ZSX Primus IV/IV*i*

X-RAY FLUORESCENCE SPECTROMETERS

Tube-above/tube-below high-performance models

Rigaku
POWERING NEW PERSPECTIVES

Industry know-how: **ZSX**

SUPPORTING ANALYSIS USING ZSX GUIDANCE
- Facilitates comprehensive analysis with automatic settings and smart selection features for quantitative applications with minimal operator intervention.

DESIGNED FOR SAFETY
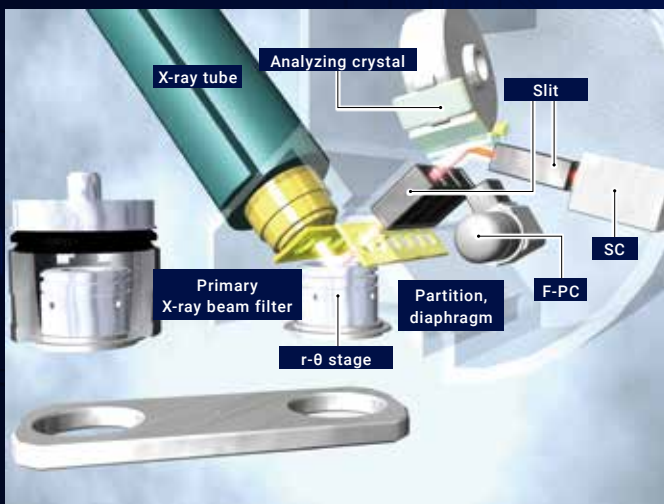- Tube-above geometry minimizes effects of catastrophic sample failures.

HIGH SPEED AND PRECISION
- High-speed goniometer, high-speed digital counting system.

UNIQUE CAPABILITIES
- Point/Mapping analysis, SQX scatter FP method.

Primus IV features

TUBE-ABOVE EXCITATION SAFELY HANDLES POWDER SAMPLES

- Tube-above optics means the instrument won't be damaged by falling sample particles. Enhanced sensitivity and improved accuracy in the analysis of powder samples made possible by measuring pressed powder samples without using sample films.
- Also enables analysis of liquid samples by using sample cells and liquid sample holders designed for tube above analyses.

Sample spills are prevented with the tube-above optics model

With a tube-above system there is no impact on the optical components due to loose particles falling from a poorly prepared sample. Sample films are often not necessary which can further improve light element sensitivity.

Dust contamination of the vacuum pump is suppressed by the use of a dual vacuum system that equilibrates the vacuum pressure between the sample inlet and the measurement chamber, and by internal filters for powder samples (standard equipment).

ZSX Primus IV*i*

SUPPORTING ANALYSIS USING ZSX GUIDANCE

- Automated analysis settings features enhanced third-generation SQX analysis software.
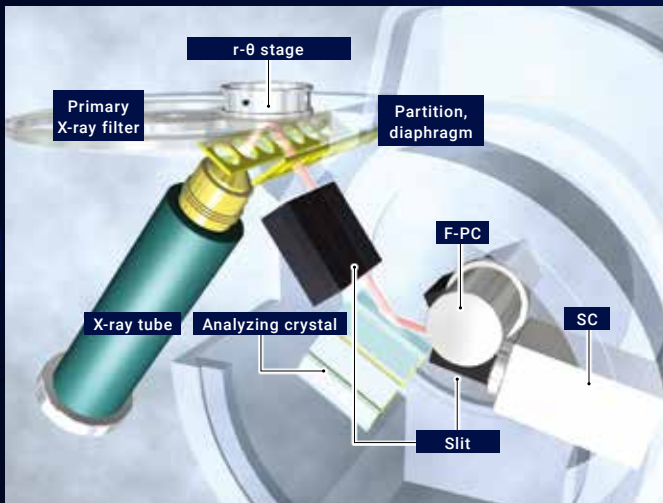
HIGH-SPEED, HIGH-PRECISION MEASUREMENTS

- Efficiency of the new drive sequence decreases instrument overhead time.

UNIQUE FUNCTIONALITY

- The tube-below optics enables convenient functionality, including new sample film corrections.
- Offers the smallest footprint in the industry.

NEXT GENERATION

ZSX Primus IV*i*

SPECIFICALLY FOR X-RAY ANALYSIS OF LIQUIDS, ALLOYS, AND PLATED METALS

- The tube-below high-performance model enables efficient analysis of samples such as liquids, alloys, and plated metals.

INTUITIVE SOFTWARE PROGRAMMABLE FOR EVERYDAY ANALYSIS USING SAMPLE TRAYS

- Sample ID settings for each tray (facilitates easy copy-and-paste for efficient measurement setup).

IMPROVED ACCURACY OF LIQUID SAMPLE ANALYSIS

- Correction of errors caused by geometry of liquid sample cups.

Advanced design facilitates easy cleaning of sample chambers

① Remove the ASC drawer

② Open the sample chamber

③ Clean as needed

X-RAY TUBE
Super Trace™

4 kW X-RAY TUBE
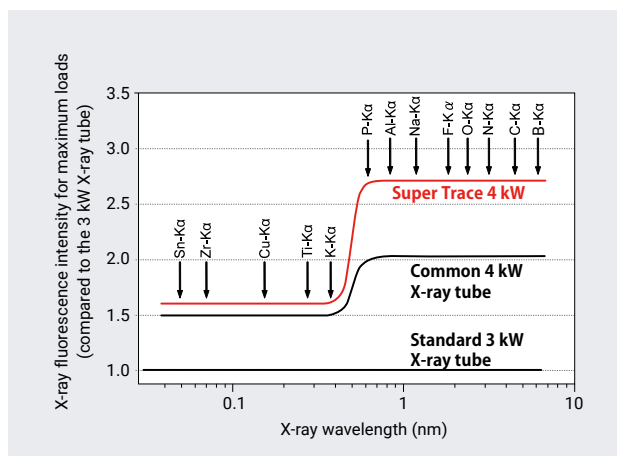
For over 20 years Rigaku has provided 4 kW X-ray tubes with 30 µm Be window thickness that enable highly sensitive measurements of light elements.

MINIMUM HEAT IMPACT ON ANALYSIS SAMPLES

HIGH STABILITY

- Minimal changes in X ray intensity over years of operation.

CRYSTAL

RX-SERIES

Newly developed synthetic multilayer for boron "RX85" represents an improvement in sensitivity for B-Kα of approximately 30% compared to previous products.

HIGH-SENSITIVITY CURVED CRYSTAL

Curved PET and Ge analyzing crystals are included as standard equipment. High-sensitivity curved Ge crystal represents a 30% improvement in P and S sensitivity compared to common flat types and 30% improvement in Al and Si sensitivity compared to flat PET. Supports SQX analysis and enables high-sensitivity standardless FP analysis for many years.

*1 PET: 30% improvement in sensitivity with curved crystal design.
*2 Ge: 30% improvement in sensitivity with curved crystal specifications.
*3 RX26 is the successor to RX25. The unique feature of RX26 and RX25 is that they do not reflect higher order spectra caused by analyzing crystals.
*4 RX85 high intensity, RX75 high resolution.

PRIMARY BEAM FILTERS

Placed between the X-ray tube and sample to decrease interference of characteristic X-ray lines or continuum X-rays generated from the X-ray tube.

| Model	Notes
Al125	Ti, Cr, Co, Fe, Zn analysis
Al25	Rh-Lα exclusion Cd-Lα measurement
Ni40	Pb-Lα, As-Kα measurement
Ni400	Rh-Kα removal, Cd-Kα measurement
Be30	For X-ray tube protection (optional)

S-PC LE - DOES NOT REQUIRE EXTERNAL GAS*
(Sealed-Proportional Counter)

Facilitates installation of equipment in regions and facilities where it is difficult to obtain P-10 gas needed for detectors used for light element analysis (F-PC).

*Optional

APC (AUTOMATIC PRESSURE CONTROL)

For ultra-light elements (Be – O) and light elements with low energy X-ray emissions (F – Al), the degree of vacuum greatly impacts X-ray intensity. The APC (Automatic Pressure Control) enables steady state vacuum conditions to be maintained and facilitates reproducible X-ray intensities for these elements.
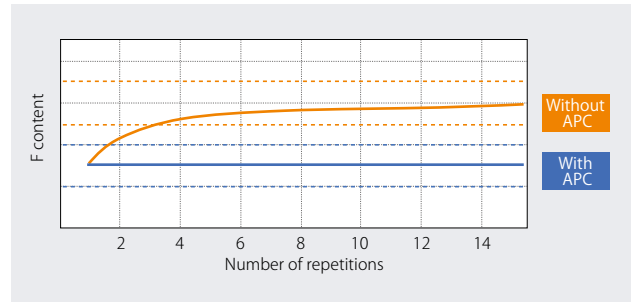
Extent of stabilization of fluorine repetitive measurements using the APC in powder samples.

IMPROVED THROUGHPUT

IMPROVED MECHANICS MINIMIZE THE ANALYSIS DEAD TIME

- Example: 16-element sequential quantitative measurement time improved from 348 seconds to 287 seconds, representing an 18% increase in efficiency.

D-MCA HIGH SPEED ANALYSIS

ENHANCED PRECISION FOR HIGH COUNTS USING DIGITAL MULTI-CHANNEL ANALYZER (D-MCA) SYSTEM

- The D-MCA facilitates high-speed digital processing for high count rates for improved analytical precision and increased throughput speeds.
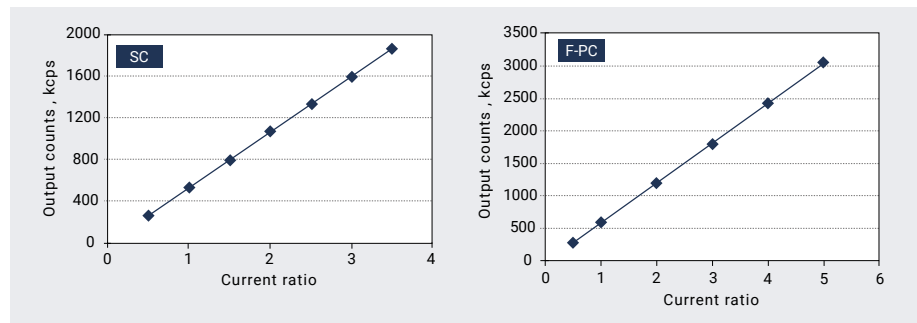
OPTICAL SYSTEM NOT EASILY IMPACTED BY SAMPLE SURFACE HEIGHT VARIATIONS

An uneven sample surface causes variations in the distance between the sample and the X-ray tube. These differences can lead to changes in the X-ray intensity. Rigaku's unique optical systems enable suppression of X-ray intensity changes caused by variation in distance. This enables accurate analysis by minimizing the impact of shape differences from fusion molds used in glass bead formulation and the impact of uneven sample surfaces during pressing of powder samples.
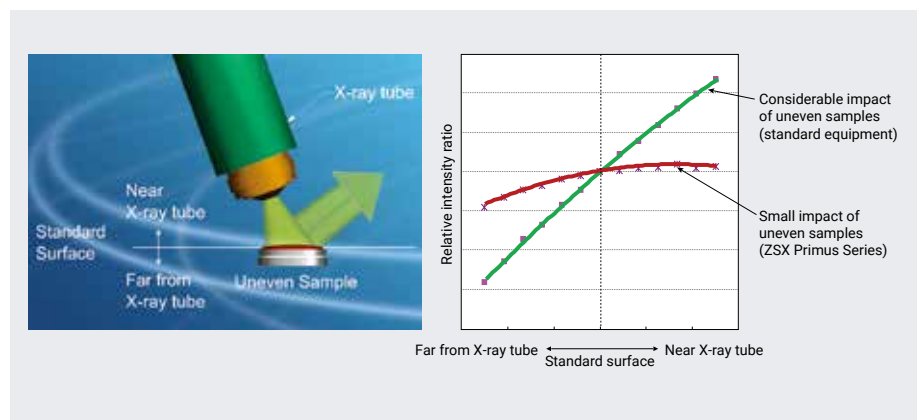

Illustration of the effect sample curvature has on intensity readings and how the Rigaku compensation minimizes this effect.

WDXRF POINT/MAPPING ANALYSIS

Equipped with a high-resolution camera that allows the user to zoom in on small features for proper identification and analysis. Enables accurate analysis by eliminating differences in sensitivity caused by measurement placement.

OPTIMIZATION OF SAMPLE POSITIONING FOR CONSTANT MEASUREMENT OF PRIMARY X-RAY REGIONS WITH MAXIMUM SENSITIVITY

a) Maximum X-ray intensity center for a small spot

b) Measurement center for ∮30mm standard area

c) Measurement center for conventional spectrometer

d) Measurement center for a small spot in ZSX
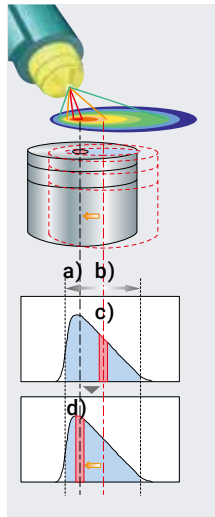
Superior design uses the hot-spot of the tube to maximize intensity/sensitivity.

Mapping area settings

6mm

6mm
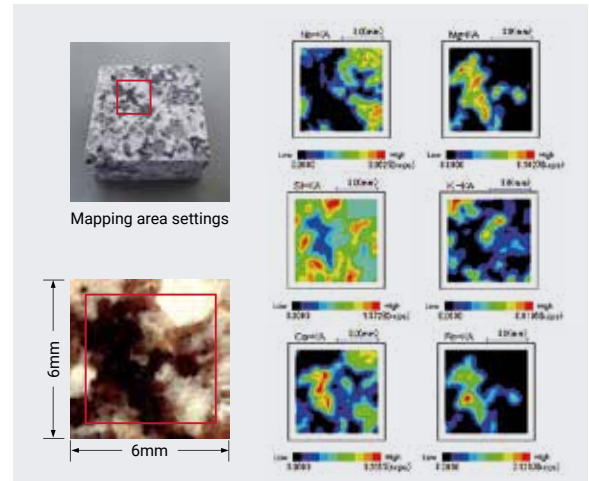
Example of mapping analysis.

SQX SCATTER FP METHOD

The presence of major ultra-light element C, H, O and N affects the analysis results in samples such as sludge and scale. The SQX scatter FP method estimates the influence of these unmeasured ultra-light elements using scattering X-ray intensity and gives accurate standardless FP analysis results.

Comparison of SQX analysis of incinerator ash using standard SQX and SQX scatter FP method.

(Unit: mass%)

Element	Standard value	SQX scatter FP method Balance estimated	SQX Element Predefined Balance As Oxygen
Ti	0.851	0.883	0.807
Cr	0.086	0.089	0.082
Mn	0.14	0.13	0.12
Fe	2.13	1.96	1.79
Ni	0.012	0.013	0.012
Cu	0.13	0.13	0.12
Zn	2.6	2.5	2.3
Se	0.0041	0.0041	0.0038
Cd	0.047	0.044	0.042
Sb	0.04	0.05	0.05
Pb	1.09	1.02	0.94
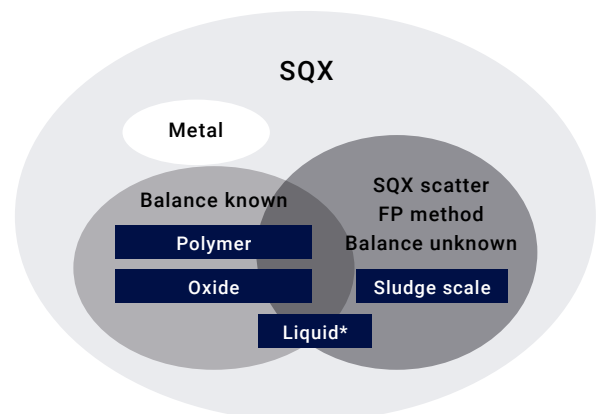
*ZSX Primus IVi specified

AUTOMATED CENTER WIRE CLEANING MECHANISM

The F-PC detector center wire gradually becomes contaminated by proportional counter quench gas, which diminishes resolution. The center wire cleaning mechanism enables restoration of performance by eliminating center wire contamination by means of electrical heating, with no need to shut off the power source or to open the cabinet.

PROGRAMMABLE OPERATION FEATURE

At the designated time, X-ray on, aging, and PHA adjustment is performed, enabling timely start of analytical tasks. Automated drift correction settings result in significant savings of labor associated with instrument setup prior to analytical tasks.

EXAMPLE OF AN AUTOMATION SEQUENCE FOR DRIFT CORRECTION

- Automated startup of equipment on a preset schedule (daily, weekly, monthly startup)
- Check analysis using samples for confirmation of analysis values
- Automatically determine whether or not errors are within tolerance
- Performs automated drift correction if outside of tolerance
- Correction confirmation by repeat check analysis

VACUUM PARTITION SYSTEM FOR ANALYZING LIQUIDS

Because the spectroscopic chamber is separated from the sample chamber when changing helium gas, the change from vacuum atmosphere to helium atmosphere is completed in less than two minutes. Furthermore, the consumption of helium gas is reduced compared to models where the spectroscopic chamber must also be purged.
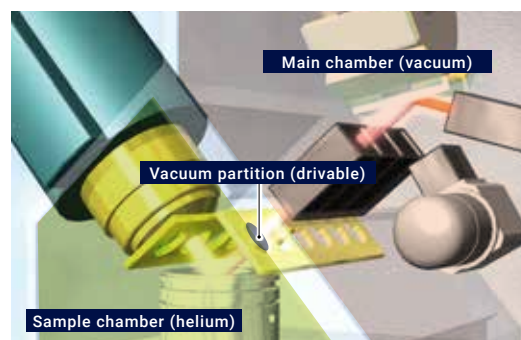
The optical system diagram above shows the ZSX Primus IV. The ZSX Primus IVi features the same vacuum partition.

SUPERIOR DATA HANDLING (ENHANCED FUNCTIONALITY FOR BROWSING ANALYTICAL RESULTS)

Enhanced browsing functionality facilitates easy recalculation processing, analytical results search functionality, and comparisons of multiple data displays.

- Data filtering
- Batch display/output of multiple analytical results
- Quantitative results recalculation
- Text output of analytical results
- Data pack of application related files
- Access to measured data and various application types
- Quantitative/qualitative applications, spectrum dialogue, SQX analytical data, mapping result files
- Supports analytical results clipboard
- Easy viewing of multiple SQX analytical results
- Simple document creation with pasting to spreadsheet software
- Standard equipment for external transmission functionality
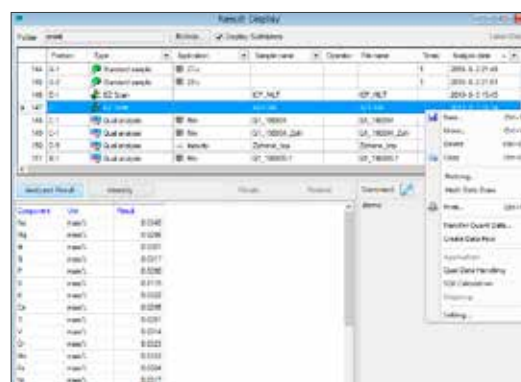
BUILT-IN PHA ADJUSTMENT SAMPLES

Built-in PHA adjustment samples eliminate the need to manually store PHA samples.

REFINED SQX ANALYSIS

SQX analysis is standardless FP analysis software for calculation of accurate elemental composition.

NEW FUNCTIONALITY

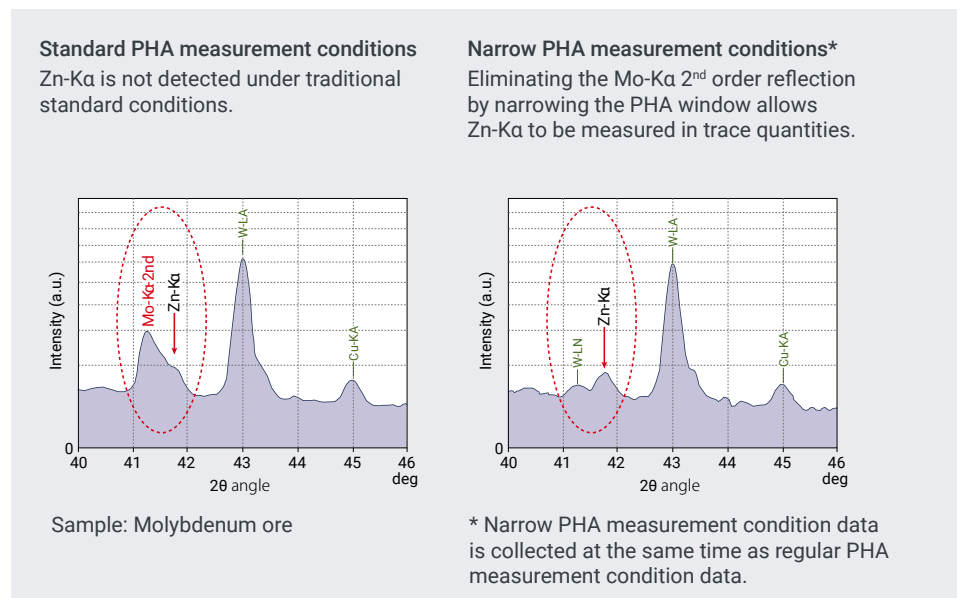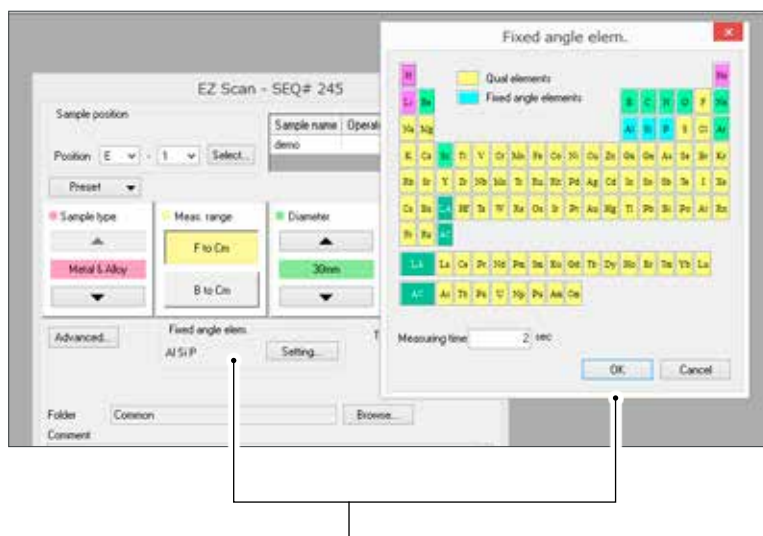- The impact of higher-order spectra primarily generated from heavy elements is assessed, and the most appropriate measurement conditions are auto-selected, resulting in more accurate SQX analytical values.
- EZ Scan features an added fixed angle measurement mode for detection of trace elements
- EZ Scan is also equipped with ultra-high-speed mode (< 2 min)
- Supports screening analysis of multilayer thin-film samples
- Enables addition of any sample support films for sample film correction
- SQX scatter FP method made even easier (Supports measured diameter of 30mm and 20mm)

EXAMPLE OF HIGHER ORDER LINE INTERFERENCE

- Enables auto collection of data for trace Zn measurement line Zn-Kα under optical conditions with no Mo high-order line impact, facilitating easy detection of measurement lines buried in conventional higher-order lines.

Standard PHA measurement conditions
Zn-Kα is not detected under traditional standard conditions.

Narrow PHA measurement conditions*
Eliminating the Mo-Kα 2nd order reflection by narrowing the PHA window allows Zn-Kα to be measured in trace quantities.

Sample: Molybdenum ore

* Narrow PHA measurement condition data is collected at the same time as regular PHA measurement condition data.

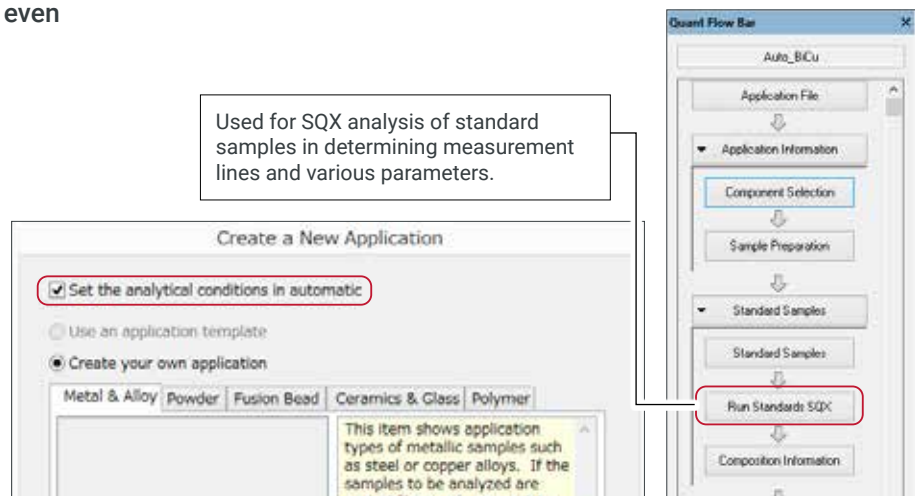## EZ SCAN FIXED ANGLE MEASUREMENT SETTING

Fixed angle measurement element setting functionality. Easy creation of measurement conditions by clicking fixed angle measurement element and determining measurement time.

AUTOMATIC QUANT APPLICATION SETUP

Easy creation of calibration curve even for new users

- Operation consists of merely inputting standard sample measured content and standard values. Based on auto-provided qualitative analytical results, various parameters such as measured line, background angle, and matrix corrections are auto-set after taking into account spectrum overlap, etc.

Used for SQX analysis of standard samples in determining measurement lines and various parameters.

Create a New Application

☑ Set the analytical conditions in automatic

○ Use an application template

◉ Create your own application

| Metal & Alloy | Powder | Fusion Bead | Ceramics & Glass | Polymer |

This item shows application types of metallic samples such as steel or copper alloys. If the samples to be analyzed are

Quant Flow Bar

Auto_BiCu

Application File

▾ Application Information

Component Selection

Sample Preparation

▾ Standard Samples

Standard Samples

Run Standards SQX

Composition Information

Quantitative flowbar specifically for auto-settings.

SUPPORTING FUNCTIONS FOR THIN FILM ANALYSES

Find the optimal analysis line combination and determine analysis possibilities for established samples with thin-film structures.
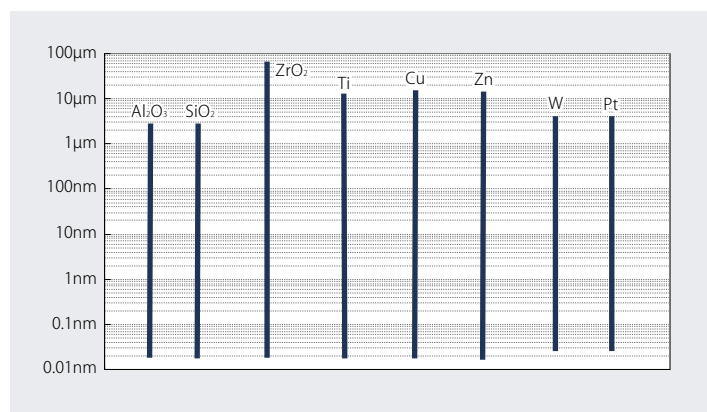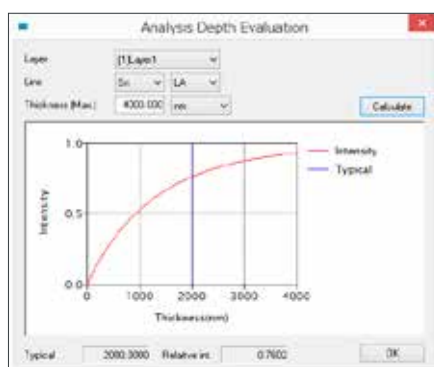
EXAMPLE OF SIMULATION OF OPTIMAL ANALYSIS LINE FOR THIN-FILM SAMPLE

- The optimal measurement line for transparent electrode ITO film (In_2O_3-SnO_2) on SiO_2 substrate was simulated.
- Sn-Lα and In-Lα lines are apparently the optimal measurement lines. In this manner, pre-investigation of the analysis line for thin-film samples is simplified.

Layer 1: In_2O_3-SnO_2

Substrate: SiO_2

Result of Search Best Lines

Best Lines

Layer	Component	Type	El.line
1	Layer1	FP method	Sn-LA
1	SnO2	Balance	
1	In2O3	FP method	In-LA
S	SiO2	Fixed	

Analysis Depth Evaluation

Layer: [1]Layer1
Line: Sn / LA
Thickness (Max): 4000.000 nm

Calculate

— Intensity
— Typical

Typical   2000.3000   Relative int.   0.7600   OK

Using the analysis depth assessment function enables easy acquisition of analysis depth information for various analysis lines.
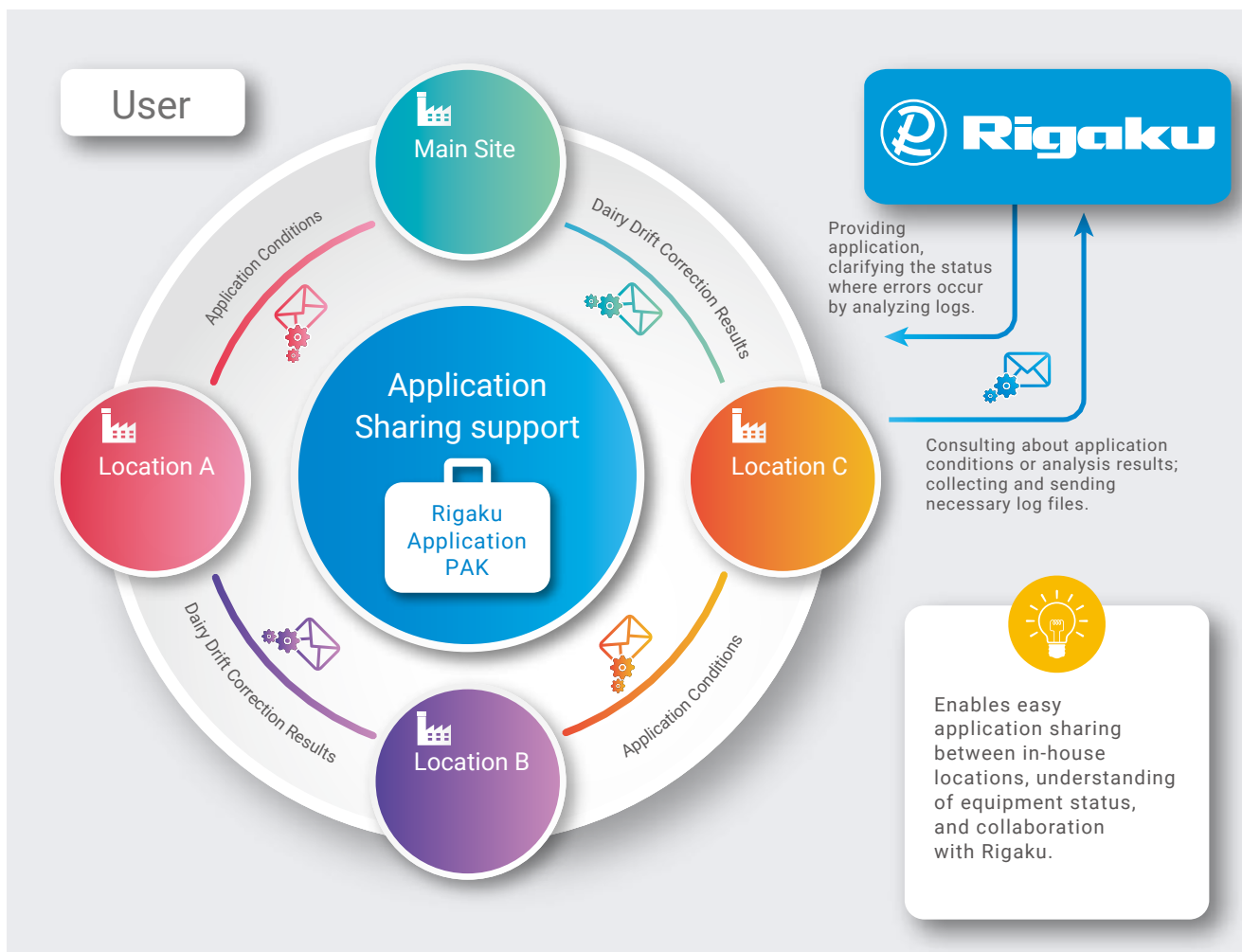
Representative thin-film measurements range.

The thin-film analysis function supports various units depending on purpose.

- Units of thickness: Angstrom, nm, μm
- Adhesion: g/m^2, mg/m^2, mg/cm^2, $μm/cm^2$
- Composition ratio: mass%, ppm, at%, mol%

User

Main Site

Application Conditions

Dairy Drift Correction Results

Application Sharing support

Rigaku Application PAK

Location A

Location C

Dairy Drift Correction Results

Application Conditions

Location B

Rigaku

Providing application, clarifying the status where errors occur by analyzing logs.

Consulting about application conditions or analysis results; collecting and sending necessary log files.

Enables easy application sharing between in-house locations, understanding of equipment status, and collaboration with Rigaku.

TRANSFER APPLICATION PARAMETERS FROM ONE EQUIPMENT TO OTHER

- Enables easy migration of application files by established correction/analysis conditions and simplifies analysis startup with existing equipment.

MONITOR SYSTEMS INSTALLED AT REMOTE SITES

- The batch export function simplifies electronic storage of everyday drift correction results.

ENHANCED SUPPORT BY RIGAKU

- Rigaku's original application package is provided.
- Simplifies preparation of related data files for consultation with Rigaku concerning analytical results and setting content of client formulated applications.

INDUSTRY-SPECIFIC ANALYTICAL PACKAGES PROVIDED BY RIGAKU

Pre-calibration packages with various stored parameters, and application packages with certified standard samples.

OXIDE-FB-PAK

- 23-component analysis of oxide samples of cement, slag and ore using the glass bead method.

GEO-TRACE-PAK

- Minor element analysis of rock, mineral, sediment, and ore powder samples using the pressed powder method (minor and major elements).
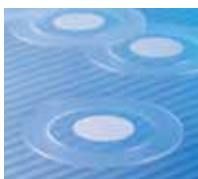
OIL-MULTI-PAK

- Multi-element analysis of lubricants using liquid analysis. (ZSX Primus IVi specific)

AUTOMATION SUPPORT

Supports various sample preparation equipment and automated analysis with connections to host computers.

SAMPLE PREPARATION ACCESSORIES

UltraCarry®

MicroCarry

Antiscatter cup (Al or Ti)

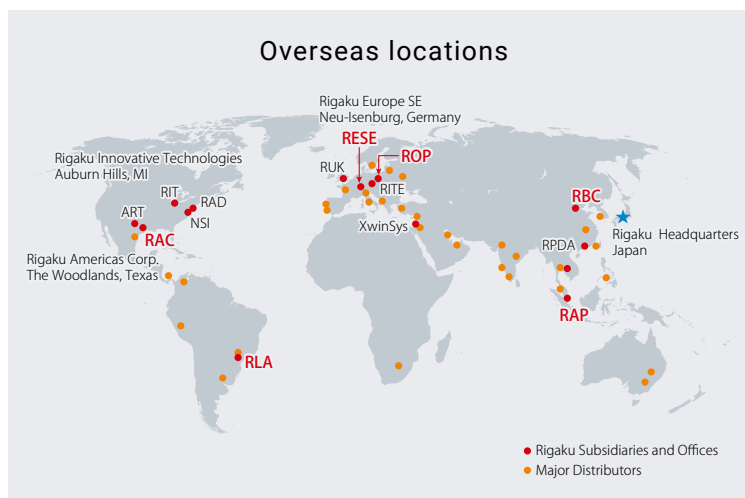Cell for loose powder

Micro/flocculant sample cup

Trace powder cup

SUPPORT

SERVICE CENTERS

- Provide timely support from various service centers in regional offices around the World.

APPLICATION SUPPORT

- Support is provided from application engineers thoroughly versed in providing technical information, measurement analysis, consultations on measurement methods, and queries from customers using the equipment.

Overseas locations

Rigaku Europe SE
Neu-Isenburg, Germany
RESE
ROP
RUK
RITE

Rigaku Innovative Technologies
Auburn Hills, MI
RIT
RAD
ART
NSI
RAC

Rigaku Americas Corp.
The Woodlands, Texas

XwinSys

RBC

RPDA

Rigaku Headquarters
Japan

RAP

RLA

- ● Rigaku Subsidiaries and Offices
- ● Major Distributors

Tokyo application laboratory

Osaka application laboratory

RAC application laboratory

ART application laboratory

RESE application laboratory

RELATED PRODUCTS

ZSX Primus III+
Sequential wavelength dispersive X-ray fluorescence spectrometer

Supermini200
Benchtop wavelength dispersive X-ray fluorescence spectrometer

Simultix 15
Multi-channel simultaneous X-ray fluorescence spectrometer

ZSX Primus 400
Sequential wavelength dispersive X-ray fluorescence spectrometer

SPECIFICATIONS

		ZSX Primus IV	ZSX Primus IVi
Analysis range[*1]		$_4$Be - $_{96}$Cm	
Spectral method		Wavelength dispersive	
X-ray generator	X-ray tube	End window type Rh target 4 kW	
	X-ray generator	High-frequency inverter system	
	Heat exchanger	Pure water circulation supplier (built-in)	
Spectrometer	Irradiation method	Tube-above	Tube-below
	Automatic sample changer	Maximum 48-sample exchange Select 12, 24, 36, or 48 samples (Optional) 96-sample exchange	Maximum 60-sample exchange Select 12,24, 36, 48, or 60 samples
	sample loading	Air-lock system	
	Sample size (maximum)	φ52 mm×30 mm (H)	φ52 mm×40 mm (H)
	Primary X-ray beam filter	4 types (Ni400, Ni40, Al125, Al25) (Optional) Be30, for X-ray tube protection	
	Diaphragm[*2]	(Standard) φ35, 30, 20, 10, 1, 0.5 mm	
	Slit	3 slit exchanger (Standard) Standard and fine (Option) Ultra-light element or ultra-high resolution	
	Goniometer	θ-2θ independent drive system	
	Continuous scan	0.1°- 600°/min	
	Crystal changer	10 position changer	
	Analyzing crystal	(Standard configuration) LiF (200), GeH, PETH, RX26	
	Optional crystals	LiF (420), LiF (220), RX9, RX4, RX35, RX40, RX45, RX61, RX61F, RX75, RX85	
	Vacuum system	Sample chamber and main chamber-per unit	Sample chamber and main chamber-shared
		Filter for powder samples	
	Atmosphere	(Option) Automatic helium purge system (Option) Liquid sample holder recognition	
	Point/mapping mechanism	r-θ stage (Option) Sample observation system	
Counting system	Pulse height analyzer	Digital multi-channel analyzer (D-MCA)	
	Detector — For use with heavy elements	SC (Scintillation counter)	
	Detector — For use with light elements	F-PC (Gas flow proportional counter) (Optional) S-PC LE (Gas sealed proportional counter: does not require proportional gas)	

INSTALLATION SPECIFICATIONS

Customer: Depressurization valve

Required power supply	Single (200 - 240V, 40A) or 3-phase (200V, 40A), 50/60 Hz Personal computer 1-phase, 100 - 240V, 10A
Grounding specification	30Ω or below grounding (Independent)
Cooling water	Temperature: Lower than 30°C Pressure: 0.29 - 0.49 MPa Flow: More than 5 L/min Quality: Equivalent to drinking water
Drained water	Gravity drain
Room temperature	15 - 30°C Daily variation within ±2°C
Relative Humidity	10 - 75% RH or less
Gas for detector	P-10 Gas (argon 90% - methane 10% mixed gas) Pressure 0.15 MPa, 7 mL/min * Not required if S-PC LE is selected

Connection port: Tapered female screw for pipes Rc1/4
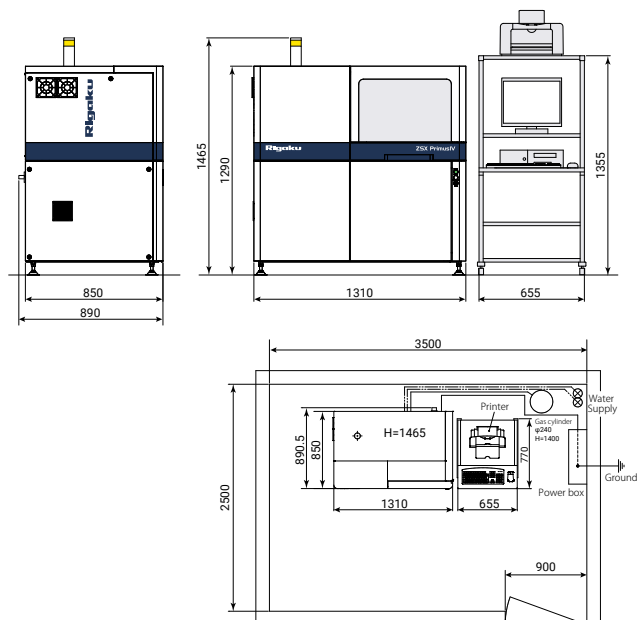
*1: Depending on crystal configuration
*2: Diaphragm diameters can be selected from the following five combinations
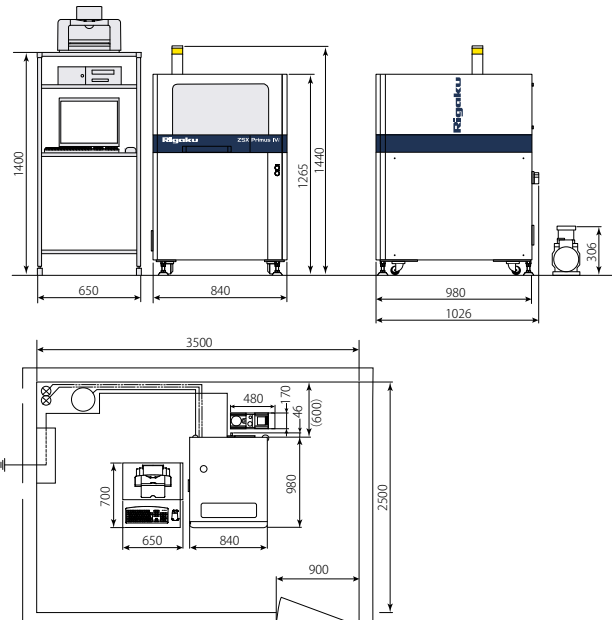
Diaphragm options:
Φ35, 30, 20, 10, 3, 1 mm
Φ35, 30, 20, 10, 3, 0.5 mm
Φ35, 27, 20, 10, 3, 1 mm
Φ35, 27, 20, 10, 3, 0.5 mm
Φ35, 27, 20, 10, 1, 0.5 mm

EXTERNAL SIZE - LAYOUTS   Unit: mm

ZSX Primus IV Weight: 620 kg

ZSX Primus IVi Weight: 500 kg

ZSX Primus IV/IV*i*

X-RAY FLUORESCENCE SPECTROMETERS

www.rigaku.com/products/wdxrf

Rigaku Corporation and its Global Subsidiaries

info@rigaku.com | www.rigaku.com