

X-ray fluorescence spectrometer

ZSX Primus 400



1. Introduction

X-ray fluorescence analysis is well-known as a non-destructive elemental analysis method. Sample preparation for the XRF technique can be performed quickly and easily, especially for solid samples. A wavelength dispersive type X-ray fluorescence spectrometer (WDXRF) has highly precise performance, so WDXRF is used for sample analysis in process and production control in many manufacturing industries. A sequential type WDXRF, which can analyze from oxygen to uranium using default optical configurations, is used for a variety of materials such as in R&D and acceptance inspections, etc. A high-performance WDXRF equipped with a sample stage and a sample observation system can perform small point analysis and area mapping. This function can apply to the inspection for abnormalities and the analysis of inclusions or inhomogeneity in manufacturing products. Thus, WDXRF has expanded its application field beyond conventional elemental analysis.

Rigaku's ZSX Primus family of WDXRF spectrometers is composed of the following instruments: ZSX Primus IV, a high-performance XRF with tube-above optics; ZSX Primus, high-performance with tube-below optics; and ZSX Primus III+, standard XRF with tube-above optics. Because all of these spectrometers use a sample holder system during measurement, sample specimens must be smaller than the dimensions of a sample holder. There are, however, numerous demands for WDXRF analysis to be performed on samples in their original product size without any processing. In order to resolve these sample size limitations, the new ZSX Primus 400 has been developed based on the earlier ZSX400 and released as a member of the ZSX Primus family,

incorporating many of the latest functions of ZSX Primus IV.

2. Features of ZSX Primus 400

ZSX Primus 400 has a tube-below optical system and is equipped with a high-performance 4kW X-ray tube with an ultra-thin beryllium window. Up to 10 analyzing crystals are available for this spectrometer. These analyzing crystals cover a wide elemental analysis range, from beryllium to uranium. ZSX Primus 400 has 5 diaphragms (mask collimators) and the minimum measurement diameter is 0.5mm. The sample stage is standard equipment to enable mapping analysis. When a sample observation camera system is optionally installed, positions for small spot analysis and areas for mapping analysis can be precisely determined on the captured sample image.

The strongest feature of ZSX Primus 400 is its high flexibility in size and shape of measurement samples. The maximum size is 400mm in diameter and 50mm in thickness. The maximum weight is 30kg. The sample adaptor system adopted in ZSX Primus 400 provides the flexibility in sample size and shape (Fig. 1). A multiple sample adapter that can hold several samples at once is available in addition to the adaptor for single large samples. Using this, consecutive analysis can be easily performed for these multiple samples, and mapping analysis can be performed on each sample on the multiple sample adapter. Custom-made adaptors are also available for different sizes, shapes and numbers of samples.

Additionally, in order to perform with high reliability with the flexibility to safely analyze wider variety of sample type, protection and safety functions for

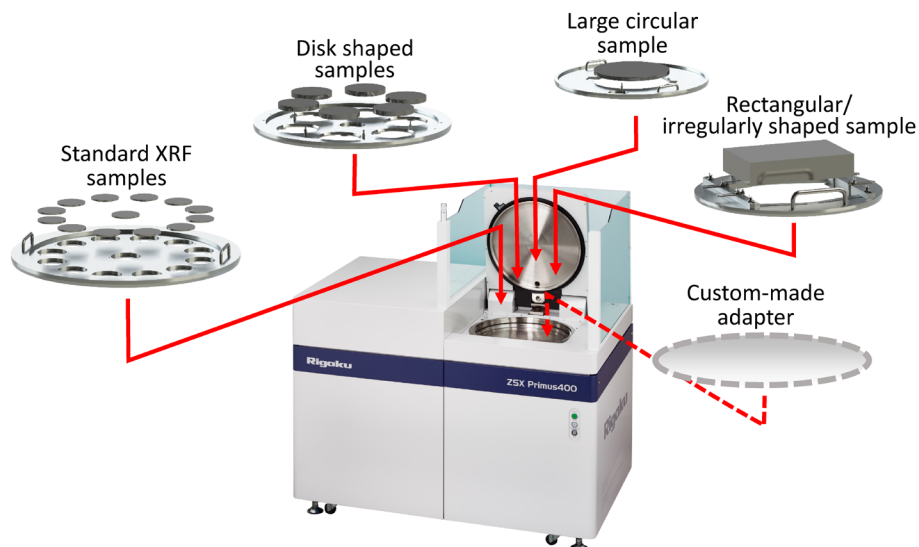


Fig. 1. Adapter system.

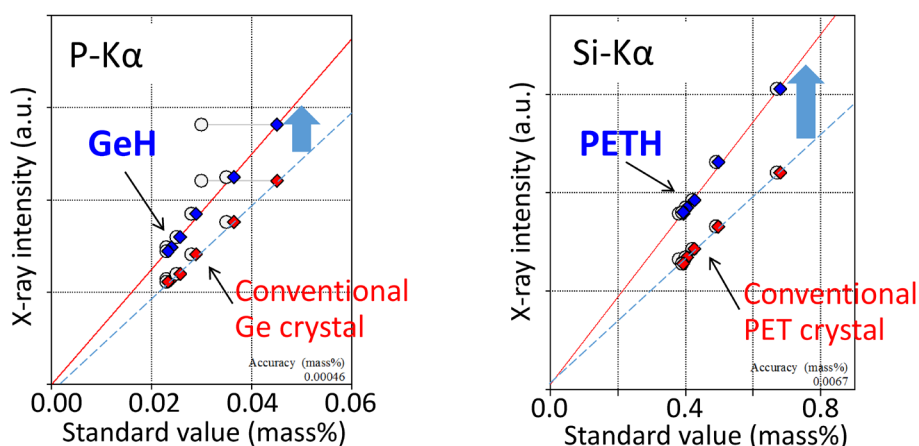


Fig. 2. Improvement of sensitivity with new, GeH and PETH crystals. Calibration curves for phosphorus and silicon in stainless steel.

spectrometer and samples are available.

The major changes from the earlier ZSX400 are described below.

3. Improved function

3.1. ZSX Guidance operation

ZSX Guidance, the latest control software for the ZSX Primus family, is installed in ZSX Primus 400. ZSX Guidance, first installed in ZSX Primus IV, has been developed to significantly improve instrument usability. ZSX Guidance features a number of convenient functions implementing Rigaku's expertise in WDXRF analysis.

3.2. Highly sensitive analyzing crystals

The new high-sensitivity analyzing crystals PETH and GeH, first adopted in ZSX Primus IV, are installed in ZSX Primus 400 as standard analyzing crystals. PETH and GeH are curved crystals that provide 30% higher X-ray intensities than conventional flat crystals. Using these crystals, high-sensitivity measurements

can be performed from aluminum to chlorine. Figure 2 shows comparisons between these new analyzing crystals and conventional crystals. In addition, a new synthetic multilayer, RX85, is optionally available for beryllium and boron analysis. RX85 also improves X-ray intensity by 30% compared to a conventional synthetic multilayer.

3.3. Primary beam filters

ZSX Primus 400 is equipped with the same 4 primary beam filters, as other members of the ZSX Primus family. A fundamental parameter (FP) sensitivity library using primary beam filters is also available in ZSX Primus 400.

Diffraction peaks line elimination filters are optionally available. These can reduce diffraction peaks in single crystal sample analysis.

3.4. Sample observation system

The imaging camera in the sample observation system has been upgraded to a 5 Mega pixel device. This allows

users to specify smaller measurement points and/or areas in high-resolution sample images during micro mapping analysis.

4. Enhancements for safe/secure analysis

4.1. Main chamber protection film

The main chamber protection film is available to prevent fallen samples from causing damages to the optical system (optional, 30mm measuring diameter only). If a sample fall occurs, this film prevents damage to optics in the main chamber so that the instrument can be returned to service quickly.

4.2. X-ray tube protection filter

A beryllium filter to protect the X-ray tube window can be optionally installed as one of the primary filters. If a sample fall occurs, this filter prevents sample from falling directly on the X-ray tube window.

4.3. Sample protection

A primary beam filter is used to eliminate interference X-rays from the X-ray tube and reduce background to improve S/N. At the same time, a primary filter is

effective in blocking heat from the X-ray tube, reducing sample damage. EZScan, the semi-quantitative analysis program integrated in ZSX Guidance, has a preset/default measurement condition using primary beam filters, which can reduce sample damage due to heat and X-ray irradiation. Additionally, if the spectrometer stops measurement during sample analysis, a Ni400 filter, the most effective for blocking heat and X-ray irradiation, is automatically set to protect sample.

5. Summary

ZSX Primus 400 has been developed to have similar capabilities and functions as other members of the ZSX Primus family, but can perform analysis on larger samples that are difficult for other ZSX Primus instruments. ZSX Primus 400 can analyze a variety of sized and/or shaped samples, but can also perform individual mapping analysis on multiple samples on a single adapter. These unique functions demonstrate that ZSX Primus 400 is capable of performing unprecedented new analysis, as well as conventional analysis for R&D, process and production control.