

## X-Ray Fluorescence Spectrometer ZSX Primus II



Fig. 1. External appearance of instrument.

### 1. Introduction

Rigaku Industrial Corporation has developed the ZSX Primus II, a versatile, high-performance and compact, tube-above wavelength dispersive X-ray fluorescence spectrometer. This new system has 50% higher sensitivity for both heavy and light elements and requires a 30% smaller footprint than our previous generation spectrometers, even when equipped with the 48 position sample changer.

This newly developed ZSX Primus II inherited the product concept of the ZSX Primus, our tube-below wavelength dispersive X-ray fluorescence spectrometer, which was developed last year. The Primus II is expected to be the most popular model of our wavelength dispersive X-ray fluorescence spectrometers through implementation of all the successful concepts of the ZSX Primus combined with the tube-above configuration. The ZSX Primus II can be used, like the ZSX Primus, for standard daily applications as well as research and development of new materials, environmental analyses of industrial wastes, sludge, *etc.*

We designed the Primus series to attain a wide range of applications with high-precision and low-cost analysis. Additional considerations in developing the ZSX Primus II were to reduce the footprint of the main unit, lower the costs of utilities, and to shorten analysis times.

Another unique concept for the Primus II is that there is no longer a need for a maintenance area behind the instrument. The rear of the instrument can be placed near the wall of the analysis room to utilize space more effectively.

### 2. Features

#### Performance:

- The new optical system has attained 50% higher sensitivity for both heavy and light elements than our older spectrometers.
- Some new options include using a newly developed synthetic multilayer analyzing crystal for boron analysis, which has doubled sensitivity and another new crystal for magnesium has eliminated a common interfering line such as a higher order line of Ca-K $\alpha$ .
- Micro-point analysis can be used to quantify

with spots as small as 500 microns and with high sensitivity, any position specified on the sample surface using a CCD camera.

- The new SQX Software (option) has enabled more accurate quantitative analyses of substances consisting predominantly of light elements (plastics, burned ash *etc.*).

**Functions:**

- By installing a special partition between the sample chamber and the analysis chamber, analysis time has been shortened. (The time required to change the atmosphere from a vacuum condition to a helium purge condition has been shortened to 1/5 of the time required for our older spectrometers.)
- Thanks to the double vacuum system, waiting time for exchanging samples is non-existent.
- A sample changer with easy loading and rapid conveyance of samples has improved the efficiency of analyses.
- The ZSX Primus II uses a semi-quantitative analysis program referred to as SQX, which enables accurate analyses without standard samples, and the EZ Scan software, a pre-programmed routine, which enables beginners to perform analyses easily through a simple dialog.
- The application templates guide analysts through the setup process for qualitative and quantitative routines in a logical progression. Sample preparation, alternate analysis lines, and cautionary warnings are included in an analytical routine evaluation button allowing even beginners to perform advanced analyses as an expert.

- By using application packages, which contain standard samples and predetermined analysis conditions, specific analyses routines can be setup easily and rapidly.
- Since pulse height adjustments are made automatically (PAS) and the center wire cleaning for the F-PC can also be carried out automatically (ACC), daily maintenance has been greatly reduced.
- The automatic program operation function can carry out pre-programmed, automated operations including primary cooling water control (automatic power off), fixed time operation, automatic aging and the energy-saving operation.

**Utilities:**

- The ZSX Primus II has been designed to be compact. The dimensions of the main unit are 1310 mm in width, 880 mm in depth and 1325mm in height. The installation area is approximately 30% smaller than those of our older spectrometers. It has an all-in-one structure which houses an X-ray generator, heat exchanger, and vacuum pumps. Furthermore, the rear of the instrument can be placed near the wall of the analysis room to utilize space more effectively.
- Measures to save energy include a reduction in the quantity of primary cooling water used—approximately 1/2 of previous consumption—and a reduction in the flow of P-10 gas to approximately 1/10 previous F-PC settings.
- The ZSX Primus II complies with the CE standards.

**3. Specifications**

| Outline of Instrument  |  |
|------------------------|--|
| Element applicable     | 4Be-92U  |
| Optics                 | Wavelength dispersive method   |
| X-Ray Generator        |  |
| X-Ray Tube             | End window type, Rh target, 4 kW or 3 kW   |
| High Voltage Generator | High frequency inverter system (built-in)<br>Maximum rating: 4 kW, 60 kV-150 mA  |
|                        | Stability: +/-0.005% (against +/- 10% input variability)<br>With various safety circuits<br>Energy saving operation (Option) |
| Cooling Device         | Water-to-water heat exchanger (built-in)   |

| Spectrometer                  |  |
|-------------------------------|--|
| Sample Changer                | Expandable sample changer (12, 24, 36 or 48 samples)   |
| Sample Inlet                  | Air lock system      Maximum Sample Size      51 mm dia.×30 mm (H)   |
| Analyzed Sample Surface       | Maximum 35mm dia.  |
| Sample Rotation               | 30 rpm   |
| Primary X-Ray Filter          | 4 kinds (Al, Ti, Cu and Zr)  |
| Analysis Area Diaphragm       | 6 sizes automatic exchange mechanism (35, 30, 20, 10, 1 and 0.5 mm dia.)   |
| Divergence Slit               | 3 position automatic exchange mechanism<br>(Standard resolution, high resolution and ultra coarse (option))  |
| Receiving Slit                | For SC and F-PC  |
| Goniometer                    | Theta and 2-theta independent driving mechanism  |
| Angular Range                 | SC: 5–118 deg., F-PC: 13–148 deg.  |
| Maximum Scan Speed            | 1400 deg./min. (2-theta)   |
| Angular Reproducibility       | +/-0.0005 deg.   |
| Continuous Scan               | 0.1–240 deg./min.  |
| Crystal Changer               | 10 crystals automatic exchange mechanism   |
| Analyzing Crystal             | Standard: LiF(200), Ge, PET and RX25<br>Option: LiF(220), RX4, RX9, RX40, RX45, RX61, RX61F, RX75, RX80 and TAP  |
| Vacuum System                 | Dual vacuum chamber,<br>High-speed vacuum system (with 2 vacuum pumps)<br>Powder trap attachment (option)  |
| He Flushing System (optional) | With partition   |
| Temperature Stabilizer        | 36.5+/-0.1°C   |
| Counter/Control System        |  |
| Detectors                     | For heavy elements: SC (Scintillation counter)<br>Counting linearity: 1,000 kcps<br>For light elements: F-PC (Gas flow proportional counter)<br>Counting linearity: 2,000 kcps<br>Heating type center wire cleaning system |
| Attenuator                    | IN-OUT automatic exchanger (Attenuation 1/10)  |
| Maintenance Functions         | Self diagnosis function<br>Automatic pulse height adjustment system (PAS)<br>Automatic center wire cleaning (ACC)<br>Automatic tube aging<br>Remote diagnosis (option)   |

| Data Processing System |   |
|------------------------|---|
| OS                     | Windows XP Professional   |
|                        | PC/AT compatible, 15" TFT display, Color ink jet printer  |
| Software               | Qualitative analysis<br>Automatic peak identification<br>Smoothing, background subtraction<br>Quantitative analysis<br>Empirical method<br>JIS method, various matrix correction formulae<br>Linear, quadratic, cubic and calibration curve division<br>Fundamental parameter method<br>EZ scan (Qualitative analysis)<br>Application template<br>Analysis area automatic selection (mask size detection)<br>Peak deconvolution (Function and standard profile)<br>Background fitting (Multi-point function fitting and area designation)<br>Fixed precision analysis<br>Universal standard sample<br>Help function<br>E-mail forwarding function<br>Analysis simulation program (Analysis depth evaluation <i>etc.</i> ) |
| Optional Program       | SOX software<br>EZ scan (SOX)<br>Fixed angle measurement<br>SOX thin-film analysis<br>Theoretical overlap correction<br>Drift correction library<br>Photoelectron FP method<br>He atmosphere correction<br>Sample film correction<br>Impurity correction<br>Matching library<br>SOX scattering X-ray FP method<br>Material judgement<br>Quantitative scattering X-ray FP method<br>Quantitative FP theoretical overlap correction<br>Fusion disk correction (flux evaporation)<br>Charge correction<br>Program operation<br>Time preset analysis<br>Energy-saving<br>Auto power off<br>Sample observation mechanism<br>Point/mapping function<br>Remote control function (VCP)  |

#### 4. Installation Requirements

|                               |   |
|-------------------------------|---|
| Outside Dimensions and Weight | Spectrometer main unit: 1310(W)×880(D)×1325(H), Weight: 490 kg<br>X-ray generator and heat exchanger: 660(W)×480(D)×625(H), Weight: 110 kg<br>Vacuum pump: 500(W)×183(D)×250(H), Weight: 27 kg×2<br>Personal computer table: 1000(W)×800(D)×700(H), Weight: 30 kg (Example)<br>The X-ray generator, heat exchanger and vacuum pumps are housed in the main unit |
| Utilities                     | Power requirements: Three phase 200 V 35 A, single phase 100 V 15 A<br>Room temperature: 15–28°C<br>Humidity: Less than 75% RH<br>Cooling water:   Water temperature: Less than 30°C<br>Pressure: 0.29–0.49 MPa<br>Flow rate: 5 L/min. or more  |