Rigaku

POWERING NEW PERSPECTIVES

XRF for Qualitative and Quantitative Materials Analysis

Rigaku

POWERING NEW PERSPECTIVES

Who we are

Rigaku is the **global leader** in analytical X-ray solutions

SCX XRD **XRF** CT XRR XRT SAXS

- Manufacturer of analytical X-ray instruments
- Partner to research institutes and industries
- High Quality craftsmanship **made in Japan**

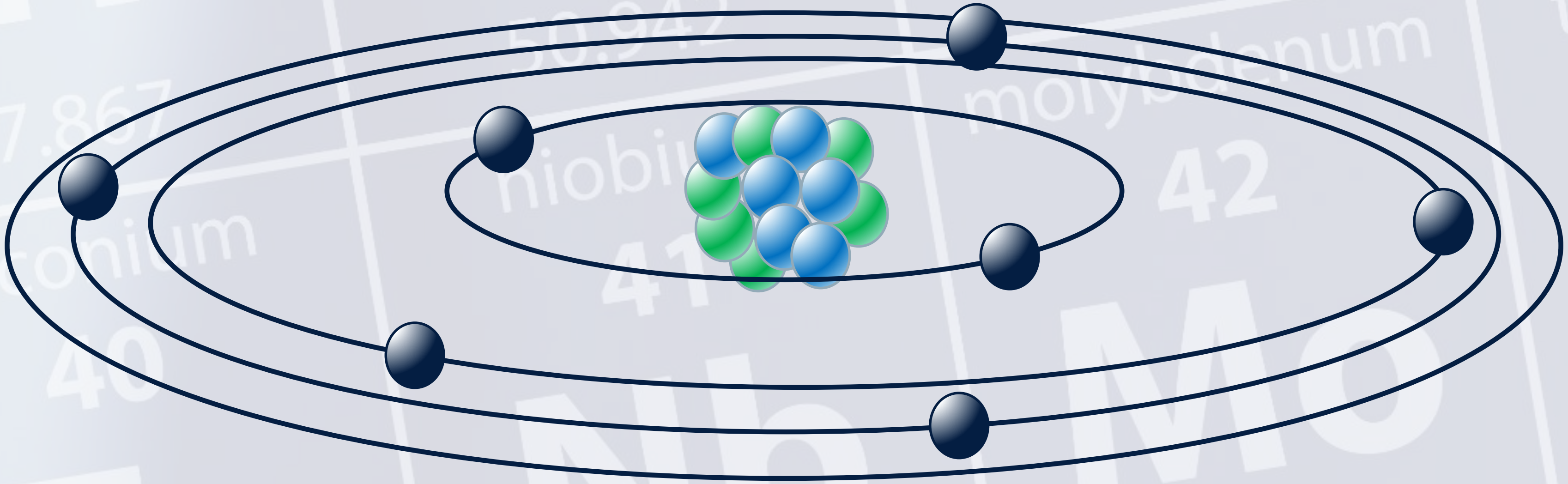
SciMed

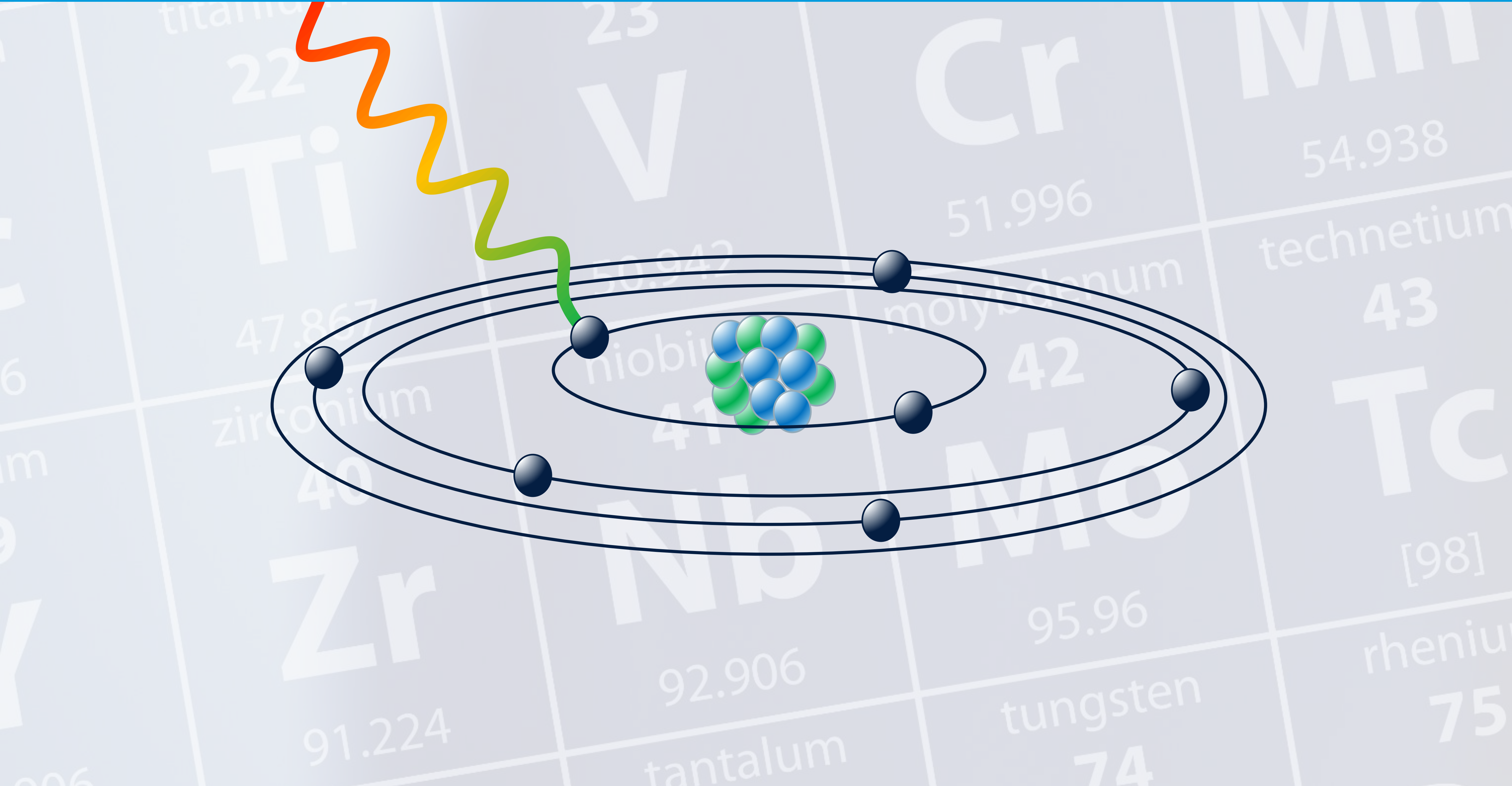
Global Brands, Local Support

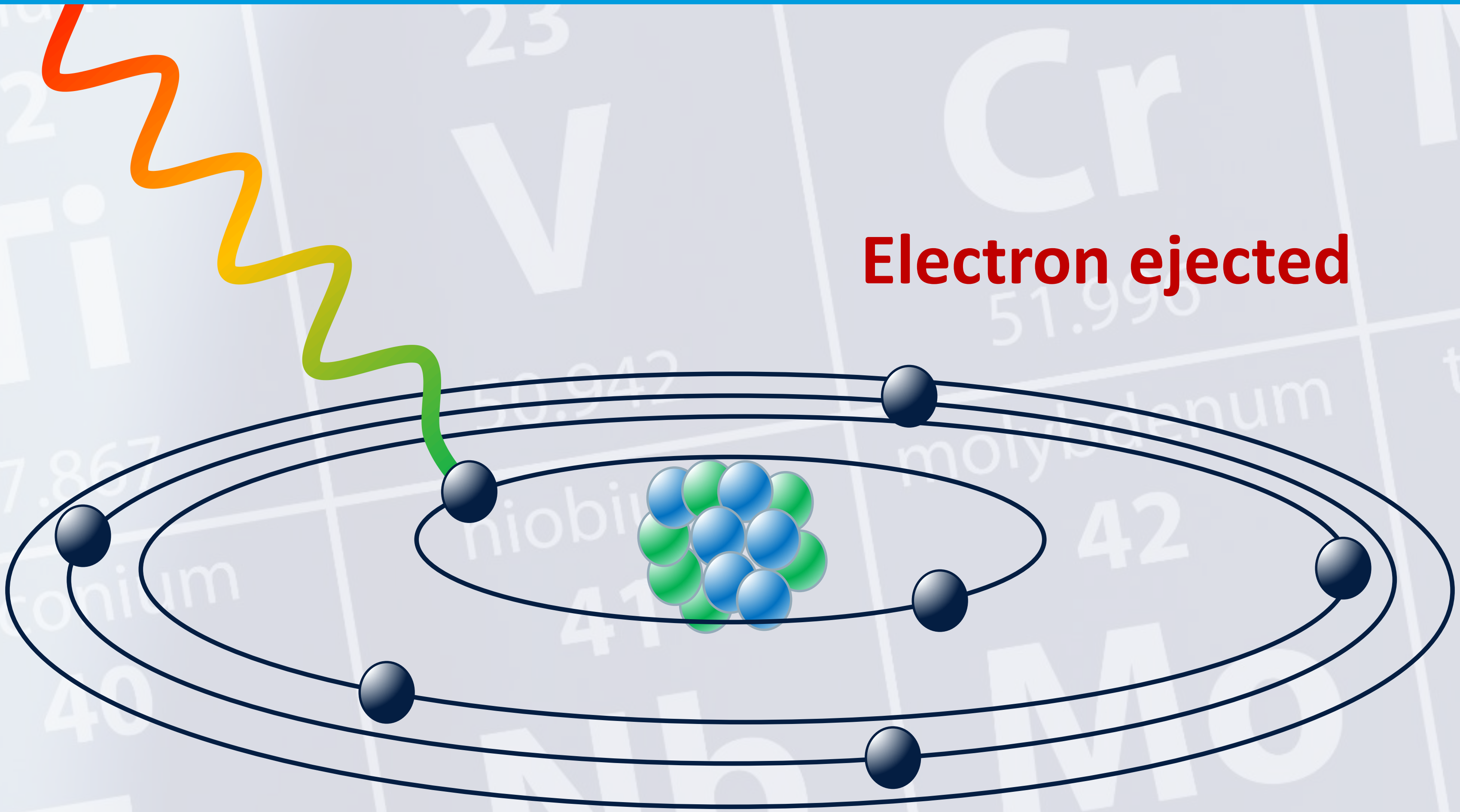
- Leading Supplier of Scientific Instrumentation, 45 years
- Global Brands, Local Support
- Head Office & Laboratories – Stockport, UK

Rigaku
POWERING NEW PERSPECTIVES

How does XRF work?

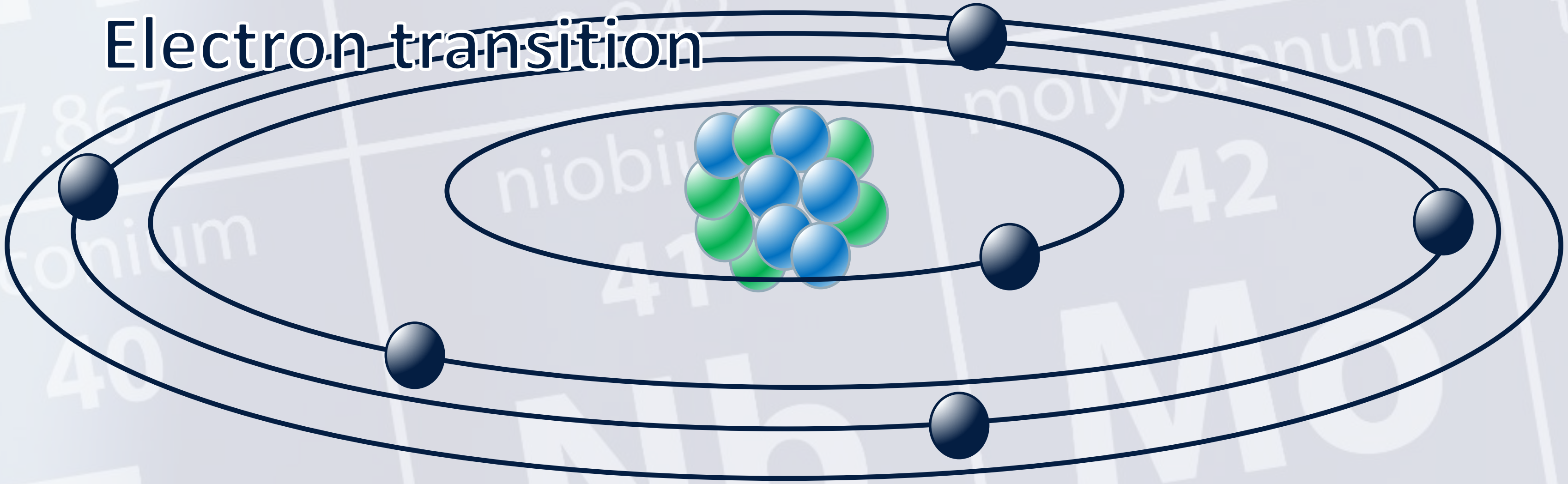


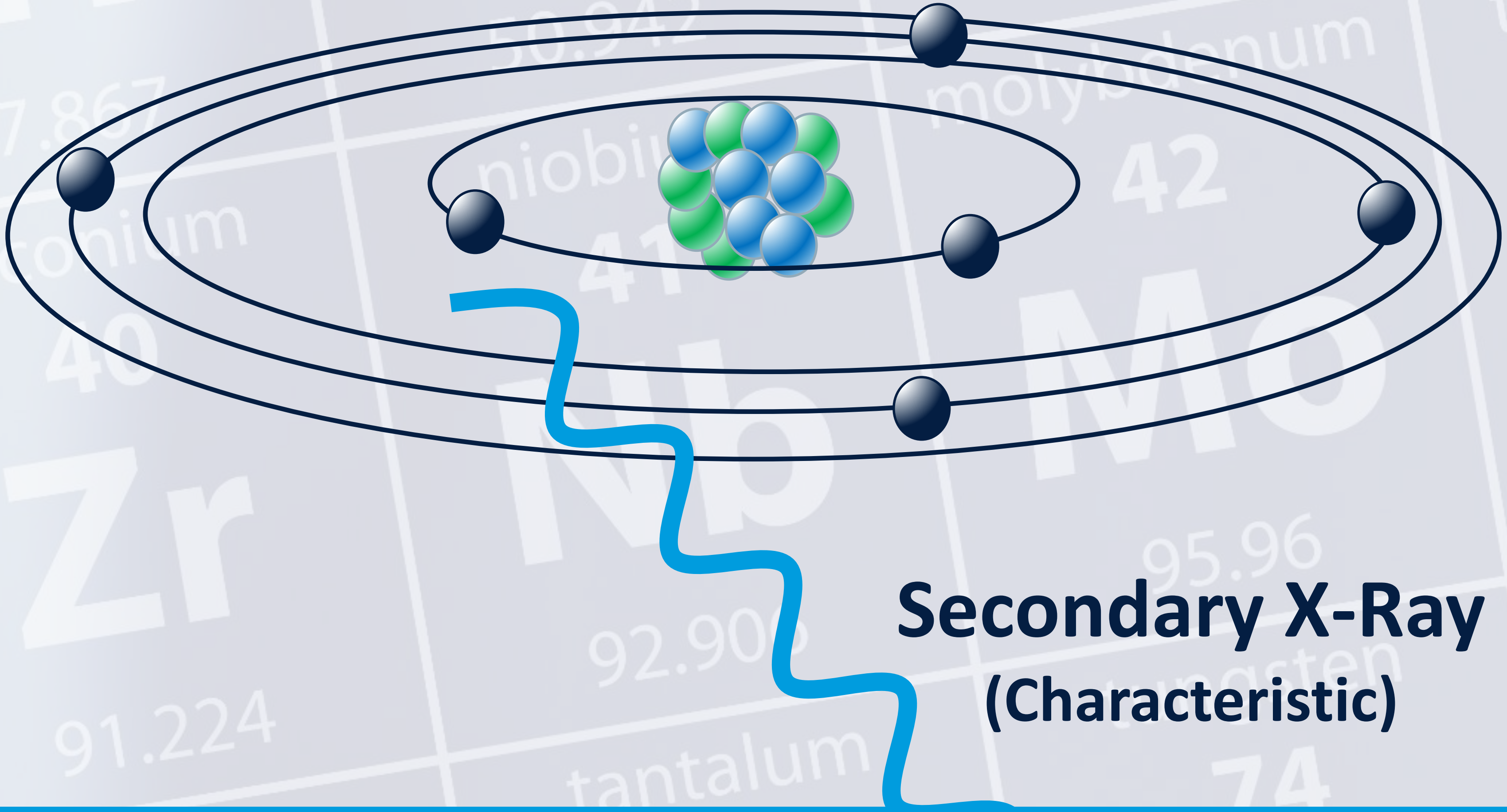

titanium
22
Ti
47.867
23
V
50.942
Cr
51.996
Mn
54.938
technetium
43
molybdenum
42
niobium
41
zirconium
40
Zr
91.224
Nb
92.906
Mo
95.96
Tc
[98]
tantalum
tungsten
74
rhenium
75



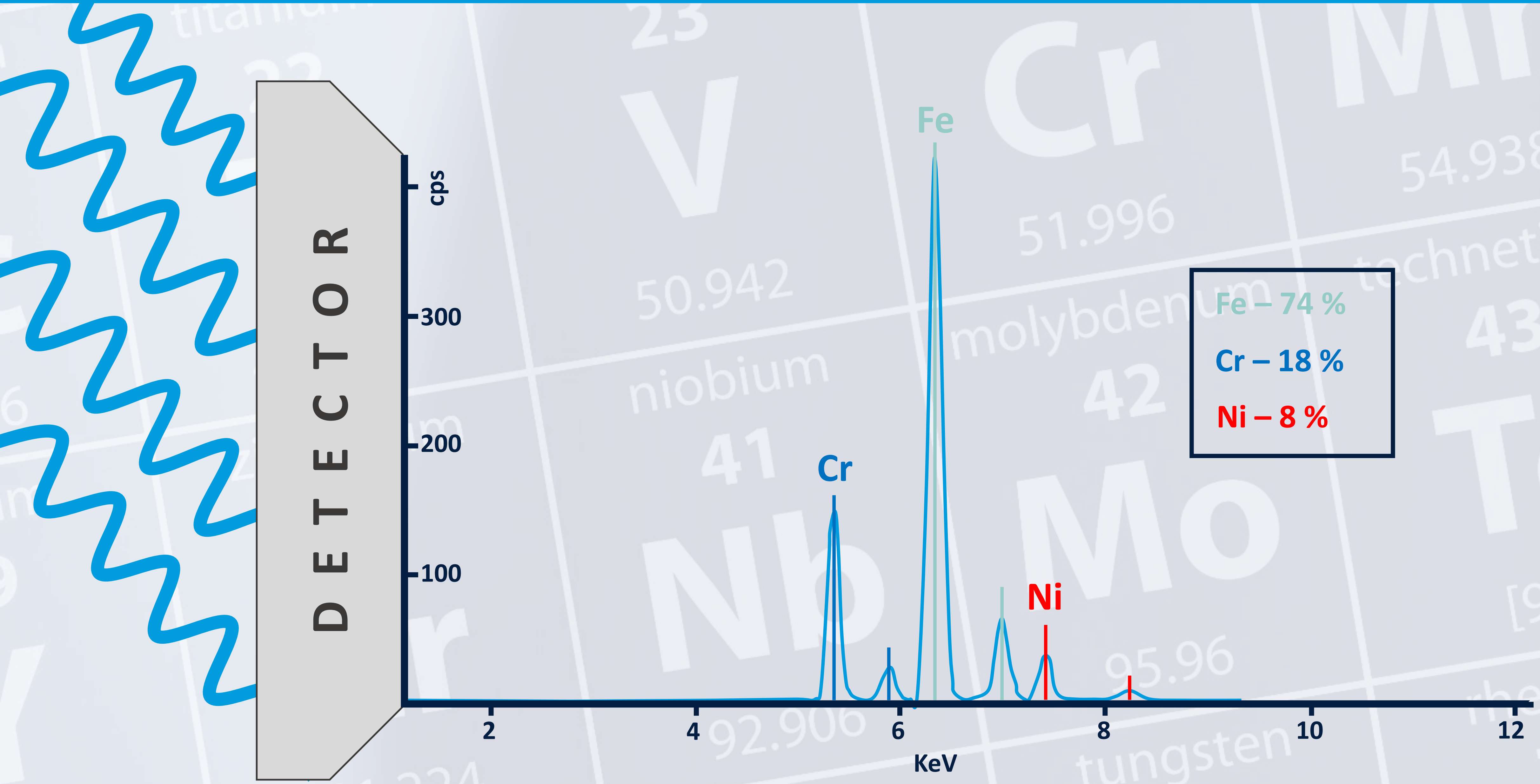
Electron ejected

Electron transition



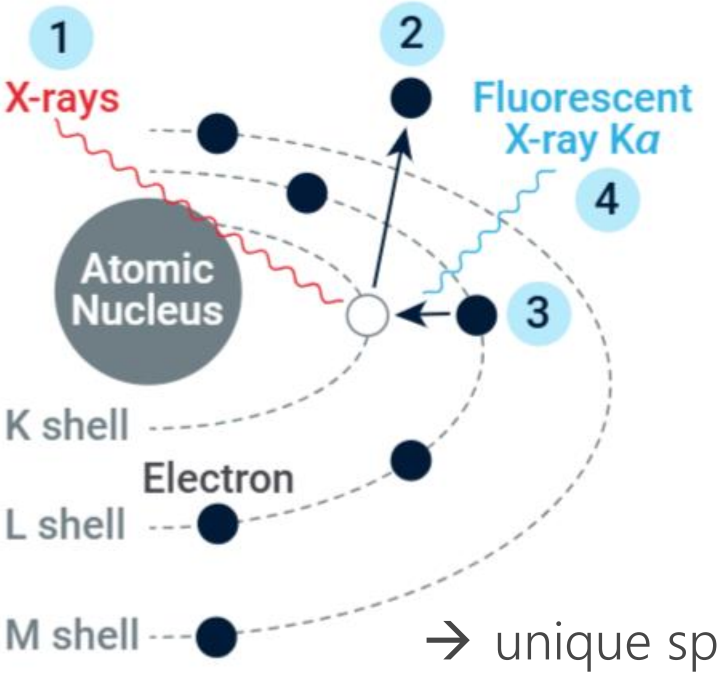


Secondary X-Ray
(Characteristic)


DETECTOR
cps
300
200
100
Fe
Cr
Ni
2
4
6
8
10
12
KeV
Fe – 74 %
Cr – 18 %
Ni – 8 %

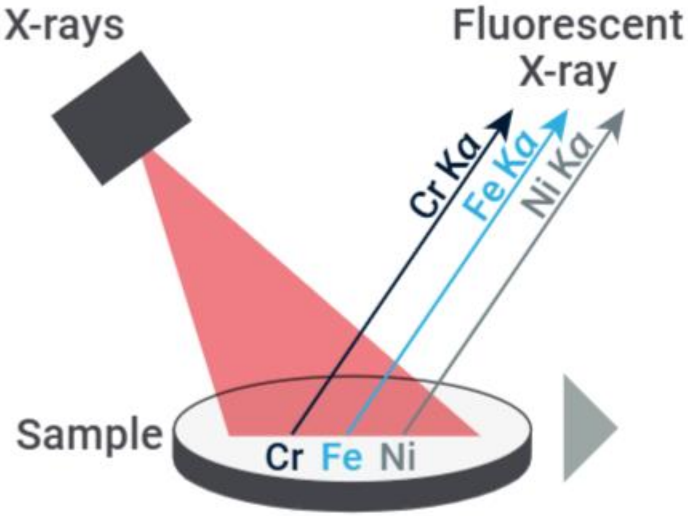
How does XRF work?

Principle



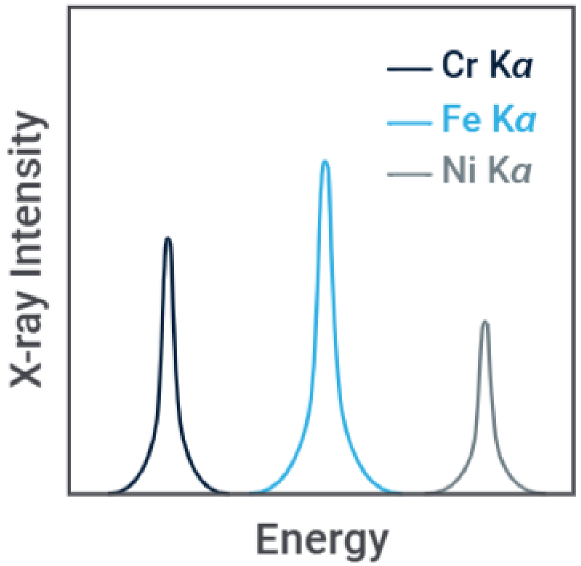
→ unique spectral fingerprint for each element

Qualitative Analysis



The elements in a sample can be identified from the energy or wavelength of the peak positions.

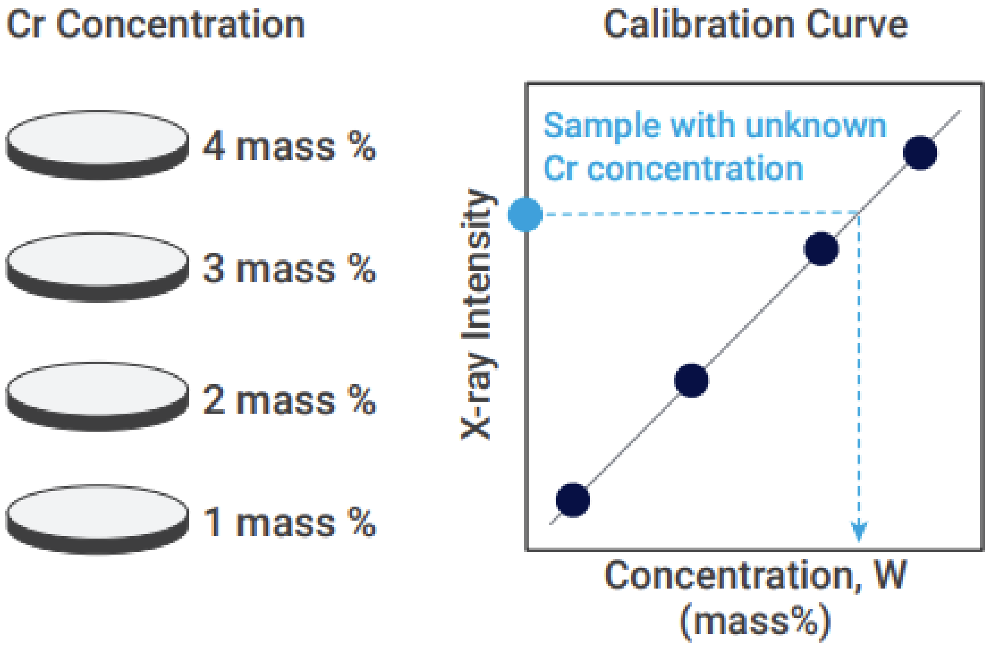
Quantitative Analysis



The elemental composition can be identified from the intensity of the signal at the peaks.

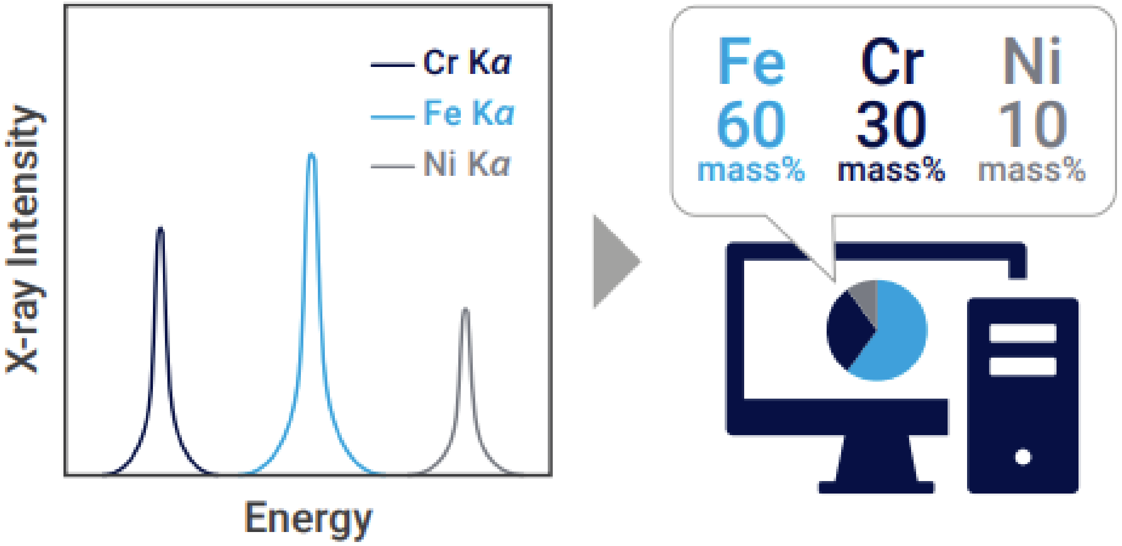
Quantitative Methods in XRF

Calibration Curve



Dedicated calibration standards for the elements of interest in similar matrix are implemented as calibration curve for most accurate quantification of unknown samples.

Fundamental Parameters (FP)

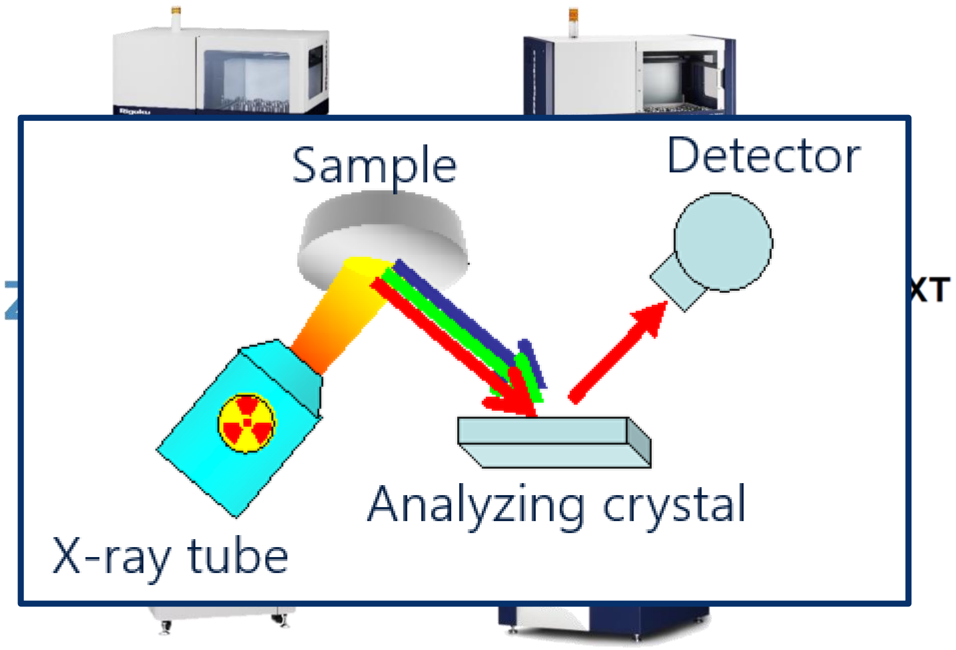


Fundamental parameters such as absorption coefficients and instrument specifications are used to calculate element concentrations without calibration standards.

Convenient for diverse samples & changing matrix.

XRF: Sub-disciplines

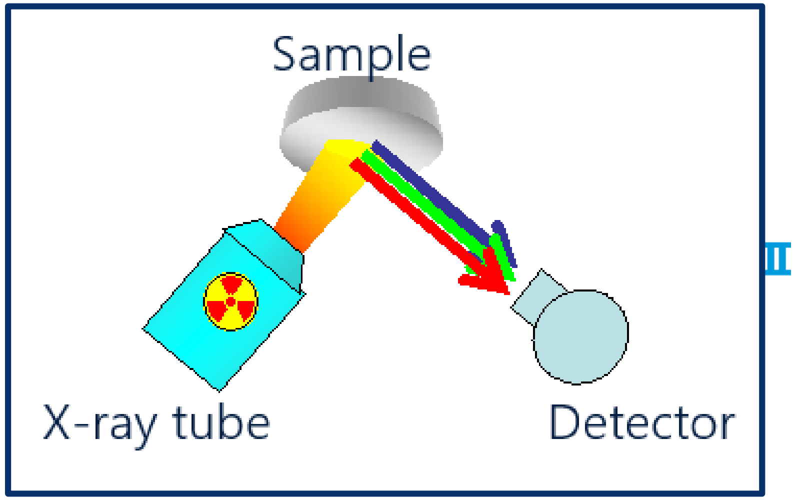
Wavelength dispersive (WD)



ZSX Primus IVi **Supermini200**

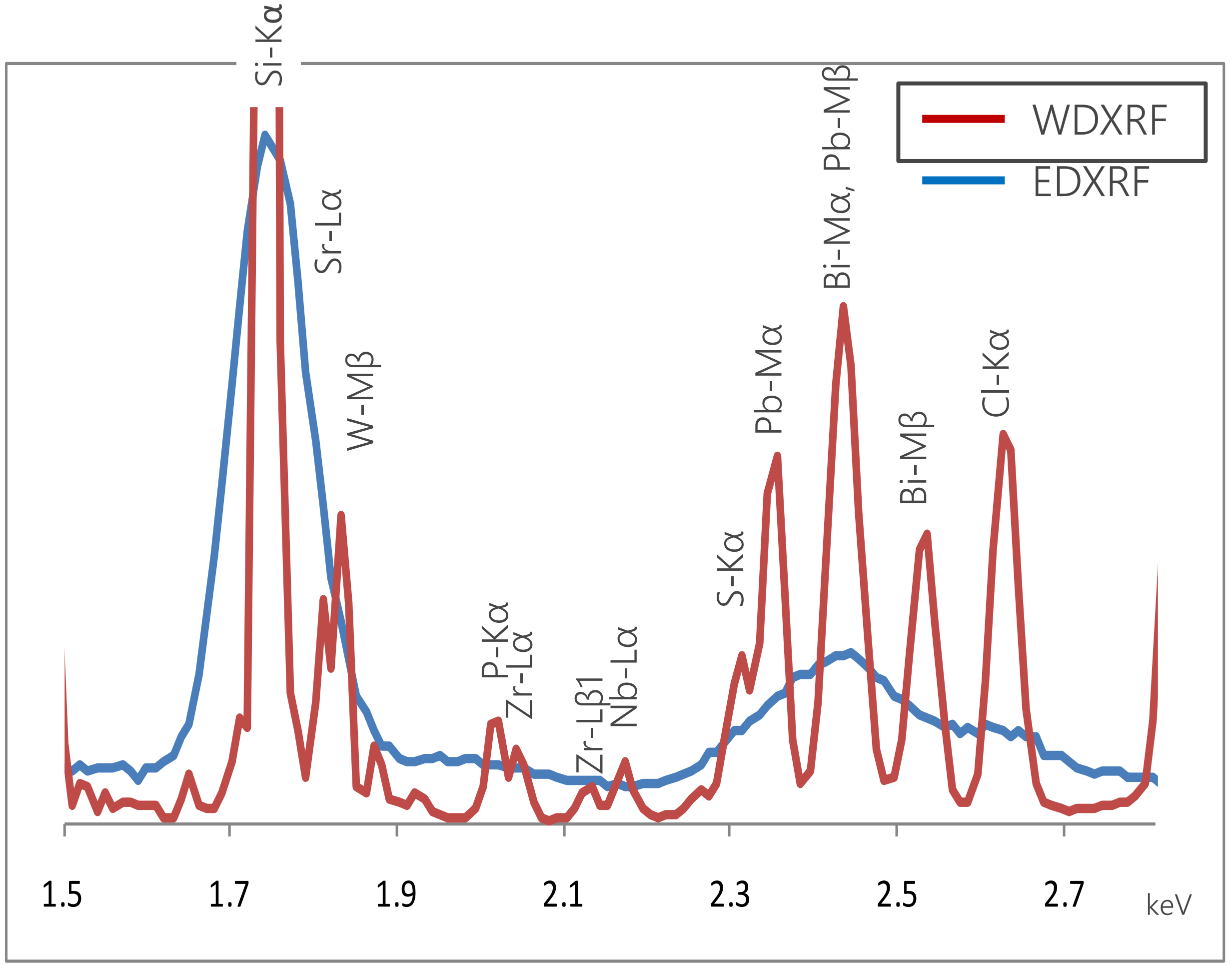
Excellent spectral resolution
(Less line overlaps)
High precision analysis

Energy dispersive (ED)



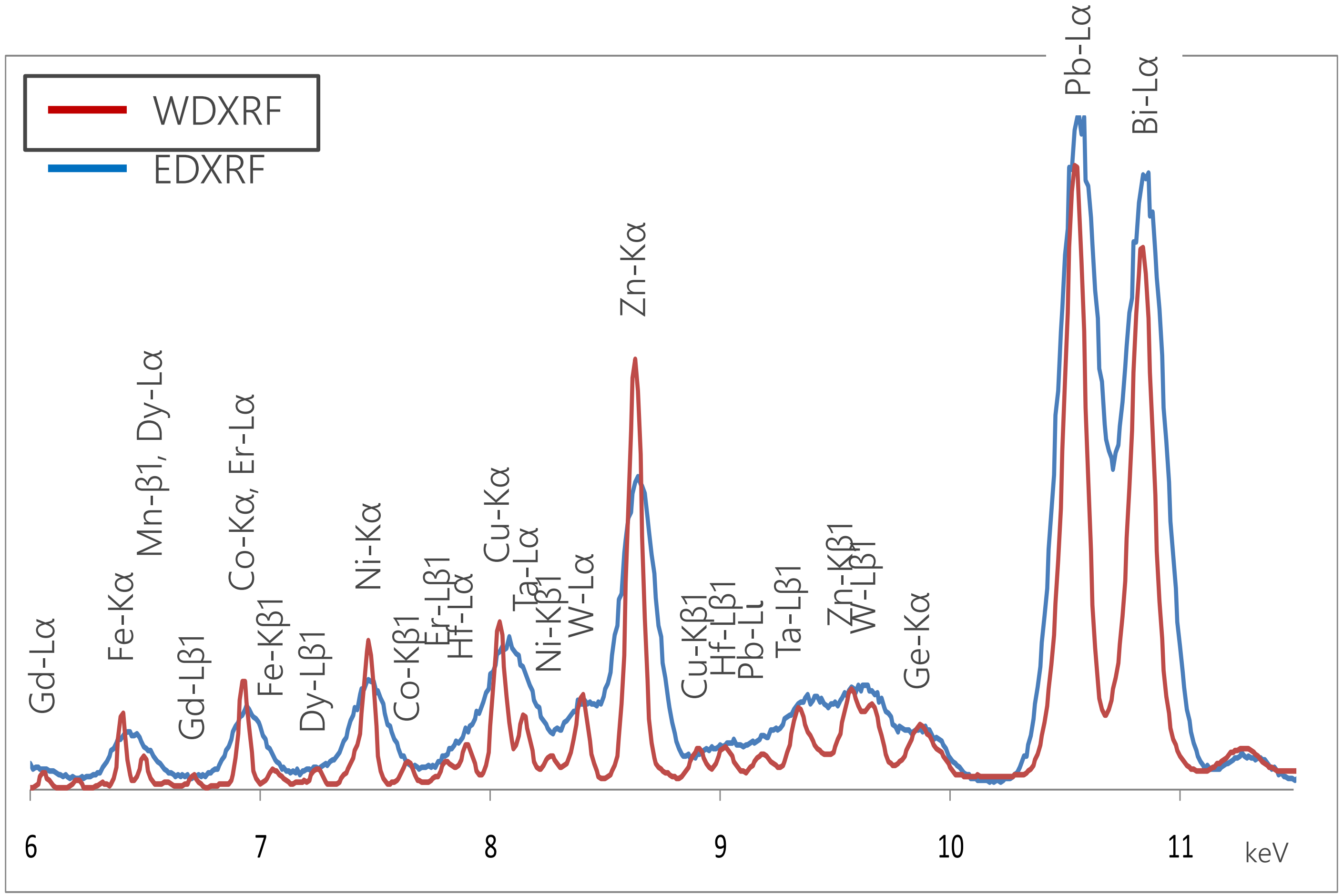
Suitable for screening analysis
Simple Operation
Fast analysis time

Light Element Range



Sample: glass

Heavy Element Range



Sample: glass

XRF the solution for a wide range of industries and applications

Academic research

Semiconductor

Metals

Petro

Cement

Battery

Pharma

Rigaku Makes Smartphones Possible

Electronic Components

Processor (SoC) | Memory | Sensors | Display

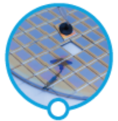
Semiconductor

Wafer Processing

XRD	XRT
Orientation analysis	Quality assurance

Film Growth / Electrode Deposition

XRD	XRF
Measurements of film thickness, lattice constants, and quality assurance	Surface contamination analysis



Dicing / Packaging

XRD

Qualitative analysis and micro-area mapping

Printed Circuit Board (PCB)

CT

Quality control

Glass

XRF

Determination of the composition of raw materials, intermediates, and final glass products

CT

Quality control

Battery

Mining Raw Materials

XRD | XRF

Monitoring composition

Refining

XRD | XRF

Quality assurance

Battery Cell

CT

Quality control and life-cycle

Casing

Plastics

Petrochemical Industry

XRF

Analyzing raw materials

Production of Polymers

XRF	XRD
Checking quality and remaining impurities	Phase identification and quantification

Metal

Mining

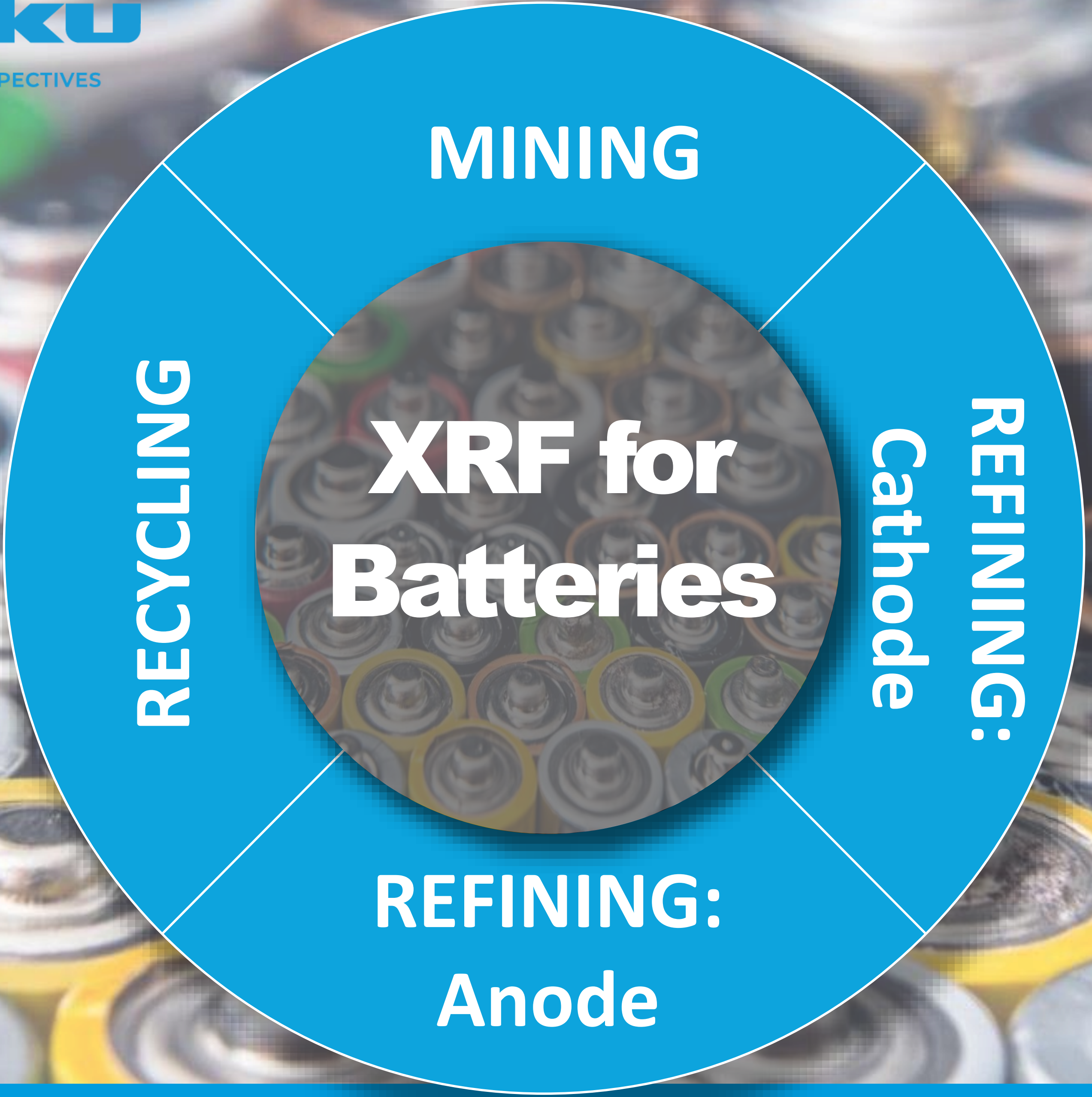
CT	XRD | XRF
Exploration of ores and determination of the phases of critical raw materials	Determination of the composition of ores

Metal Production

XRD	XRF
Identifying phases in metals and alloys, residual stress analysis, determining crystallite size and texture, and quality control of coatings and texture	Monitoring composition of intermediate products, verifying the composition of alloys and inspecting end products CT Quality control

Rigaku

POWERING NEW PERSPECTIVES



XRF for Batteries

MINING

REFINING: Cathode

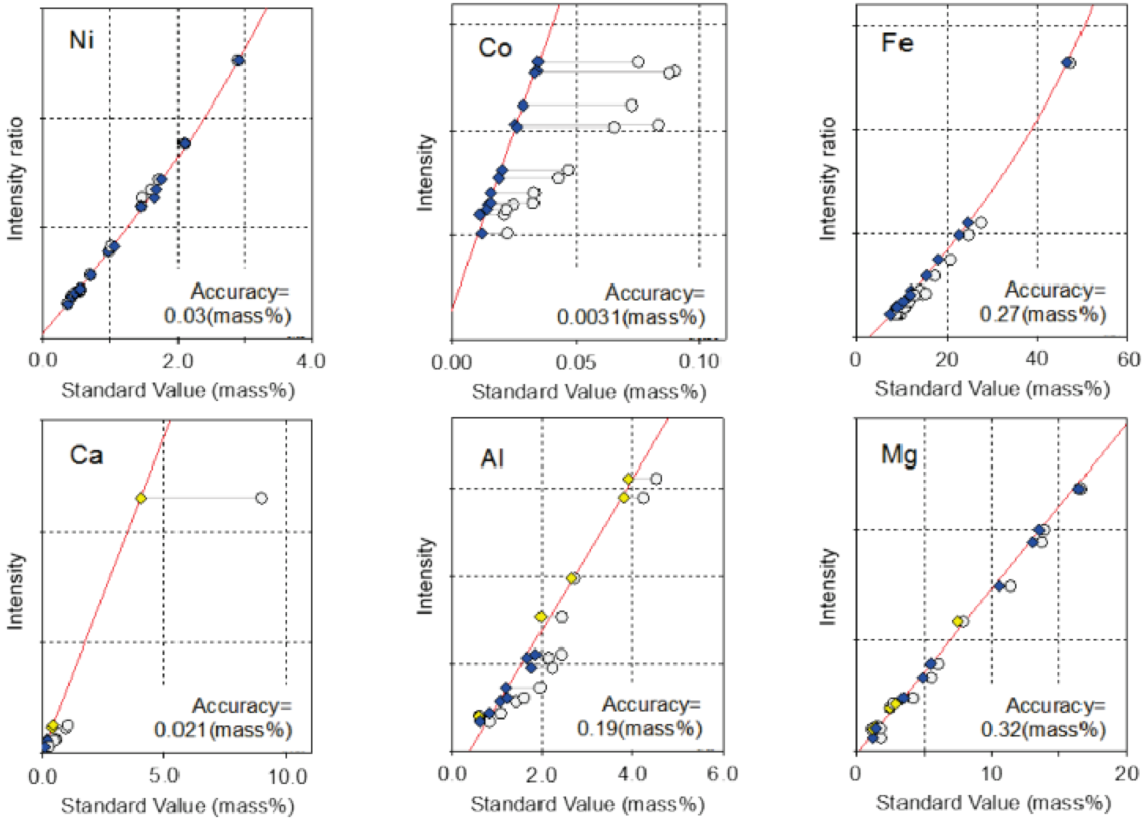
REFINING: Anode

RECYCLING

MINING

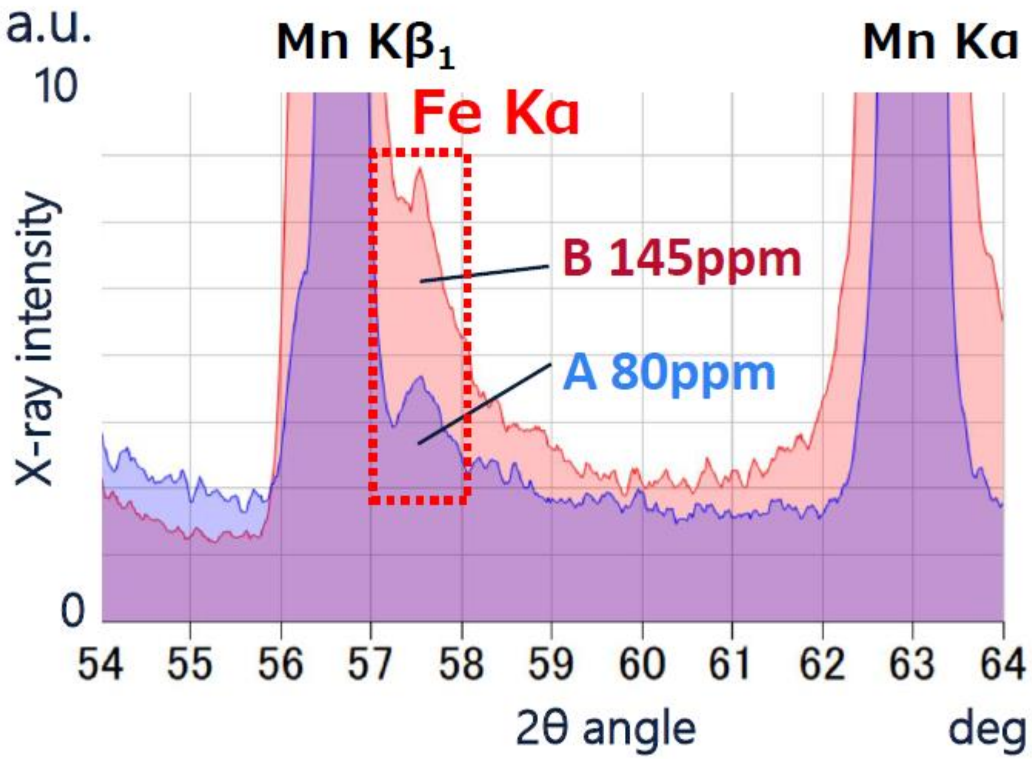
POWERING NEW PERSPECTIVES

SUPERMINI 200

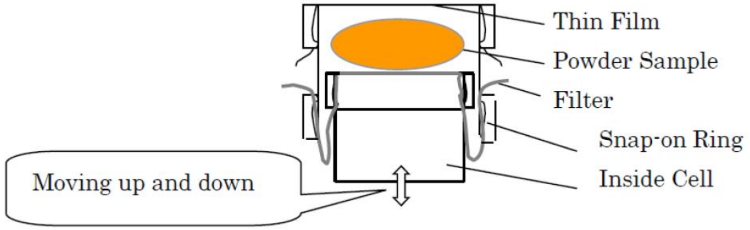


REFINING: Cathode

PRIMUS IV



REFINING: Anode



Graphite powder

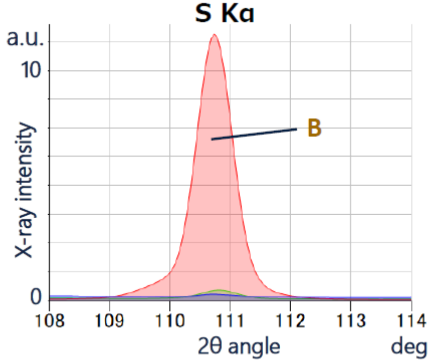
SQX analysis result of impurities

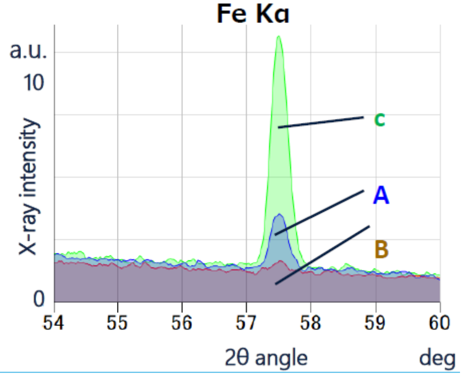
Unit: ppm

Sample	Na	Mg	Al	S	Ca	Fe	Zr
A	83	249	28	38	73	39	13
B	N.D.	975	24	2958	41	6	N.D.
C	81	242	42	76	81	180	4

* N.D.: under detection limit

- Impurities in graphite samples were detected with high accuracy.
- High concentration of S and Fe impurities were detected in sample B and sample C, respectively. The difference in impurity levels depends on the sample grade.

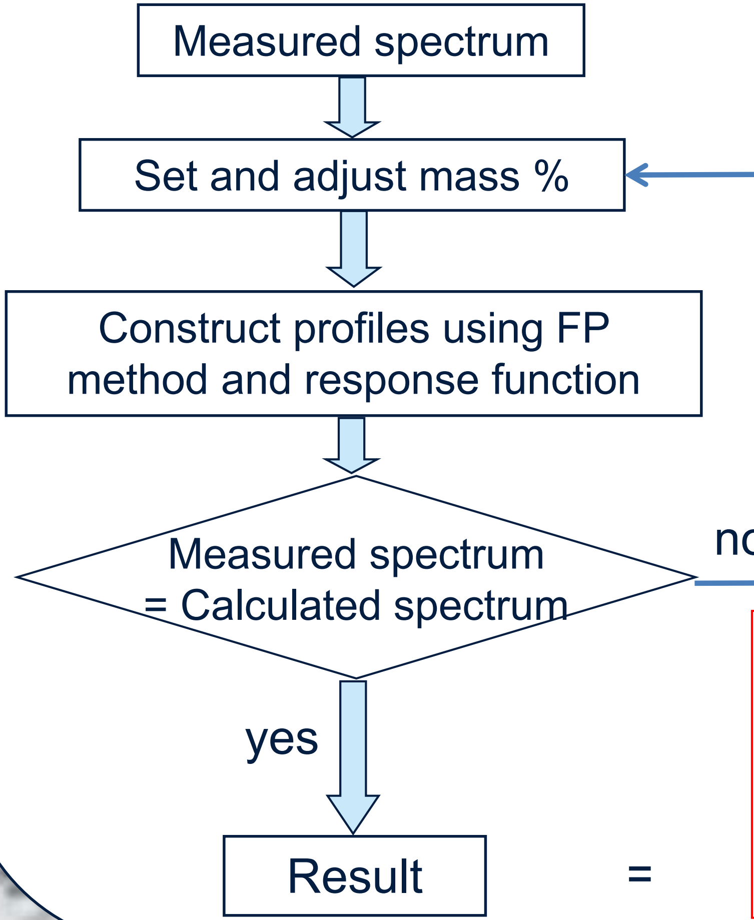




RECYCLING

Rigaku
POWERING NEW PERSPECTIVES

RIGAKU SQX FP


Measured spectrum

Set and adjust mass %

Construct profiles using FP method and response function

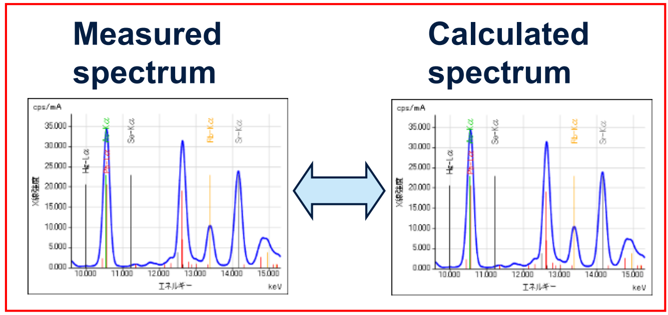
Measured spectrum = Calculated spectrum

no

yes

Result

=



XRF vs ICP: Black Mass

		Ni	Co	Al	Cu
A	ICP	6.36	31.3	15.2	8.68
	XRF	6.45	31.0	12.1	7.34
B	ICP	17.2	17.7	8.46	4.41
	XRF	19.7	20.3	7.69	4.83
C	ICP	26.9	18.8	14.5	2.54
	XRF	26.0	20.8	14.7	2.50

Rigaku’s WDXRF Instruments

Sequential

Supermini200

- Optimized as a benchtop WDXRF
- Best Light element
- Best for the determination of Cl, no spectral overlap

ZSX Primus III ^{NEXT}

- Optimized for solids
- Standard system
- Normal sample throughput

ZSX Primus IV

- Optimized for powder samples
- Standard system
- High sample throughput

ZSX Primus IV*i*

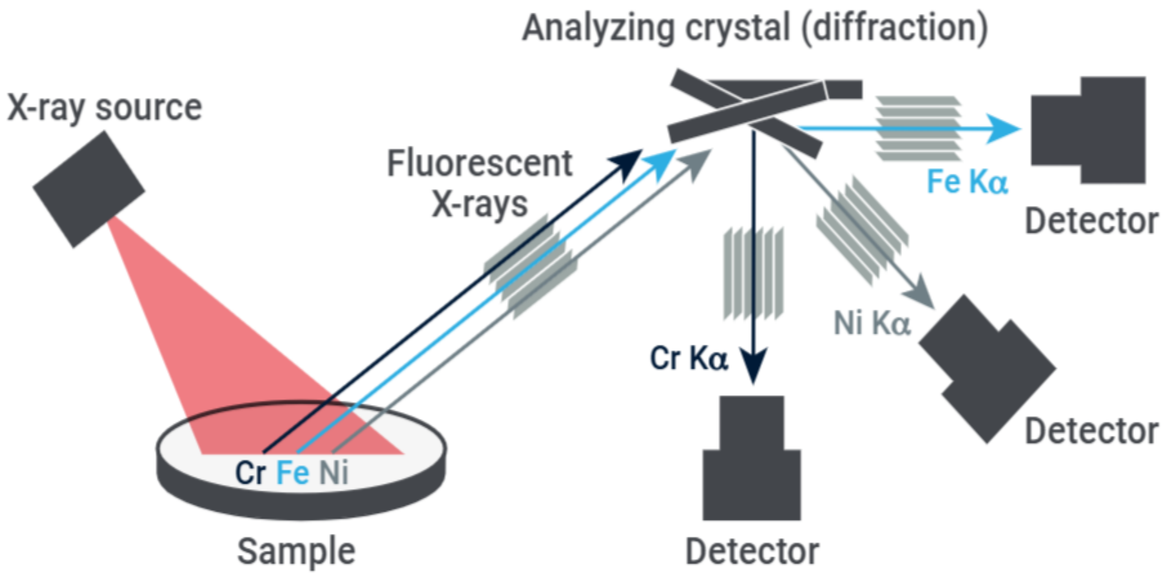
- Optimized for liquid samples
- Small Footprint
- Normal to high sample throughput

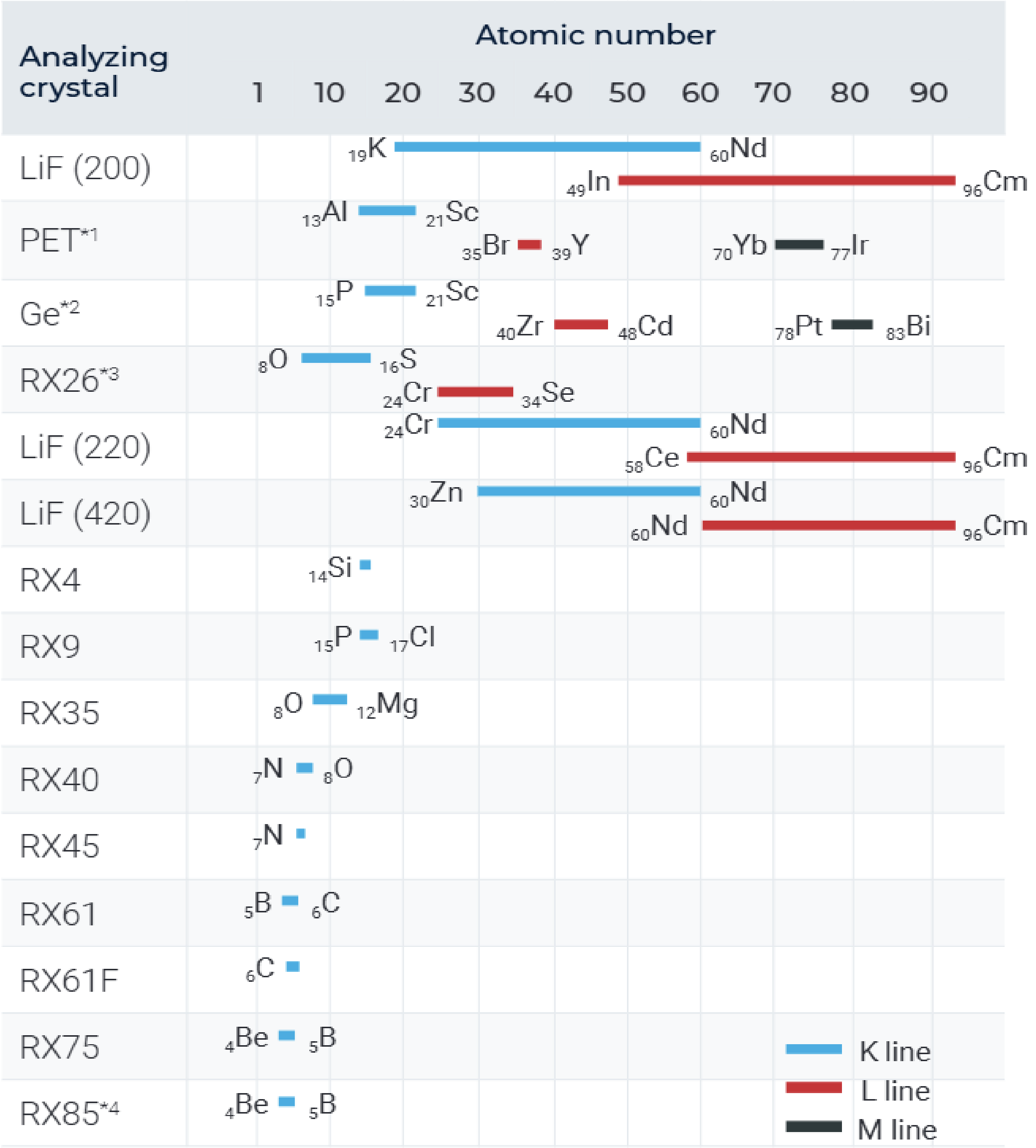
Simultaneous

Simultix 15

- Optimized for high speed
- Most powerful system
- High sample throughput

Instrumental Set-Up – Advanced Analysis





Tube-above geometry allows for thinner tube window and hence gives higher intensities for detection of trace elements & fast measurements.

optimize selection of analyzer crystals for elements to be detected

Rigaku

Support by our XRF Application Team

SciMed
Global Brands, Local Support

Send in your samples

XRF feasibility demonstration

Qualitative and (semi-) quantitative measurements of your samples

XRF Demonstrations

XRF demonstrations or 3 days application training in our lab

Hardware and software training including method development

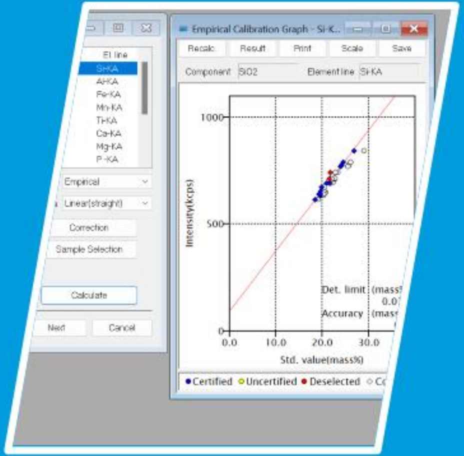
XRF Training

2-4 days application training at your facilities

Hardware and software training including method development

After-care Support

Remote support via. Phone, TeamViewer or MS Teams



Component SiO2 Element line Si-KA

Empirical

Linear(straight)

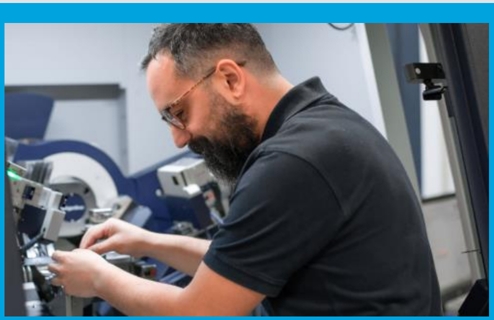
Advising on software, hardware and application solutions

Rigaku

Contact us: enquires@scimed.co.uk

Mission Statement

In everything we do at Rigaku, we believe in advancing humanity through **science** and **technology**

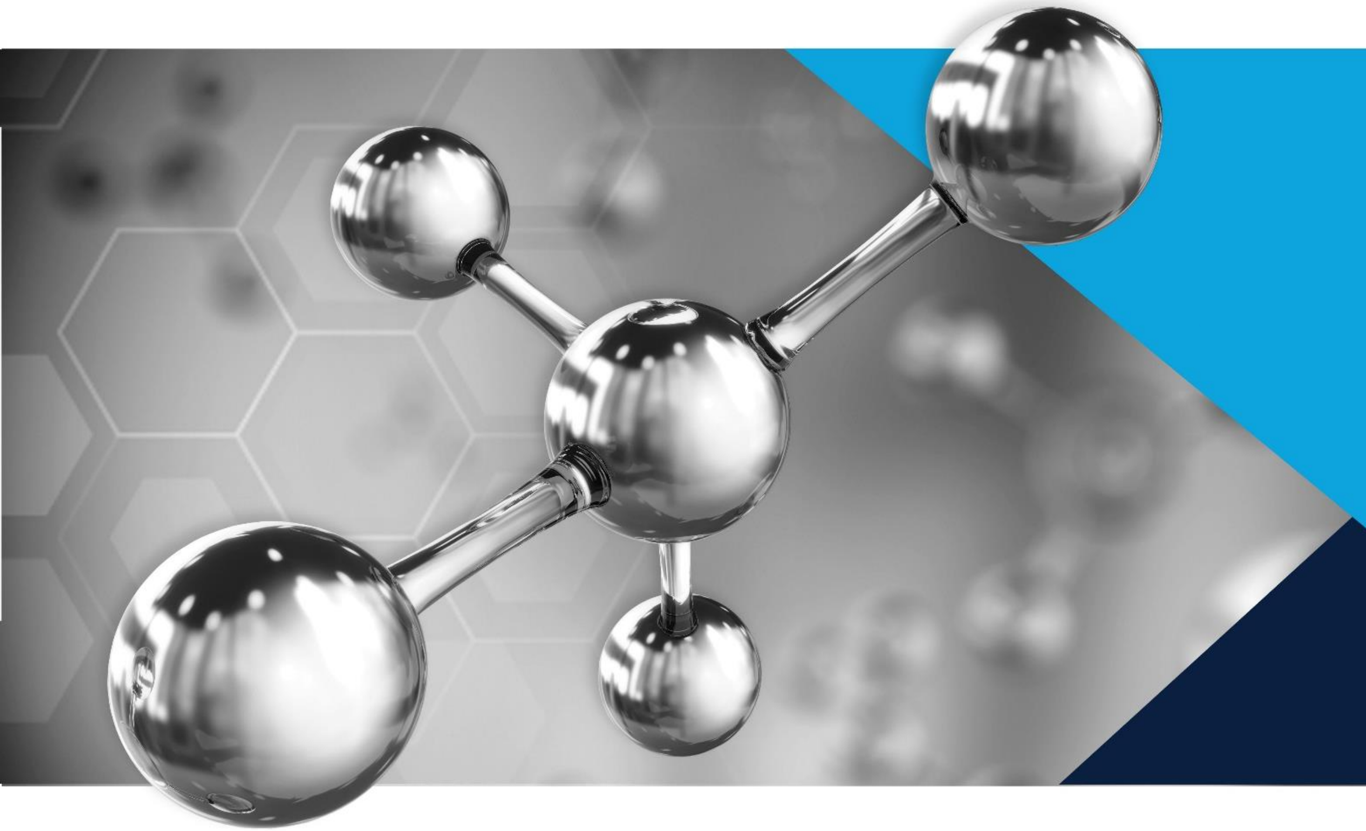


We do this by making our instruments exceptionally **engineered**, **user-friendly** and we offer the **best service**

Thus, Rigaku has grown from a manufacturer of X-ray instruments into a leading provider of

analytical X-ray solutions for material analysis

Rigaku
POWERING NEW PERSPECTIVES



Questions?