Benchtop wavelength dispersive X-ray spectrometer

1. Introduction

In recent years, with new developments in industrialized countries, there are increasing demands for the analysis of rare metals and other mineral resources. Supermini, a 200-W benchtop wavelength dispersive X-ray fluorescence spectrometer (WDX), has been developed to meet these demands. Supermini is a compact sized benchtop instrument without requiring cooling water, and this makes it easy to install and operate. Elements from light elements including Na and F to heavy elements can be analyzed with high precisions.

2. Features

2.1. Wavelength dispersion

WDX has the following two advantages compared to EDX (energy dispersive X-ray fluorescence spectrometer):

(1) Excellent sensitivity for analysis of light elements.
(2) Excellent spectral resolution and practically very few overlaps.

Although the size of an ordinary WDX spectrometer is larger in comparing to that of an EDX spectrometer, Supermini and its former model Primini are compact sized benchtop WDX spectrometers. Figure 1 shows a comparison of spectra of F and Na obtained using a Supermini and an EDX.

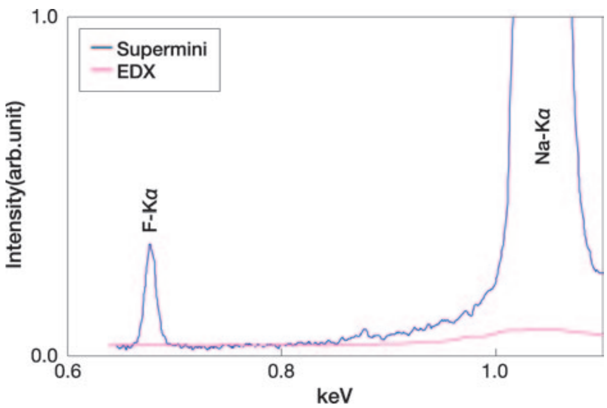

Fig. 1. Comparison of spectra obtained using Supermini and EDX: sample: Opal glass NIST91.

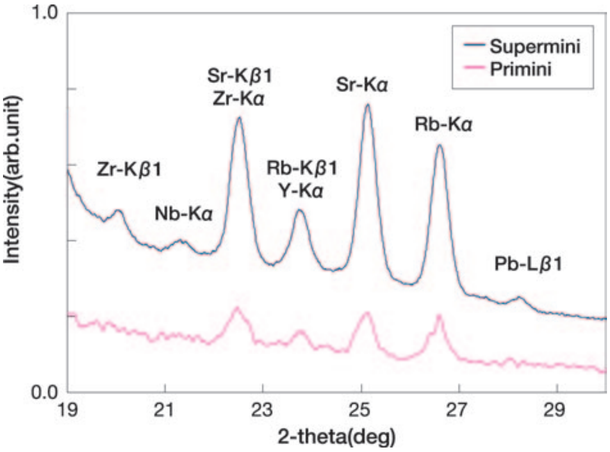

Fig. 2. Comparison of spectra obtained using Supermini and Primini, sample: Rock GSJ JG-1a.

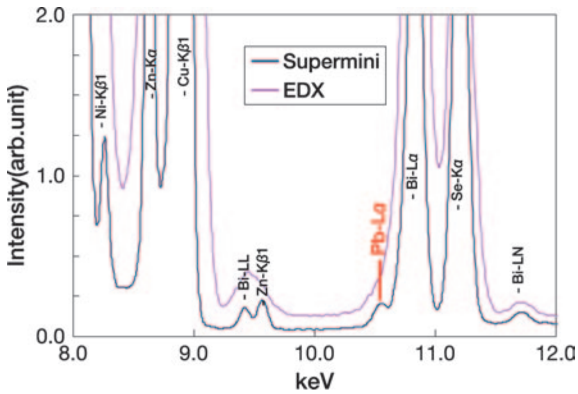

Fig. 3. Spectra of Pb, Se and Bi in bismuth bronze, sample: MBH32X SEB3 Pb 0.109%, Se 1.42% and Bi 5.4%.

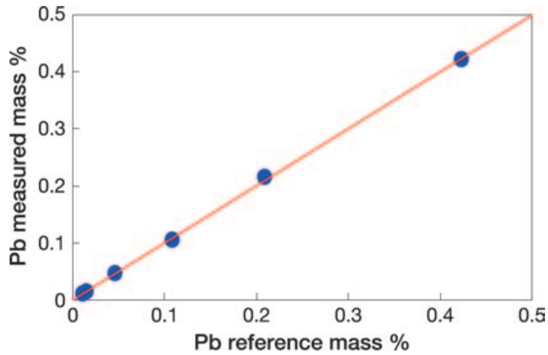

Fig. 4. Correlation between measured values and reference values of Pb in bismuth bronze.

2.2. High output power

The former product Primini is a benchtop WDS having a 50-W X-ray output power, and is used extensively for analyses of the thicknesses of metal platings, the amount of Si deposit on a film, etc. While keeping the compact size and light weight of Primini, Supermini is equipped with a new high power X-ray tube, which greatly enhances the fluorescence sensitivity by 4 to 6 times than that of Primini. Supermini can be used for wide range of applications from a production-control analysis to an environmental analysis. Figure 2 shows a comparison of spectra of heavy elements obtained by measuring a rock sample using Supermini and Primini.

2.3. Simple benchtop instrument

Supermini is not only compact in size but also free from cooling water and liquid nitrogen, and it can easily be installed and simple to operate.

2.4. High resolution and high sensitivity

The X-ray fluorescence (XRF) analysis method is widely used for the elemental analysis of WEEE/RoHS and ELV directives. Recently, the XRF analysis of metal-element concentrations, such as Pb in lead-free solder and bismuth bronze in ELV directives, has gained increasing attentions. Figure 3 shows a comparison of the spectra obtained from a bismuth bronze sample using a Supermini and an EDX. The Pb Lα and the Bi Lα peaks are clearly separated in the high-resolution WDS spectrum. This allows the detection of hazardous trace elements such as Pb presented in a bismuth bronze sample from a high-sensitivity WDS spectrum. Figure 4 shows the correlation of the standard values and the X-ray analysis values in the quantitative analysis of Pb in the bismuth bronze sample. Accuracy of 0.0040% and the detection limit of 0.0013% are obtained from these data.

Since a voltage up to 50 kV can be operated in the X-ray tube of a Supermini spectrometer, heavy elements with higher sensitivities than those from a Primini spectrometer can be obtained. Supermini is equipped with an automatic primary X-ray filter exchange mechanism, a trace amount of Cd can therefore be easily detected.

2.5. Simple operation and user-friendly software

Supermini adopts the same software as the one used in a scanning fluorescence X-ray spectrometer, the ZSX Primus series. This software has a well-established reputation in its simple operation and high performance. A theoretical overlap correction function is added to the fundamental parameter method (FP method) SQX software*[1] (optional), which is capable of analyzing an unknown sample without using standard samples, Also, accurate concentration values in a semi-quantitative analysis can be obtained using the EZ scan*[2]. Figure 5 and Table 1 show the qualitative analysis chart and the semi-quantitative analysis results from a pressed pellet of a rock sample (GSJ JG1a).

*[1] Semi-quantitative analysis software using the FP method.
*[2] Analysis method capable of performing a semi-quantitative analysis with simple operations.

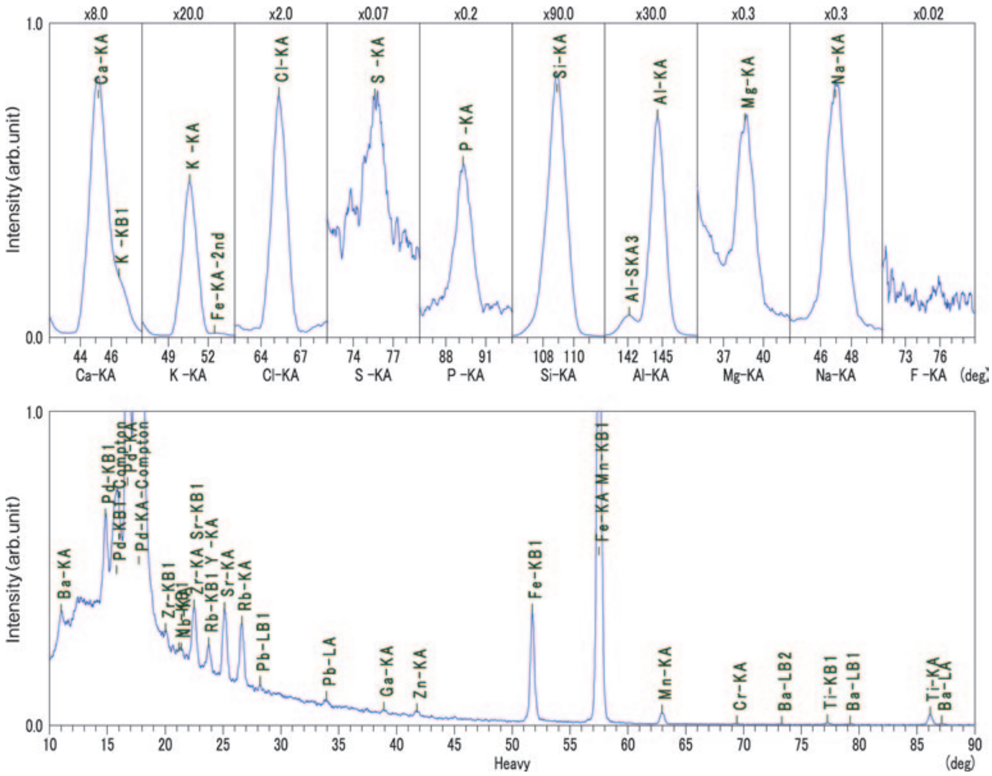

Fig. 5. Qualitative analysis charts for a granite rock sample.

Table 1. Semi-quantitative XRF analysis results on the major and trace components in a granite rock pressed sample, GSJ-JG1a, using the SQX software.

Major component	Standard value mass%	Analysis value mass%
Na_2O	3.41	3.36
MgO	0.69	0.63
Al_2O_3	14.22	14.36
SiO_2	72.19	72.54
P_2O_5	0.08	0.08
K_2O	4.01	3.93
CaO	2.13	2.35
TiO_2	0.25	0.24
Fe_2O_3	2.05	2.09
Trace component	**Standard value ppm**	**Analysis values ppm**
Cr	18.6	24
Zn	38.8	35
Rb	180	183
Sr	185	188
Y	31.6	36
Zr	121	106
Nb	12	7
Ba	458	486
Pb	27	31