Horiba XGT9000: Micro X-ray fluorescence instrument (µXRF)

POLiS Post Lithium Storage Cluster of Excellence

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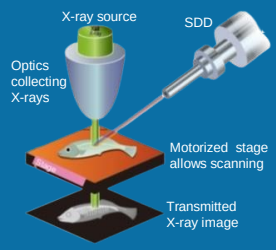
Photographs of Horiba XGT9000 instrument and its internal structure



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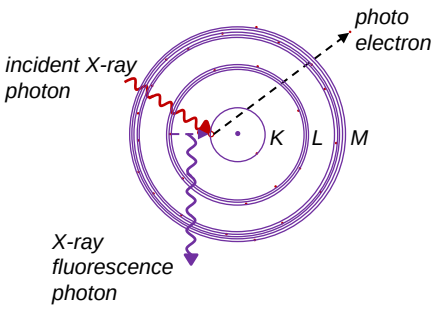
Specifications of Horiba XGT9000

Parameter	Value
X-ray source	Rh-Kα: 20.2 keV
Detector	SDD: Resolution @MnKα ~ 130 eV
Tube voltage	15 kV, 30 kV, 50kV
Tube current	20 µA – 1000 mA
Spot size	≥ 10 µm
Analyzed area	≤ (100×100) mm^2
Sample type	Solid (flat), powder, liquid
Atmosphere	Vacuum and air

X-ray fluorescence (XRF)

When high-energy X-rays from a controlled source strike a sample, they can eject electrons from the inner shell of an atom. The atom stabilises by filling the gap with an electron from a higher energy level, emitting a characteristic X-ray photon known as X-ray fluorescence (XRF). Measuring the energy of these photons reveals the elemental composition of the sample. Counting photons of a certain energy (measuring intensity) leads to quantification.

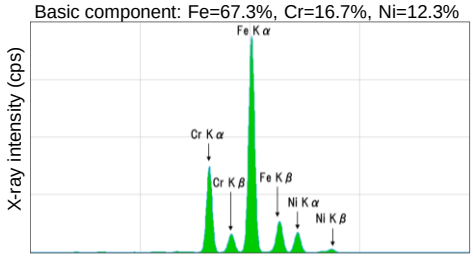


Excitation and relaxation by XRF

Micro X-ray fluorescence (µXRF)

The µXRF instrumentation consists of X-ray focusing optics to achieve a fine beam size and a movable sample stage, which work together to produce laterally resolved elemental maps of (flat) samples.

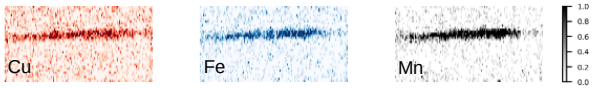
Sample: stainless steel (SUS304
Basic component: Fe=67.3%, Cr=16.7%, Ni=12.3%



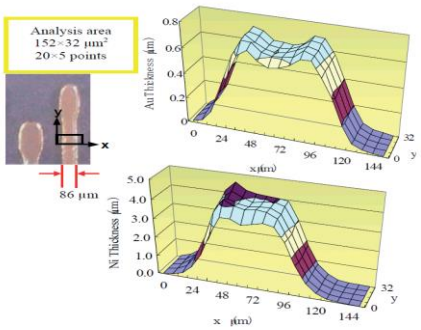
XRF spectrum measured on stainless steel (©Horiba Ltd.)

µXRF in battery research

µXRF in battery research can be used to study elemental composition and distribution of elements with atomic numbers $z \geq 11$ with lateral resolution of approx. 10 µm. Electrode electrodes, electrolyte and separators can be studied providing an element sensitivity down to sub-ppm range. This enables the investigation of homogeneity, impurities, dissolution and deposition of (active) elements. Furthermore, (metal) film thickness on a substrates can be studied.



Distribution of Cu, Fe, and Mn (active elements) along the thickness of electrode $Na_{0.9}Mn_{0.48}Fe_{0.3}Cu_{0.22}O_2$ (measured on Horiba XGT9000).



Variations of Au and Ni layer thicknesses deposited on Cu substrate, acquired across the region shown in the optical image (© Horiba Ltd.)

Reference

1. www.horiba.com/int/scientific/
2. Sadique *et al*. MRS Advances (2022)7:361-365.
3. Evertz *et al*. Journal of Power Sources (2016)329:364-371