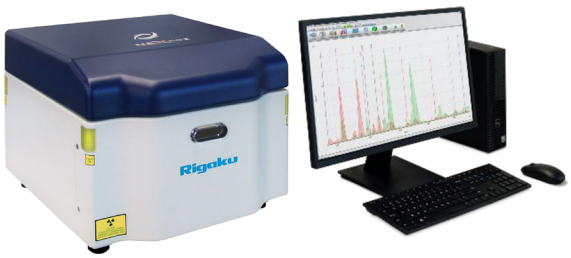
Energy Dispersive X-ray Fluorescence Spectrometer

—Advanced Cartesian Geometry EDXRF—

NEX CG II



Introduction

NEX CG II is a multi-element, multi-purpose energy dispersive X-ray fluorescence (EDXRF) spectrometer that performs rapid qualitative and quantitative trace elemental analyses and addresses needs across many industries. This next-generation, high-end spectrometer is ideal for trace heavy metal and halogen analysis, which is in increasing demand for several sectors. These capabilities make NEX CG II especially well-suited for trace element analysis for environmental monitoring, industrial waste applications, recycled materials, electronic components, pharmaceutical materials, cosmetics, and many others. Additionally, NEX CG II provides non-destructive analysis of sodium (Na) through uranium (U) in almost any matrix—from oils and liquids to solids, metals, polymers, powders, pastes, coatings, and thin films.

Unlike conventional EDXRF spectrometers, NEX CG II is an indirect excitation system using secondary targets rather than tube filters. Monochromatic and polarized excitation from secondary targets in full 90° Cartesian Geometry eliminates background noise and delivers exceptionally low detection limits of less than 1 ppm. Its three-dimensional (3D) Cartesian Geometry optical configuration and high-performance large-area silicon drift detector (SDD) offers superior analytical capabilities for elements in highly scattering matrices like water, hydrocarbons, and biological materials. NEX CG II excels in complex applications with trace elements and variable-base matrices, such as testing agricultural soils and plant materials, analyzing finished animal feeds, and measuring waste oils.

1. Characteristics

Table 1 shows the main specifications of NEX CG II.

Table 1. NEX CG II specifications.

Items	Specification	
Element range		Na to U
X-ray tube	Air-cooled	Target: Pd, max 50 W (max voltage 50 kV)
Detector		SDD (silicon drift detector)
Secondary targets	Automatic switching	Five standard polarization and secondary targets for optimum excitation
Atmosphere		Air (standard)/vacuum, helium (option)
Measuring diameter		20 mm
Sample chamber	Chamber size	Diameter 325 mm × height 75 mm
	Sample stage	・Flat window ring sample stage (standard) Optional trays: ・15-position sample tray (for sample size ϕ32 mm) ・10-position sample tray (for sample size ϕ40 mm) ・9-position sample tray (for sample size ϕ52 mm) ・10-position sample spinner tray (for sample sizes ϕ32 mm to ϕ40 mm)
Data processing	Laptop PC/desktop PC	Microsoft® Windows® operating system, QuantEZ® software
Dimensions, weight		463 mm (W) × 492 mm (D) × 382 mm (H) Approximately 65 kg

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Cartesian Geometry EDXRF

The optics of NEX CG II adopts Cartesian Geometry, as shown in Fig. 1. The 3D arrangement between the X-ray tube, secondary target, measurement sample, and detector reduces and virtually eliminates the Bremsstrahlung background that could interfere with analysis, allowing more elemental signal in the detector for excellent detection of trace peaks in many matrices.

A new level of analytical sensitivity

NEX CG II is a second-generation spectrometer that builds on NEX CG's legacy of using Cartesian Geometry and secondary targets for trace-level sensitivity. NEX CG II features a unique and improved close-coupled Cartesian Geometry optical kernel that dramatically increases the signal-to-noise ratio and delivers enhanced elemental analysis. Users can measure ultra-low and trace element concentrations, even in challenging sample types.

NEX CG II achieves this superior analytical power with a 50 kV 50 W end-window palladium-anode X-ray tube, five secondary targets covering the complete elemental range sodium through uranium (Na–U), and a large-area high-throughput SDD. The 3D optical kernel, combined with Rigaku's advanced RPF-SQX Fundamental Parameters (FP) software, delivers the most sensitive EDXRF measurements and brings a new level of analytical sensitivity to XRF technology.

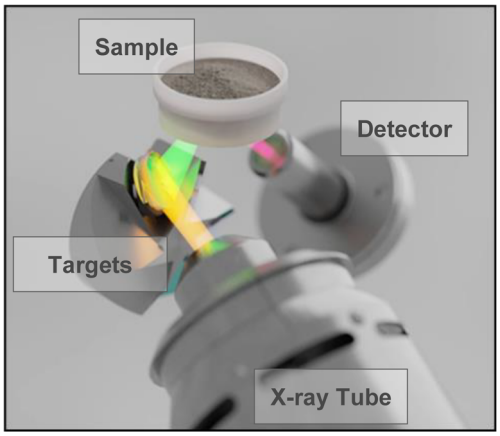

Fig. 1. Structure of Cartesian Geometry.

Measurement element, analysis diameter

Analysis can be performed from sodium (Na) to uranium (U) under vacuum and helium atmosphere (from aluminum (Al) to uranium (U) under air). The analysis diameter is 20 mm.

Five secondary targets

Five types of secondary targets are built in as X-ray excitation sources. When creating measurement conditions for the desired application, the appropriate secondary target is automatically selected according to the energy region of the components (analytical lines) of interest. The measurement can be performed under highly sensitive conditions for elements in a wide energy range since the most appropriate excitation X-ray line can be selected for each element.

Large sample chamber and automated sample handling

The large sample chamber (325 mm in diameter×75 mm in height) allows samples that are difficult to subdivide to be measured as is. Also, an optional removable sample tray can be utilized for continuous measurement of multiple samples. Three types of automatic sample trays can be installed: a 15-position sample tray (for 32 mm sample diameter), a 10-position sample tray (for 40 mm sample diameter), and a 9-position sample tray (for 52 mm sample diameter). The tray can be selected according to the size of the sample (Fig. 2).

A 10-position sample spinner tray accommodating sample diameters of 32 mm or 40 mm is also available as an option. Averaged composition information can be obtained for samples with high segregation.

Basic configuration can be selected according to the application

Helium purge, vacuum pump mechanism, and sample exchange functions are available as options, allowing users to select the configuration required to match their specific needs.

Software

User-friendly software supports measurement condition setting and analysis operation, contributing to high-sensitivity analysis in the field. Installed with

Fig. 2. Sample chamber and automatic sampling.

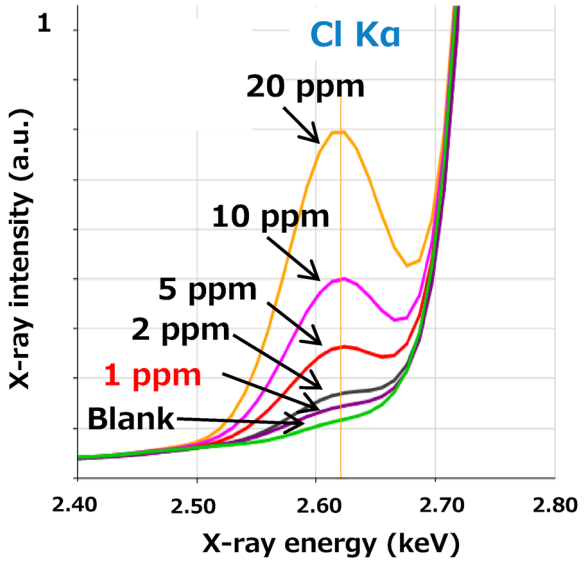

Fig. 3. Qualitative analysis spectrum near Cl Kα line in organic solvents.

the FP quantitative program RPF-SQX (Rigaku Profile Fitting–Spectra Quant X), standardless FP analysis can be performed for various samples without standard samples. Not only elemental analysis of solids or liquids but also thickness analysis of thin films such as plating can be performed.

In addition, the SQX Scattering FP method, which has been well received by the ZSX® Primus series and NEX CG, is included. Accurate analysis results can be obtained by performing balance component estimation, even though non-measurable components are unknown.

Given at least one sample of the actual material with known concentrations from a referee technique such as ICP, the software allows the user to quickly and easily create a Matching Library. This feature changes the analysis from semi-quant to fully quantitative and tunes the SQX FP theory to match the actual material and referee numbers.

Utility, smaller footprint

NEX CG II is operated on a 100 VAC power supply and does not require cooling water or liquid nitrogen. The enclosure measures 463 mm (W) × 492 mm (D) × 382 mm (H), achieving a footprint reduction of approximately two-thirds that of the first-generation NEX CG. With this reduction, there was also a reduction in the instrument's weight to approximately 65 kg.

Added user support functions with the Application Support Package

The Application Support Package allows data to be transported between users and Rigaku analysts with minimal data volume. It becomes easier to create various applications for support.

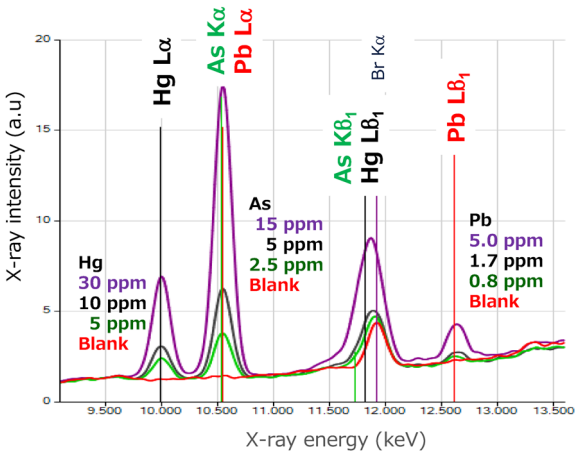

Fig. 4. Qualitative spectra of Pb, As, and Hg in cellulose.

2. Application examples

Analysis of trace amounts of chlorine (Cl) in organic solvents

Chlorine (Cl) in organic solvents used in manufacturing may cause corrosion or alteration of products, degrading their functions and performance.

NEX CG II uses a Pd target X-ray tube and monochromatic excitation X-rays using the RX9 polarization crystal as the secondary target so that the background is reduced, and high-sensitivity analysis of trace amounts of Cl can be realized. Peaks at the 1 ppm level chlorine can be observed (see Fig. 3). The lower limit of detection calculated from the calibration curve was 0.13 ppm at a measurement time of 300 seconds.

Trace heavy metal analysis of APIs and formulation samples

NEX CG II can also be used for the analysis of metal impurities in API (Active Pharmaceutical Ingredient) and formulation samples in pharmaceutical products, as well as elements that are categorized to class 1, 2A, and 2B in ICH Q3D (guideline). The spectrum of a sample containing trace amounts of class 1 (As, Pb, and Hg) is shown in Fig. 4. The ppm level peaks of these elements can be recognized.

3. Summary

NEX CG II is an advanced Cartesian Geometry EDXRF system that achieves LLD (lower limit of detection) of less than 1 ppm for trace heavy metal and halogen analysis. Moreover, it plays an active role in providing many industries and organizations with a reliable tool to solve their analytical needs.

Applications range from research and development to industrial and in-plant quality control and quality assurance. It is easy to use for non-technical operators yet powerful enough for expert use in commercial labs and R&D facilities. Users can achieve the lowest limits of detection and easily manage complex applications.