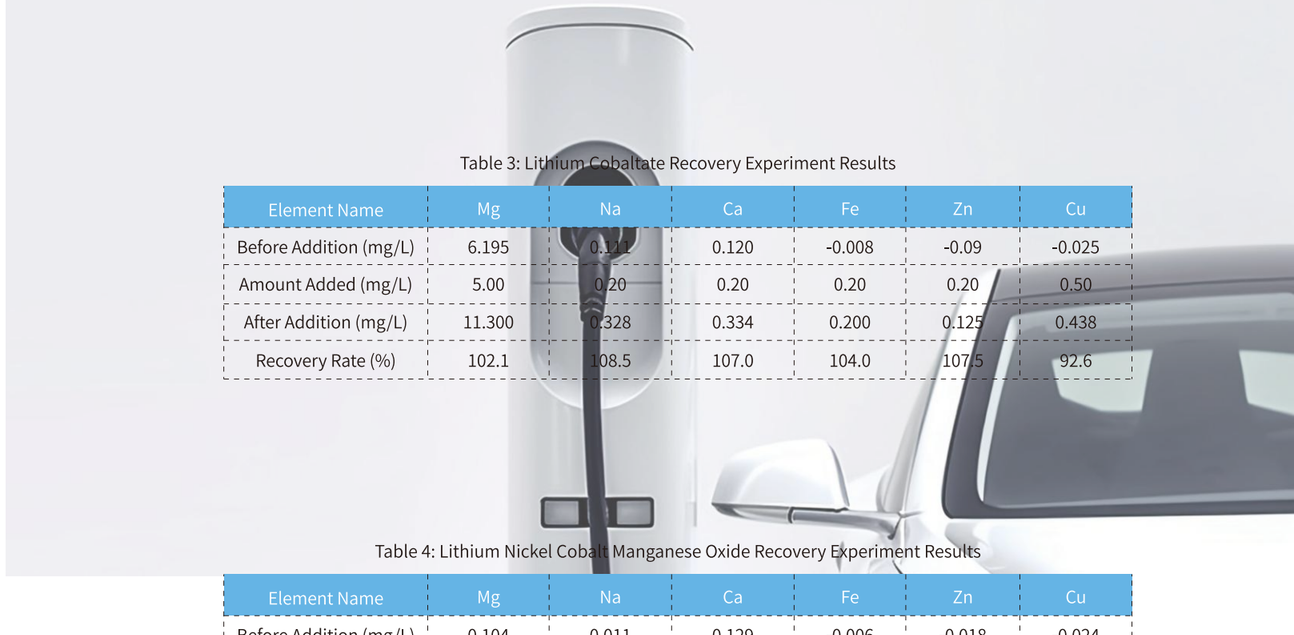


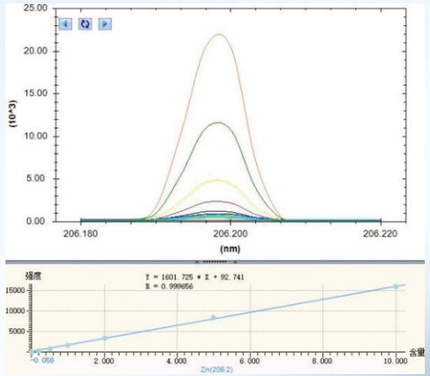
Table 3: Lithium Cobaltate Recovery Experiment Results

Element Name	Mg	Na	Ca	Fe	Zn	Cu
Before Addition (mg/L)	6.195	0.111	0.120	-0.008	-0.09	-0.025
Amount Added (mg/L)	5.00	0.20	0.20	0.20	0.20	0.50
After Addition (mg/L)	11.300	0.328	0.334	0.200	0.125	0.438
Recovery Rate (%)	102.1	108.5	107.0	104.0	107.5	92.6

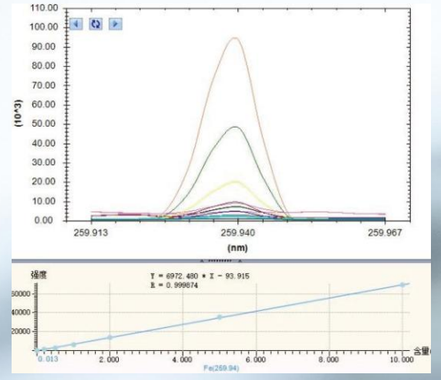
Table 4: Lithium Nickel Cobalt Manganese Oxide Recovery Experiment Results

Element Name	Mg	Na	Ca	Fe	Zn	Cu
Before Addition (mg/L)	0.104	0.011	0.129	-0.006	-0.018	-0.024
Amount Added (mg/L)	0.20	0.20	0.20	0.20	0.20	0.20
After Addition (mg/L)	0.300	0.230	0.334	0.205	0.173	0.169
Recovery Rate (%)	98.0	109.5	102.5	105.5	95.5	96.5

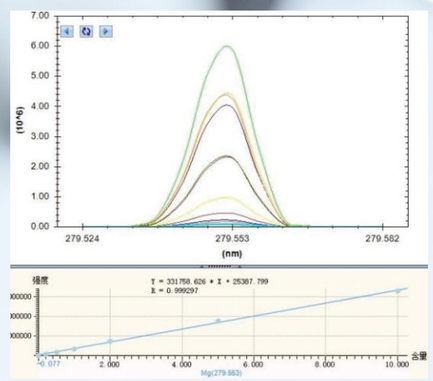
Partial Elemental Spectra



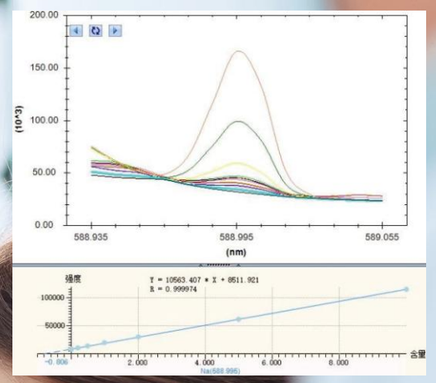
Zn-206.2nm



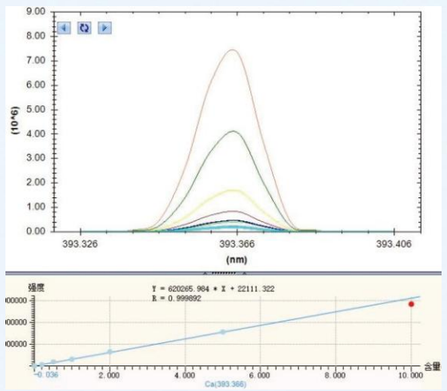
Fe-259.94nm



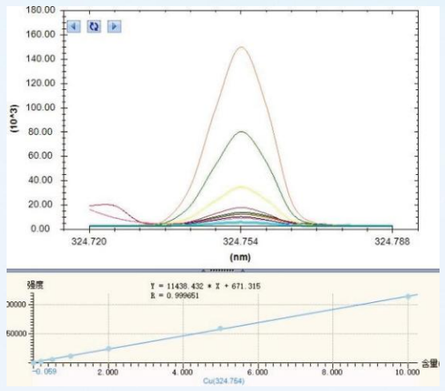
Ca-393.366nm



Cu-324.754nm



Mg-279.553nm



Na-588.995nm

Construction Materials Industry

Precise and rapid analysis of impurities in construction materials such as cement, glass, and refractory materials helps with quality control, ensuring safe construction and contributing to the construction of better living environments.

Lithium Battery Industry

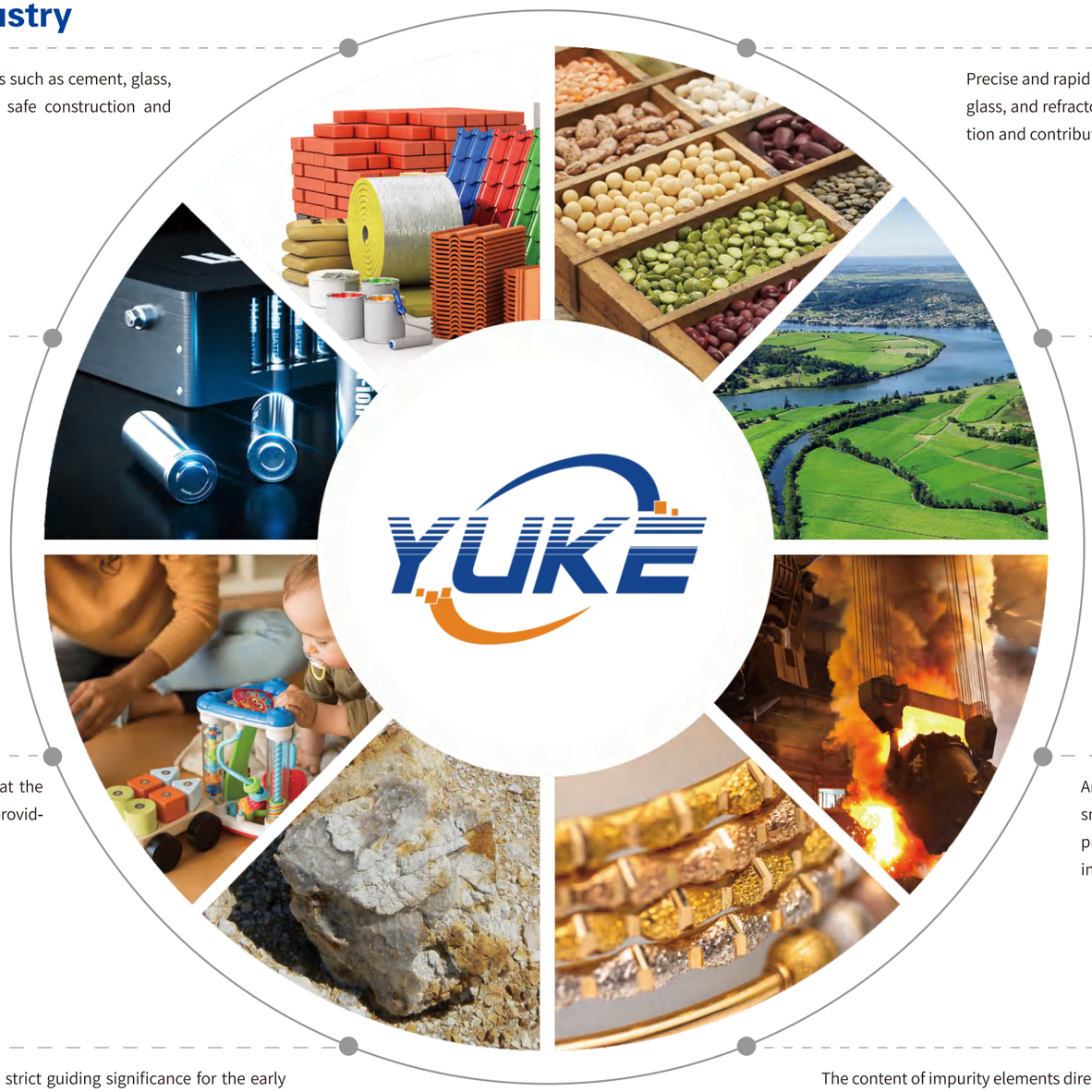
Effortlessly solving the analysis of major elements and impurity elements in the cathode and anode materials of lithium-ion batteries has significant implications for guiding lithium battery production and development, improving performance, and ensuring safety.

Toy Industry

Analysis of heavy metal elements in children's toys ensures that the heavy metal content in toy products is within controlled limits, providing peace of mind for parents and children.

Mining Industry

Accurate and rapid analysis of element content in minerals has strict guiding significance for the early mining, mid-term control, and later restoration of mines.



Feed and Food Industry

Precise and rapid analysis of impurities in construction materials such as cement, glass, and refractory materials helps with quality control, ensuring safe construction and contributing to the construction of better living environments.

Environmental Protection Industry

The precise and rapid analysis of heavy metal elements in environmental samples (such as water and soil) plays a vital role in safeguarding human daily life and the environment.

Metallurgical Industry

Analysis of material input and impurity control during metal smelting processes has important guiding significance for timely process optimization, ensuring product performance, and reducing costs.

Precious Metals Industry

The content of impurity elements directly impacts the purity and performance of precious metals and, in turn, their intrinsic value. Accurately determining the content of low-level impurity elements is of utmost importance in the precious metals industry.