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Portable X-ray Spectrometer

Portarix

1. Introduction

Conventional X-ray spectrometer systems are designed for use in the laboratory, where samples are collected in the field and brought into the lab for preparation and analysis. Of course, some special systems are incorporated into plant production lines to perform automated sample collection, preparation and analysis. However, criminal investigations and archaeological, geological and environmental studies increasingly are demanding on-site analysis to achieve the fastest analysis of as many samples as possible. Additionally, there is a growing need to analyze samples in-situ, either because they cannot be separated, such as a part in a permanent structure, or because the sample cannot be transported. The Portarix, as the name suggests, was developed as a portable unit to provide on-thespot, in-situ analysis without removing and preparing samples wherever possible. It is an energy dispersive type X-ray spectrometer. As a compact, lightweight instrument, the Portarix employs a miniature X-ray tube and an electronically cooled semiconductor detector system that does not require liquid nitrogen. To handle a variety of sample shapes and sizes, its measuring probe and signal processor (controller) are separated from each other. Optically, primary X-rays are directed into a very small focus (1 mm dia,) and monochromatized with a cylindrical monochromator to make practical low-background measurements practical. Software for automatic qualitative and semiquantitative analysis is provided to ensure that on-site analysis is a simple procedure.

2. Features

(1) All-in-one portability:

The measuring probe and controller can be stored in a carrying case for ease of transport (Fig. 1). In the field, the operator simply opens a lid and make connection to the power supply, and the system is ready for analysis. In addition to a IOOV/200V AC power supply, the system is also adaptable to a portable generator or a car battery.

(2) Accommodates a variety of sample shapes and sizes:

When a sample is too large to be placed in the sample chamber or when the sample is part of a permanent structure that cannot be separated or transferred, measurement can be made by applying the measuring probe to the sample. Fig. 2 shows an example using an optionally available dedicated stand. Liquid and powder samples can be analyzed by varying specially provided sample holders.

(3) Low-background measurement:

Primary X-rays are monochromatized with an analyzing crystal to ensure an extremely low background level for measurement data.

(4) Analysis of a very small region (1 mm dia.):

Fig. 1. Example of carrying

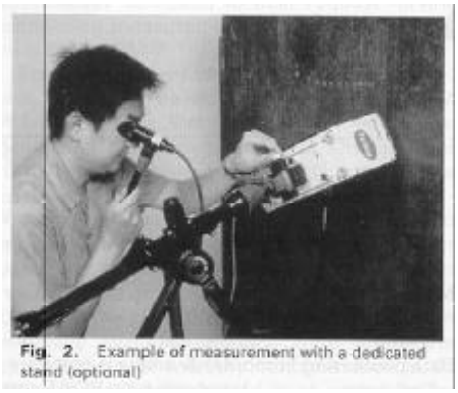

Fig. 2. Example of measurement with a dedicated stand (optional)

The outline of the measuring probe optics is shown in Fig. 3. With a cylindrically bent analyzing crystal, primary Xrays are focused on an area of less than Imm diameter. This makes it possible to analyze not only a very small sample but a very small foreign substance which may be present on the surface of a large sample.

(5) Electronically cooled semiconductor detector system:

The detector uses an electronic cooling system Si-PIN photodiode designed to perform cooling by the Pertier effect instead of using liquid nitrogen. This contributes to accurate analysis characterized by high energy resolution (< 300eV at 5.9 keV).

(6) Air cooling system for miniature X-ray tube:

A miniatures X-ray tube by an air cooling system is used as the excitation source for primary X-rays. Unlike conventional portable units, radioisotop is not used and analysis can be carried out safely and simply. Also, the air cooling system makes it unnecessary to use cooling water.

(7) A Notebook PC is standardly provided:

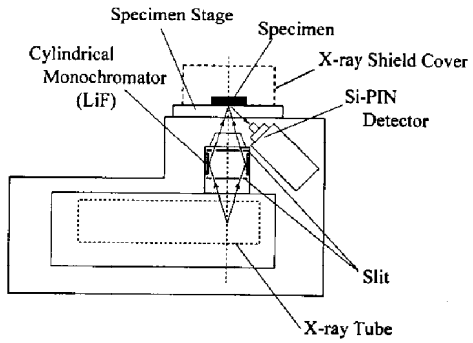

Fig. 3. Outline of measuring head optics

For analytical processing, a 32-bit notebook PC is provided. This PC can be stored in the controller carrying case for transportation.

(8) Software for automatic qualitative and semi-quantitative analysis:

Upon completion of measurement, the system automatically performs qualitative analysis and then to semiquantitative analysis, referred to as "order analysis" which does not required a standard reference sample. Manual designation for detected elements is also possible. The analysis software provided is easy to use to be run on Windows 95.

3. Measurement Example

Fig. 4 shows an example of qualitative analysis of red colored paint fragments of car. It is quite obvious that elemental composition is different between two red colored specimens.

4. Specifications

External dimensions & weight

Measuring head:	110 m m(W) x 280 mm (D) x 163 mm(H), approx. 6 kg
Controller:	580 mm(W) x 420 mm(D) x 230 mm(H), approx, 17 kg (Total weight in carrying: approx. 27 kg)

X-ray tube

Target:	Mo
Voltage-current:	35 kV-1 mA
Cooling:	Forced air cooling by oil immersion and fan

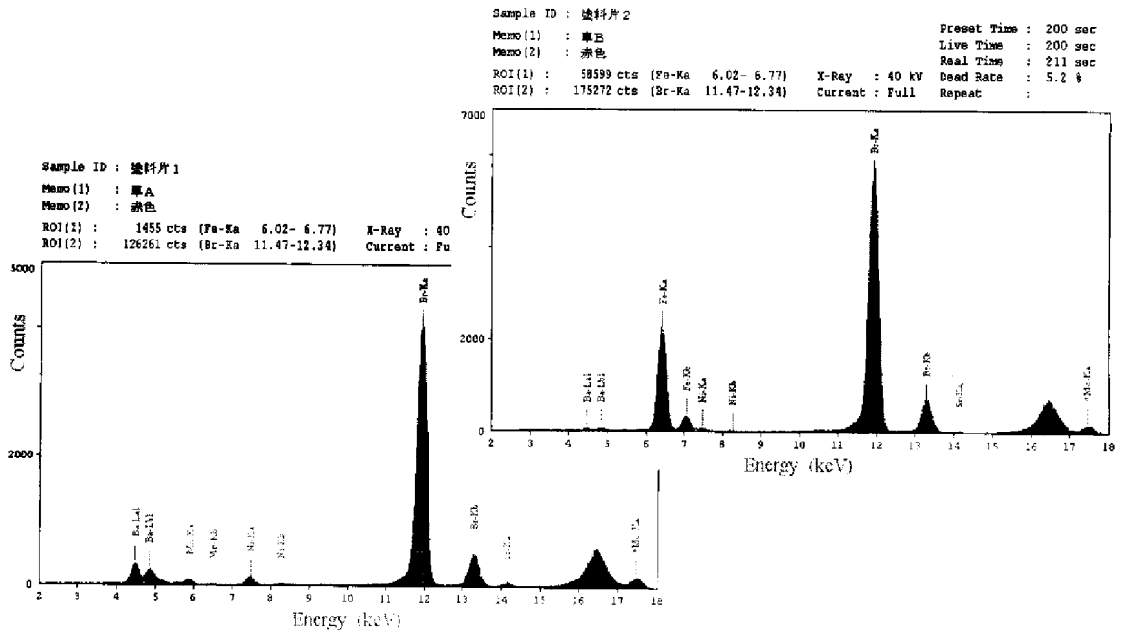

Fig. 4. Qualitative analysis example

Detector

Type:	Electronic cooling system Si-PIN photodiode
Energy resolution:	300 eV (FWHM, at 5.9 keV) or less
Measurement atmosphere:	Air

Monochromator

Analyzing crystal:	LiF (200)
Shape:	Cylindrical

Data processing computer & analysis software

Computer:	Notebook type PC/AT compatible
OS:	Windows 95®
Analysis software:	Automatic qualitative analysis and automatic semi-quantitative analysis software

Required power: 100 V/110 V/200 V/220 V AC, 50/60 Hz, less than 200 VA

Optional items:

Color printer

Fiber scope

Dedicated stand (tripod)

Inverter for car battery (12V DC→100V AC, 200 W)

Portable generator (100 V AC, 300 W)

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