



MICRO-XRF

ELIO

Portable Micro X-ray Fluorescence
Spectrometer

Innovation with Integrity

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 nondestructive elemental analysis of valuable materials. It delivers high performance, accuracy, and precision for the most demanding applications.

The ELIO improves the 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.

Micro-XRF analysis of a miniature painting

The ELIO spectrometer is used to analyze the otherwise invisible original painting underneath the later applied overpainting. Sample courtesy of Fitzwilliam Museum, Cambridge, UK

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.
- **Material science** – mobile scanning of elemental distribution in advanced materials for various applications ranging from space science to consumer products.
- **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 an intuitive 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 mapping.
- 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 provides highest signal quality, excellent throughput and best signal-to-noise ratio.
- The state-of-the-art detector technology provides an energy resolution of < 140 eV at Mn $K\alpha$ with high output count rate (OCR) and enables very fast analysis while retaining excellent energy resolution.
- The powerful 50 kV X-ray source and the close measurement geometry allow non-contact measurements within seconds.
- The ELIO is easy and quick to set up and very flexible in terms of its positioning in front of the sample.

Truly portable

- The compact design of the measurement head and the lightweight aluminum tripod makes the ELIO ideally suited for mobile use.
- The total weight of the measurement head is just 2.1 kg.
- The tripod-mounted ELIO is the most portable and lightest way to perform elemental analysis regardless of the sample size.
- The optional compact motorized XY stage provides a truly field portable mapping solution.



Enhanced Performance

Filter 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.

There are different standard and customizable filters available for optimizing the following applications:

- Metals
- Heavy metals
- Chlorine and sulfur
- Trace elements.



Filter set for easy filter change by the user.

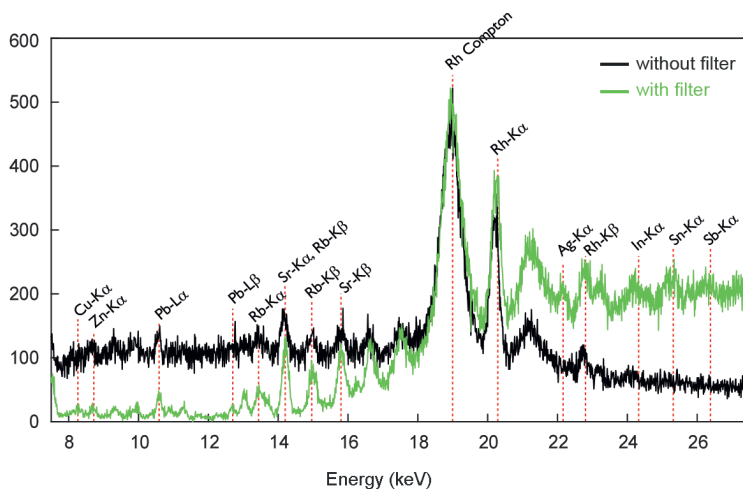
Light element sensitivity

The ELIO's integrated helium purge function along with its low background and excellent energy resolution permit the detection of light elements.

Measurement of trace elements in glass

The NIST SRM612 silicate glass standard 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. Comparing spectra measured with and without filter clearly shows how the aluminum filter significantly improves separation of the trace element peaks (measurement time 60 s, collimator 1 mm, Rh anode with X-ray tube voltage of 50 kV, tube current normalized for same Rh scattered peak intensity).energy resolution permit the detection of light elements.



Spectrum comparison of NIST standard SRM612 with and without filtering.

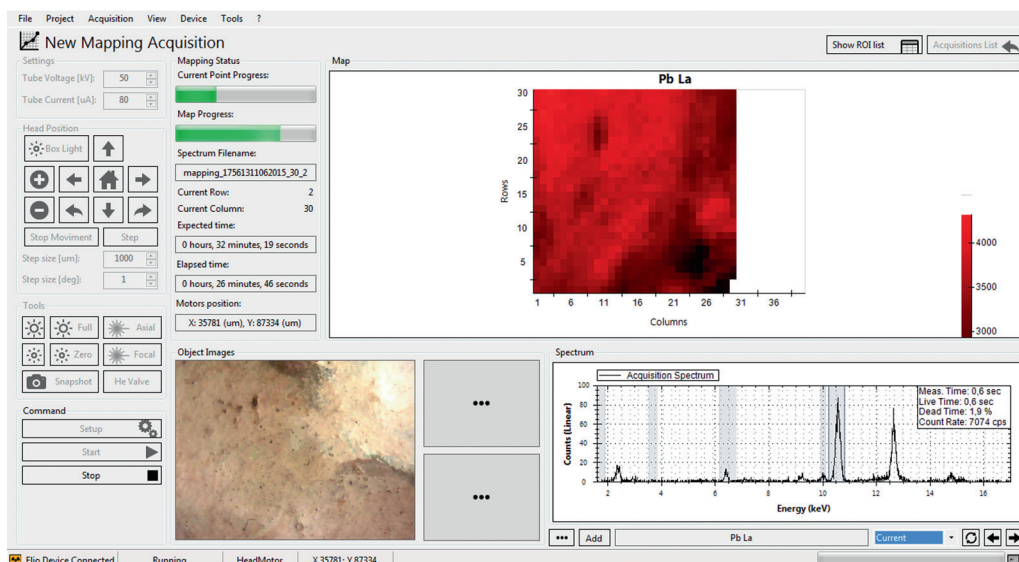
ELIO Control and Analysis Software

The ELIO's software is easy to use and provides accurate spectroscopic analysis as well as powerful tools for spectra comparison. 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.

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 optional automatic XRF peak identification provides a quick visual indication of elements in a sample. Estimated element 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.

ESPRIT Reveal Analysis Software

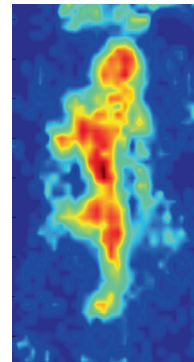
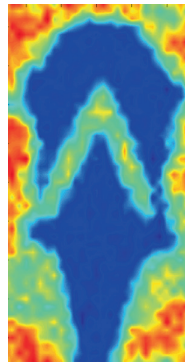
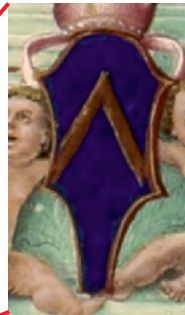
ESPRIT Reveal is an analytic software for XRF spectra and maps. The software offers a wide range of tools for detailed post processing of data acquired with the ELIO software. With an easy-to-use interface and high-performance ESPRIT Reveal is the ideal option to support your ELIO research activities with even more detailed analysis capabilities.

The software can visualize the distribution for each element as layer on top of a visual image of the sample. Elements are automatically identified in both spectra and maps.

The deconvolution allows to separate elements with similar emission energies. The semi-quantitative analysis allows an estimate of the full sample composition or parts of it chosen by the user.

English, Chinese, French, German, Spanish, Russian, and Japanese are available as languages for the user interface.

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 manuscript of a prominent 15th century bishop. The spatial distribution of lead in different paint layers (Pb M α from the surface layer, Pb L α /M α 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 XRF mapping system. The measurement head and mapping substructure remain light and compact, weighing only 3.3 kg in total.

Using the 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 ELIO software can store an image for every pixel, allowing easy back-tracing of information.

Intuitive software for map acquisition and visualization

The ELIO mapping system comes with all-in-one software for the acquisition and visualization of the maps. In a unique and easy-to-use software interface, the user can choose between the single spot, multi spot and mapping 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.

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

The easy-to-use mapping 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 to determine material, as well as 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, sculptures, textiles and manuscripts. For art conservators, the investigation of pigments, coatings and binders with the ELIO provides essential information for the preservation of paintings.

Analysis of ceramics

Understanding the use of European materials in the fabrication of Chinese ceramics over time is a major topic for investigation, for which Bruker's micro-XRF is perfectly suited.
© Baur Foundation Geneva, Chinese imperial ceramics collection.

Material science

Complex 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.



Technical Data

Excitation	Rh target X-ray tube, 10 kV – 50 kV, 5 μ A – 200 μ A, 4 W, filter package included
Detection	17 mm ² SDD with CUBE technology, energy resolution < 140 eV for Mn K α , optional 50 mm ² large area SDD
Collimation	1 mm
Analysis range	Na (Z = 11) to U (Z = 92), light elements capable down to Na with helium 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 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 travel range of 100 mm x 100 mm. Fully integrated mapping software for automatic control and map visualization.
Software package	ELIO software for instrument control, data acquisition, data evaluation and report generation in one easy-to-use interface. Optional ESPRIT Reveal software for detailed post processing analysis.
Analysis	Single point (spot) and distribution (mapping) analysis, 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 \pm 10% Frequency: 50/60 Hz Maximum power: 66 W 6 – 8 h operation with optional 12 V 8 Ah battery



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