ELIO

- Portable Micro X-ray Fluorescence Spectrometer

Innovation with Integrity

Micro-XRF

The Portable X-ray Fluorescence Solution for Elemental Analysis of Large Objects

The ELIO is a compact and portable energy dispersive X-ray fluorescence spectrometer for reliable non-contact and non-destructive elemental analysis of valuable materials. It delivers high performance, accuracy and precision in the most demanding applications. The ELIO accelerates state-of-the-art in XRF analytical instrumentation with truly portable elemental map acquisition incorporating CUBE technology, accurate spot positioning, straightforward add-on hardware and mapping software.

Fields of application

- **Cultural heritage science** – in-situ scans of objects for archaeological studies, art authentication and conservation. The ELIO's portability saves users from having to transport – and possibly jeopardize – objects of immeasurable value.
- **Geoscience** – analysis of large drill core sections or other mineral samples. The sophisticated map and spectral analysis capabilities help scientists successfully work through the challenges of wide-ranging elemental content and high variability in geomaterials.
- **Materials science** – mobile scanning of elemental distribution in advanced materials for various applications ranging from space science to consumer products.
- **Food science** – elemental maps of plants allow to identify nutrient rich locations; and help understand the distribution of fortificants in processed foods.
- **Science education and research** – ultimate teaching and research tool to analyze objects and materials in the field, classroom or laboratory.

Setting Standards in Micro-XRF Analysis

Easy and fast non-contact measurements

- The ELIO features a simple and elegant design with a 1 mm laser-positioned analysis spot, an internal camera and innovative electronics.
- The measurement head is mounted on a tripod with two motorized stages to perform elemental map acquisition.
- The narrow nose enables access to measurement points and tight corners difficult to reach.
- The ELIO supports extremely fast measurements based on high excitation intensity and fast stage movement. The control software provides tools for even further acquisition time optimization.
- The large area silicon drift detector (SDD) with the advanced CUBE technology provide excellent throughput and signal-to-noise ratio.
- The state-of-the-art detector technology provides an energy resolution of < 140 eV at Mn Kα with high output count rate (OCR) and enables very fast analysis while preserving excellent energy resolution.
- The powerful 50 kV X-ray source combined with the close measurement geometry enable non-contact measurements within seconds.
- Flexible setting options for the X-ray tube anode, filters and collimators provide optimized performance for all applications of interest.

Truly portable

- The compact design of the measurement head mounted on a light-weight aluminum tripod makes the ELIO ideally suited for mobile use.
- The total weight of the measurement head is just 2.1 kg.
- The ELIO on a tripod is the most portable and lightest way to perform elemental analysis regardless of the sample size.
- Several tripod options are available to meet varying user requirements.
- Optional compact motorized XY stage provides a truly field portable mapping solution.

ELIO mounting options

Enhanced Performance

Filters set

The ELIO micro-XRF spectrometer can be equipped with several X-ray filters to optimize the excitation conditions for specific applications.

The user can select and easily change the best filter to increase the measurement sensitivity for particular elements of interest. This enables the analysis of trace elements on the parts per million (ppm) level for a variety of matrices.

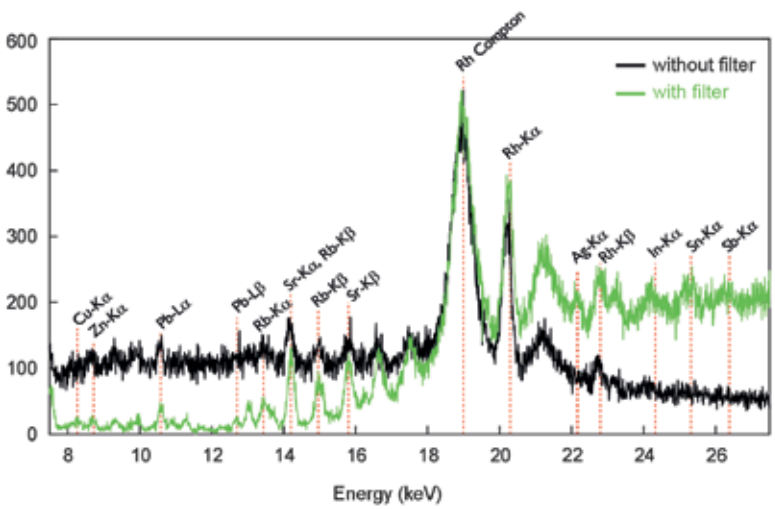
Available filters for analysis optimization:
- Aluminum
- Silver
- Copper
- Titanium
- Multilayer filters.

Light element sensitivity

ELIO's ability to work in helium atmosphere along with its low background and excellent energy resolution permit the detection of light elements.

Easy interchange of filters by the user

Measurement of trace elements in glass using an aluminum filter



Spectrum comparison of the NIST standard SRM612 with and without filtering. This silicate glass is widely used as reference material for various micro-analytical techniques and has been nominally doped with 61 trace elements at the 50 ppm level. Measurement time 60 s, collimator 1 mm, Rh anode with X-ray tube voltage of 50 kV. The tube current was normalized to have the same Rh scattered peak intensity. The spectrum measured with a filter clearly shows the excellent separation of the trace element peaks.

ELIO Control and Analysis Software

The ELIO's software is easy to use and provides accurate spectroscopic analysis. The software interface is user configurable and shows the spectrum and the element concentration while the acquisition is running. In the same screen the user can monitor other technical information as well as the sample image taken by video cameras.

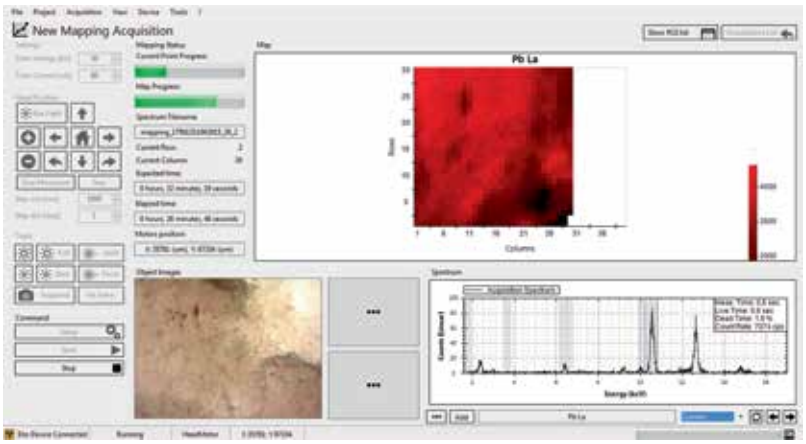
In addition to the integrated microscope camera, two video cameras can be connected to the ELIO.

Alignment lasers easily identify the measurement point and ensure the correct and safe distance between sample and measurement head.

The full spectrum is accessible and is saved with all information (images, sample composition). Each project file can include several measurements with spectra, images and analyses results.

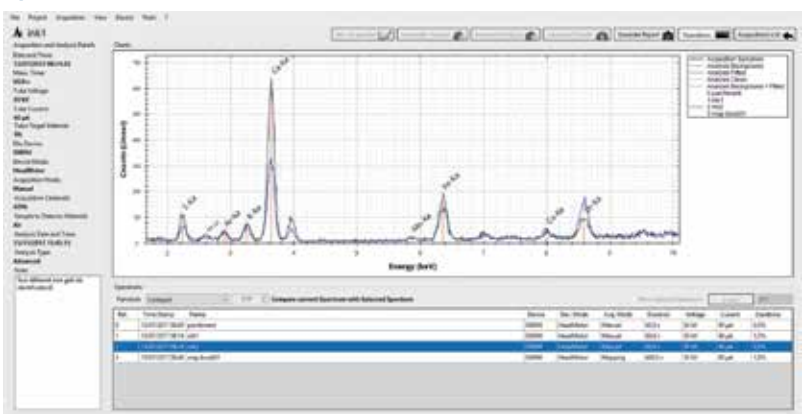
The ELIO's automatic peak ID provides a quick visual indication of elements in a sample. Estimated elemental concentrations calculated by the Fundamental Parameters (FP) method are displayed and updated during spectrum acquisition.

ELIO user interface



The ELIO software user interface provides quick access to all the key controls and measurement information. The image shows the map acquisition progress during the analysis of Pb in ceramics.

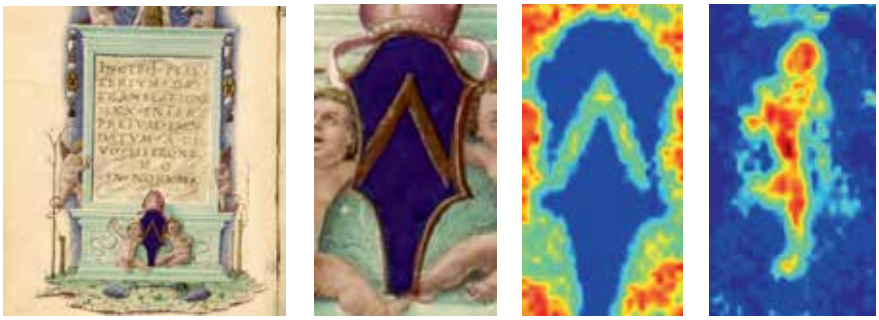
Spectrum viewer



The versatile spectrum viewer contains powerful functions for spectral comparison and evaluation. The overlaid spectrum of two different ink samples provides a quick overview of spectral differences.

Elemental Distribution Mapping System

Non-invasive analysis of an illuminated manuscript



The mapping system provides non-invasive analysis of multilayer objects. The elemental distribution maps identify hidden details in an illuminated manuscript of a prominent 15th century bishop. The spatial distribution of lead in different paint layers (Pb Mα from the surface layer, Pb Lα/Mα ratio) reveal a "lion" on the coat of arms, which was afterwards painted over by an inverted "V". (Mosca et al., *Microchemical Journal* (2016), Vol. 124, pp. 775-784).

Mapping and spectroscopy in a portable instrument

With the addition of its mapping option, the ELIO becomes the only truly portable industrial mapping system. The measurement head and mapping substructure remain light and compact, combined weighing only 3.3 kg.

Using the standard tripod, maps of up to 10 cm x 10 cm can be acquired with the full energy range to detect both light and heavy elements. The software stores an image for every pixel, allowing easy back-tracing of information.

Plug-in software for map acquisition and visualization

The ELIO mapping system comes with plug-in software for the acquisition and visualization of the maps. In a unique and easy-to-use software interface, the user can choose between both the Mapping and Spot Analysis modes. The software automatically calculates the estimated map completion time before starting the measurement.

Highly accurate sample spot positioning

The ELIO's 1 mm spot size enables the acquisition of high resolution maps with a level of detail consistent with the feature size of many works of art and historical documents.

Two video cameras can be connected to the ELIO along with the integrated microscope camera. LEDs provide sample illumination, while alignment lasers help position and identify the measurement point.

The easy-to-use map interface provides great features for image processing. In addition to elemental maps, it allows users to overlay an optical image.

Applications

Non-destructive portable XRF measurements with non-contact, yet precise sample positioning and elemental distribution mapping capabilities provide high-value analyses for multiple fields of applications.

Cultural heritage

Skilled and knowledgeable conservation scientists in leading museums, institutes and universities around the world use the ELIO to help research, authenticate, interpret and preserve natural objects and artifacts of artistic, cultural or historical significance.

The ELIO helps determine material, chemical and technical aspects of cultural objects for preservation of highly valued and priceless, but complex samples.

Qualitative, semi-quantitative, comparative and elemental distribution map analysis with the ELIO can be performed on diverse materials including architecture, furniture, adornments, sculpture, textiles and manuscripts. For art conservators, the investigation of pigments, coatings and binders with the ELIO provides essential information for the preservation of paintings and other objects.

Materials science

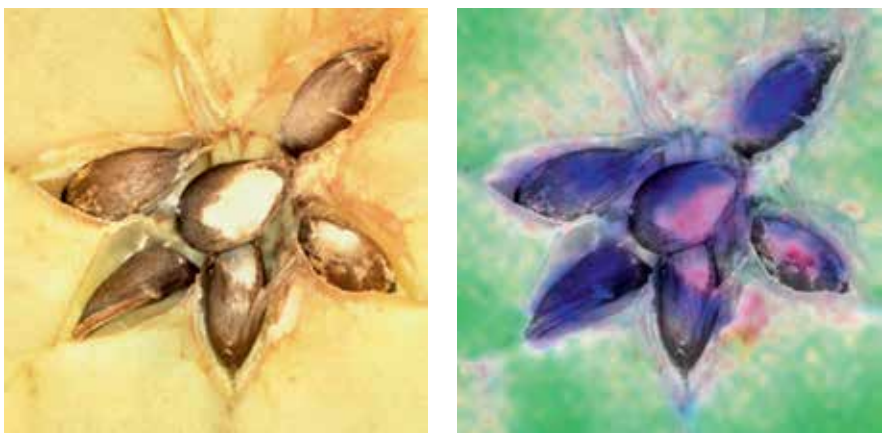
Intricate development and processing of advanced materials are required for electronics, aerospace, automotive, coatings, and energy storage products. From space science to consumer products, the study of elemental distribution in these materials is critical.

For example, low-temperature co-fired ceramic (LTCC) is utilized in industrial electronic multilayer packaging. The independent layer processing requires real-time information on the distribution of major elements, such as gold and lanthanum, which the ELIO delivers.

Food science

Nutrients and dietary minerals, like phosphorus, potassium and calcium are essential for human biochemical processes. Mapping the relative abundance of nutrients in food, such as apples, with the ELIO helps quickly identify nutrient-rich locations and understand the distribution of fortificants in processed foods. Portable XRF also supports research for the optimization of surface treatments for preservation of products during storage and transport.

Apple core slice



Left: optical image of an apple core slice; Right: elemental distribution map with Ca (blue), K (green), and S (red).

Technical Specifications

Excitation	Rh-target microfocus-X-ray tube (Au, Ag, Mo, W on request), 10 – 50 kV, 5 – 200 µA, 4 W Several filters available: Al, Ag, Cu, Ti, ...
Detection	17 mm² SDD with CUBE technology, energy resolution < 140 eV for Mn Kα, optional 50 mm² large area SDD
Collimation	1 mm (other sizes optionally available)
Analysis range	Na (Z = 11) to U (Z = 92), light elements capable down to Na with optional He purge
Alignment and monitoring	Integrated video microscope camera for magnified image of the analysis area, field of view ~ 10 mm x 10 mm. External USB HD video camera for large field of view images, axial and focal laser for precise analysis point adjustment.
Scanning	Motorized XY stage (optional), mounted on a tripod for 1D or 2D mapping with a total travel of 100 mm x 100 mm. Fully integrated mapping software for automatic control and map visualization.
Software package	Sophisticated software including instrument control, data acquisition, data evaluation and presentation and report generation in one easy-to-use interface.
Analysis	Single point (spot) and distribution (mapping) analysis, spectral deconvolution for qualitative analysis and standardless FP for semi-quantitative analysis.
Dimensions and weight	Measurement head W x D x H: 170 mm x 265 mm x 170 mm, weight 2.1 kg Tripod with geared column: weight 4.3 kg, height adjustment 43 cm – 188 cm, Fine positioning plate: length 120 mm
Power supply	Voltage: 110/230 V ± 10% Phase: 50/60 Hz Maximum power: 66 W 6 – 8 h operation with 12 V 8 Ah battery

Bruker Nano GmbH
Berlin · Germany
Phone +49 (30) 670990-0
Fax +49 (30) 670990-30
info.bna@bruker.com

www.bruker.com/elio