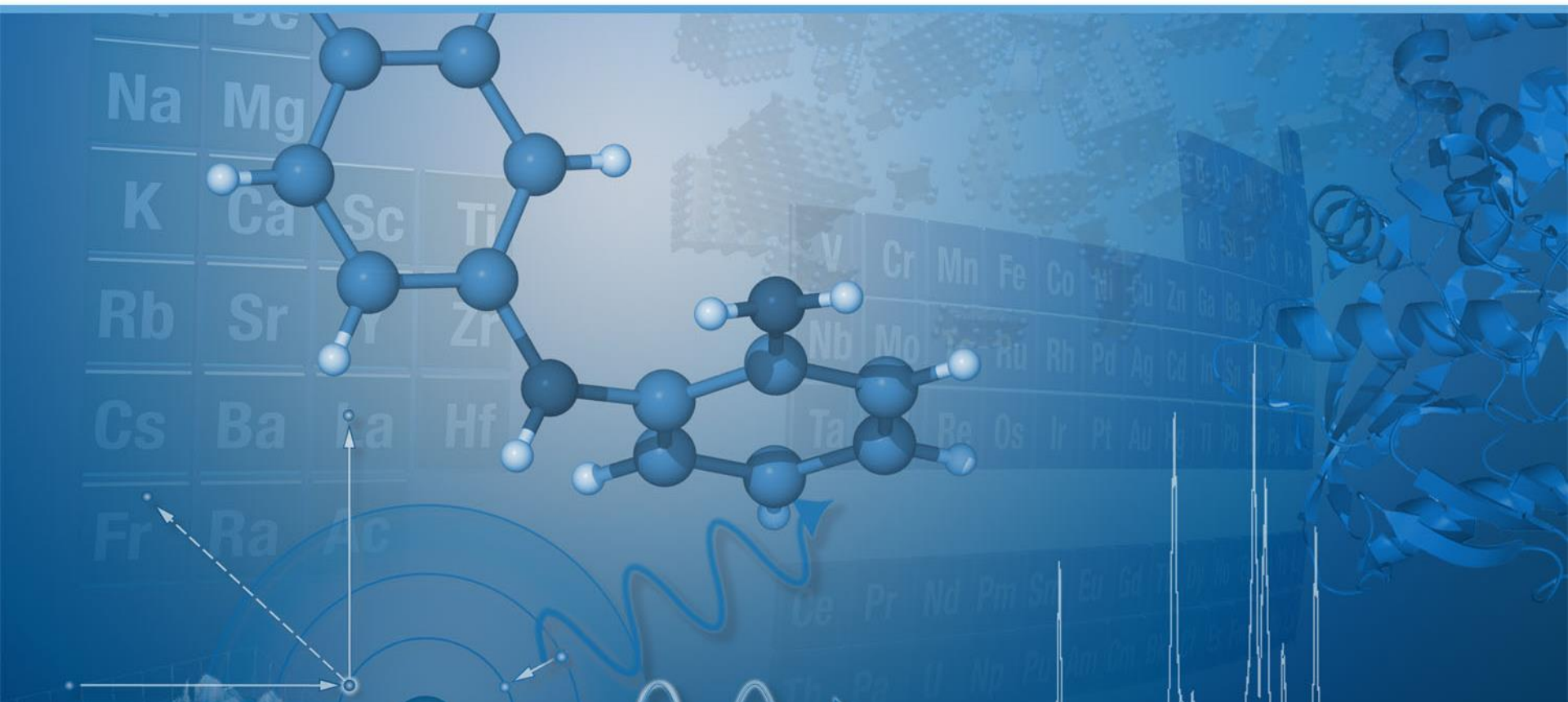


Bruker's S2 PUMA™ Series 2 Elemental Analyzer

Enhanced in speed, flexibility, and usability



S2 PUMA™ Series 2 Elemental Analyzer

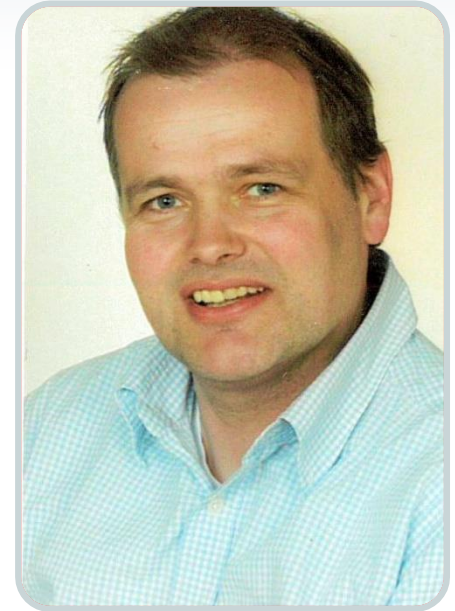


- History of EDXRF at Bruker
- S2 PUMA Series 2
- Inside SPECTRA.ELEMENTS
- Application examples
- Brief Summary
- Q&A Session



Dr. Adrian Fiege

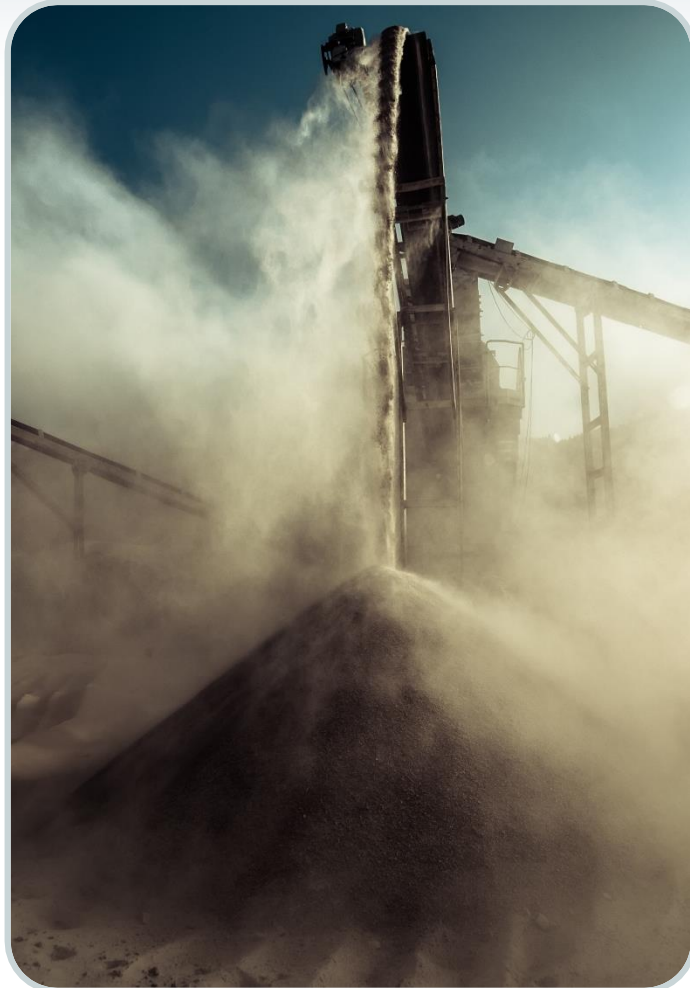
Product Management XRF
Karlsruhe, Germany



Dr. Kai Behrens

Head of Product
Management XRF
Karlsruhe, Germany

Energy Dispersive X-ray Fluorescence Requirements and Expectations

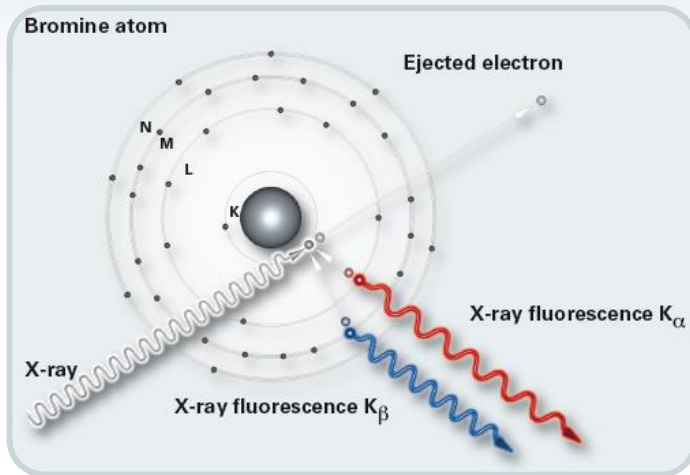


- Analytical tool with high flexibility
- Meet changing requirements to ensure excellent data quality
- Analysis adds value and can often determine the suitability of a product for specific applications
- Each application defines the final quality criteria regarding **elemental and phase composition, impurities**, grain size and other chemical and structural properties

Examples

- Sand for glass industry (Fe content)
- Cyanite for refractories (mineral composition, Al/Si and Fe)
- Additives in engine oils
- Clay as filler for polymers (mineral type and composition)

Energy Dispersive X-ray Fluorescence Continuous Improvements



The principles of EDXRF remain the same. Historical and current improvements in hardware and software result in many benefits:

- Shorter measurement times
- Faster and more flexible software
- More intuitive user interface
- Protection of vital system components
- Higher system uptime
- More flexible and easier sample handling

History of EDXRF at Bruker

Experience turned into Performance



- 2003: Launch of the **S2 RANGER**
 - Autochanger
 - SDD (no liquid nitrogen needed)
- 2015: Launch of the **S2 PUMA**
 - Modern, more powerful software
 - Multiple configurations
 - Next version SDD
- 2020: Launch of the **S2 PUMA Series 2**
 - New Detector
 - New Software
 - and more...

XFlash®
Technology
V4



XFlash®
Technology
V5



HighSense™
Technology



S2 PUMA™ Series 2 Elemental Analyzer

Analyze. Everything. Faster



Enhanced Speed: Shorter measurement times and higher throughput thanks to HighSense™ technology

Enhanced Flexibility: Additional configurations and new software features to fulfill all analytical needs and requirements.

Enhanced Usability: Next generation software based on state-of-the-art programming resulting in a smooth, time-efficient, and worry-free operation.

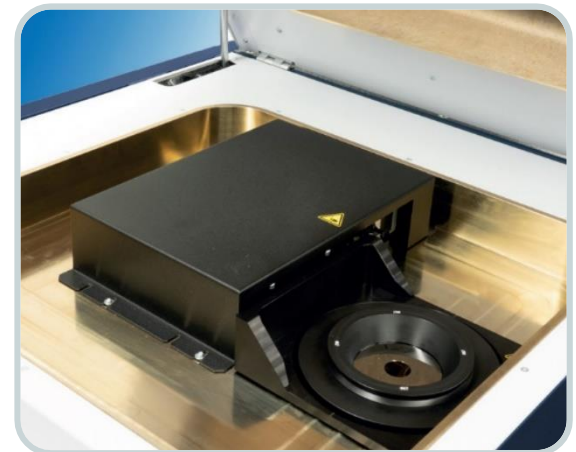


S2 PUMA Series 2

Optimal Configuration for Your Application



- Single
- XY Autochanger and Automation
- Carousel
- Mapping-Stage



S2 PUMA Series 2

Optimal Configuration for Your Application



- **The Single** – Results and Best Performance at Your Fingertips
 - Convenient and fail-safe sample handling for low sample volumes
 - Intuitive TouchControl™:
 - Load the sample, touch the button and get results within minutes.
 - Rotation for heterogeneous samples



S2 PUMA Series 2

Optimal Configuration for Your Application



- **The XY Autochanger** – Add Efficiency and Flexibility to your lab
 - EasyLoad™ XY tray with 20 sample positions
 - New samples can be loaded and added at any time
- **The XY Automation** – No Compromise on Productivity
 - Samples are fed directly, via robot or belt, from the automated sample preparation system
 - LIMS-compatible: The AXSCOM interface connects to the process control software



Working in the Cement Industry?

- Ask for our special Ultra-High-Count settings for Cement Applications

S2 PUMA Series 2

Optimal Configuration for Your Application



- **The Carousel** – Largest Variety of Sample Types
 - EasyLoad™ tray with 12 positions for samples with up to 51.5 mm in diameter
 - 18-position EasyLoad™ tray for 40 mm samples
 - Remove tray to measure large samples
 - Use the HD camera to position the sample
 - Largest EDXRF chamber (450 x 420 mm)
 - Spot size: 34 mm down to 1 mm

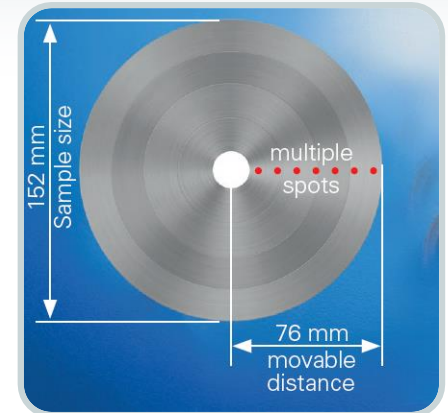


S2 PUMA Series 2

Optimal Configuration for Your Application

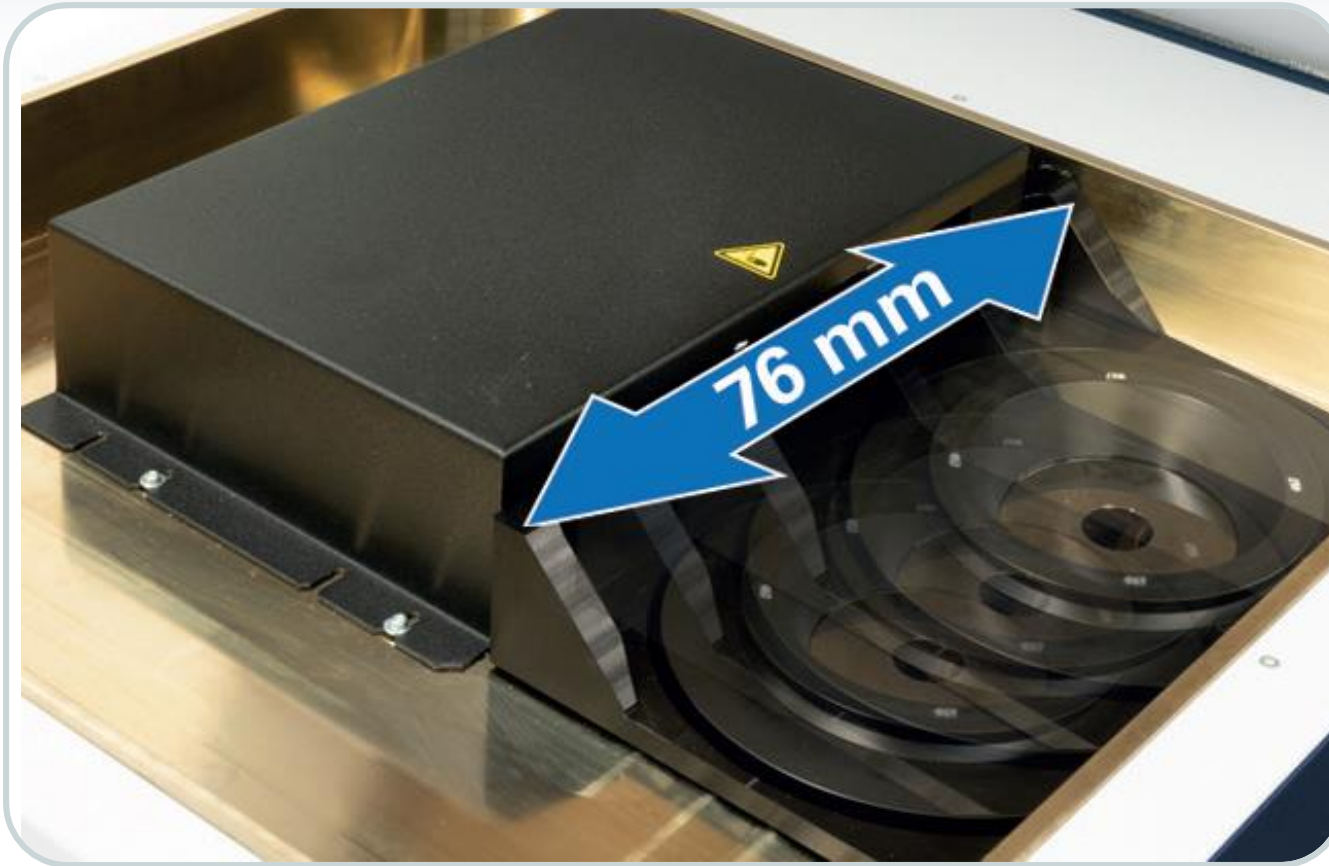


- **The Mapping-Stage** – When spatial resolution is required!
 - For semiconductors, coatings, etc.
 - Coating homogeneity
 - Coating thickness
 - Material homogeneity
 - Max. sample diameter: 152 mm
 - Use inserts to reduce sample size
 - Movable Distance: 0 mm to +76 mm
 - Spot size: 1 mm to 34 mm
 - Spatial precision: <0.1 mm



S2 PUMA Series 2

Optimal Configuration for Your Application



S2 PUMA Series 2 with Mapping-Stage

S2 PUMA Series 2

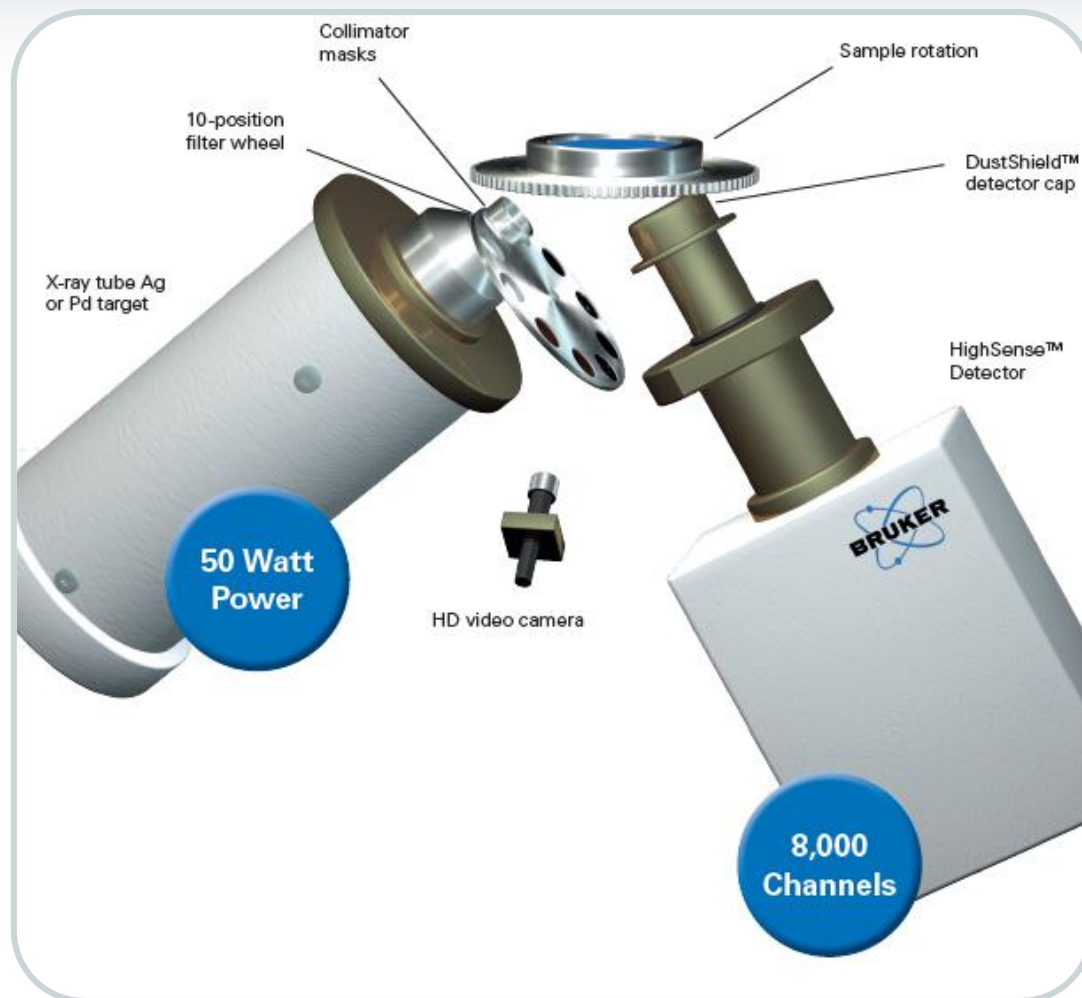
Powered by HighSense™ Technology



Optimal excitation of the sample is ensured by:

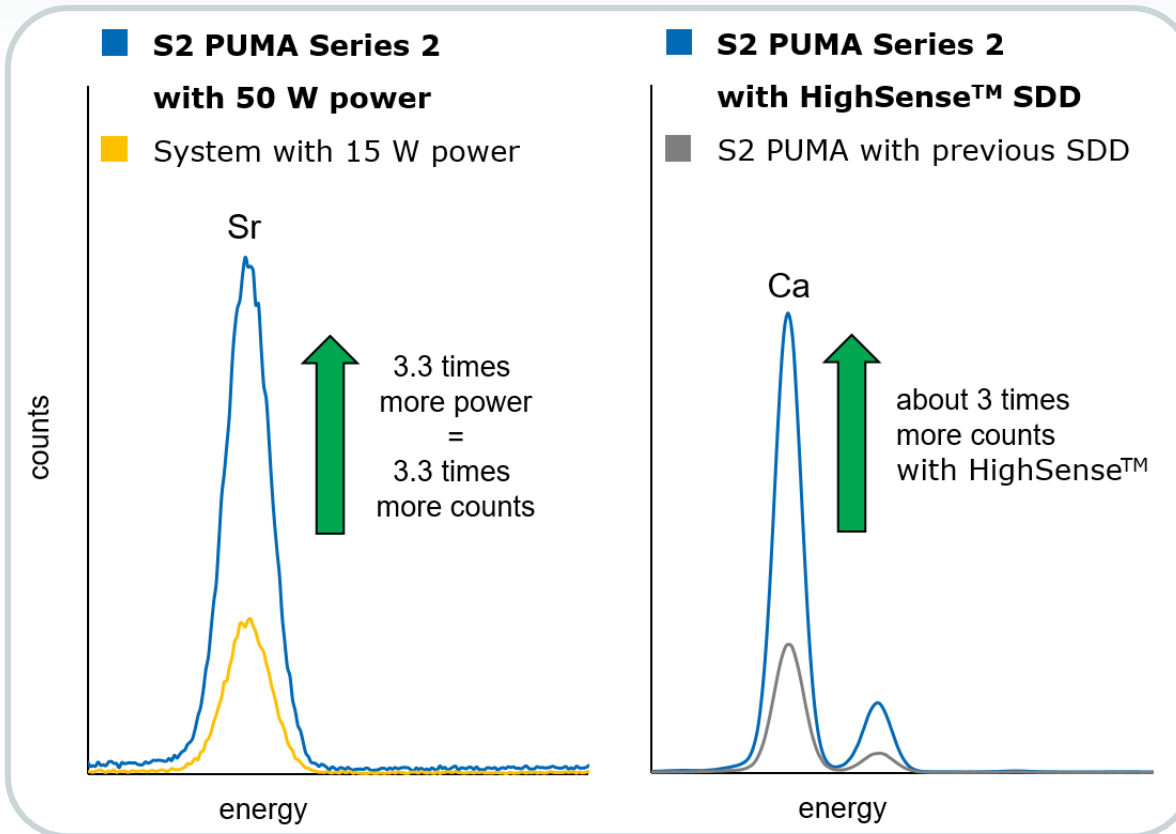
- High power 50 Watt X-ray tube
- Up to 2 mA and 50 kV
- Optional 30 kV version
- Closely coupled optics
- 10-position primary beam filter
- The Next generation silicon drift detectors (SDD) with super high count rate and excellent energy resolution

HighSense™ is the key to the unrivaled analytical performance of the S2 PUMA Series 2



S2 PUMA Series 2

Powered by HighSense™ Technology



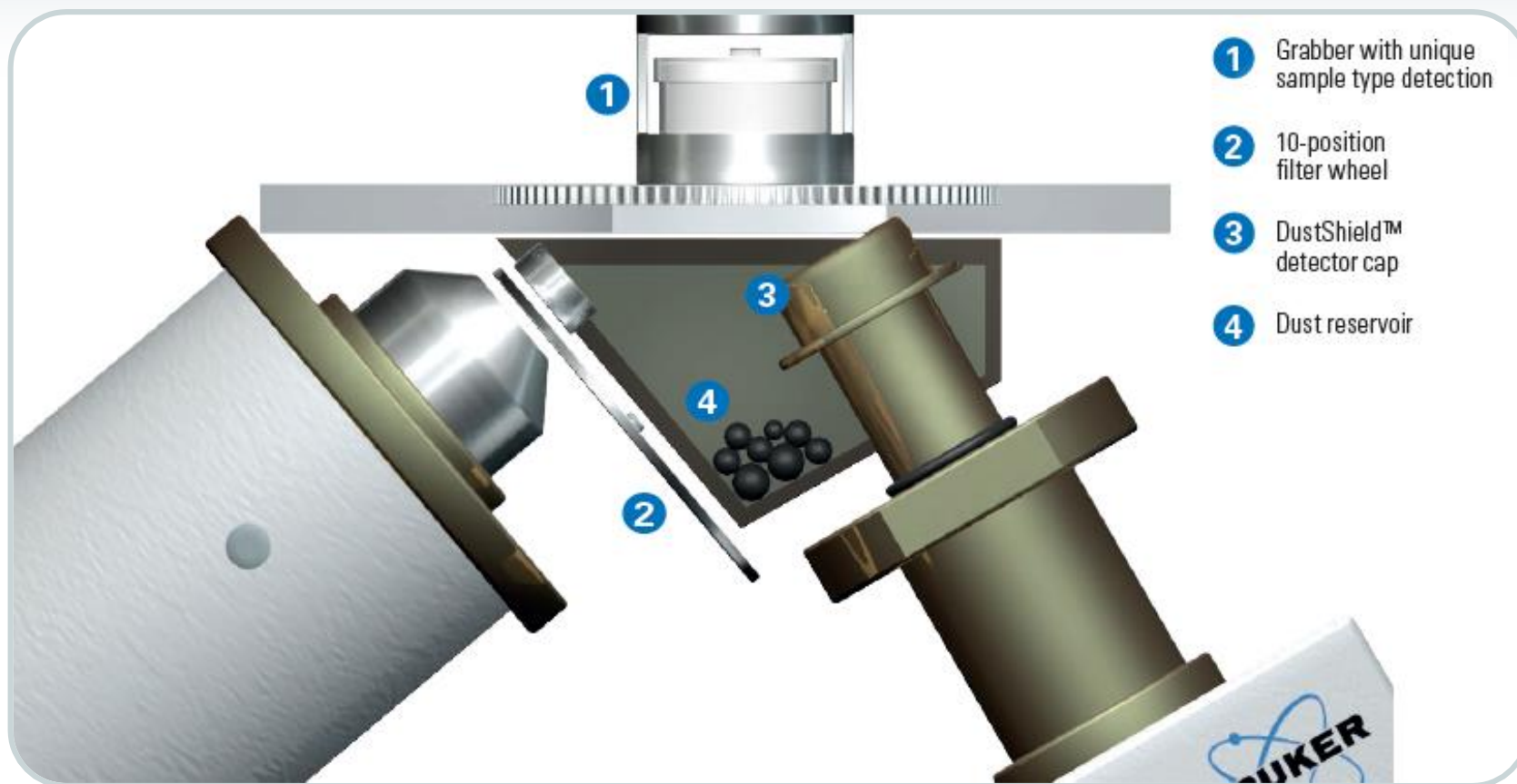
Up to 3 x Shorter Counting Time **and** Higher Precision,
thanks to HighSense™ Technology



- ## Always with 50 Watt Power!



SampleCare™ for High Uptime and Easy Maintenance



SampleCare™: A unique, multi-layer system to protect vital system components

S2 PUMA Series 2

Enhancing Performance, Reducing Cost



Helium Free Operation for Best Light Element Detection in Solid Samples

Lowest (0.08L/min) Gas Consumption for Lowest Running Costs for Volatile Liquids

Optimal Atmosphere

- Vacuum, Helium, Air, Nitrogen

For All Sample Types and Applications

- Solids, Liquids, Powders, Pressed Pellets, Fused Beads, Bulk



S2 PUMA Series 2 Even Faster!



Vacuum takes time? Not with the **S2 PUMA Series 2**

S2 PUMA Series 2

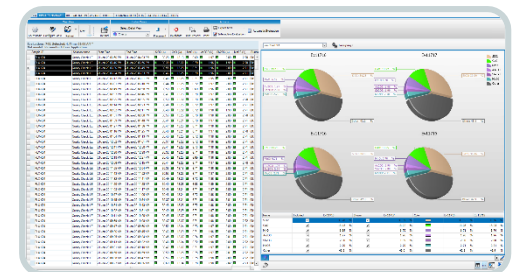
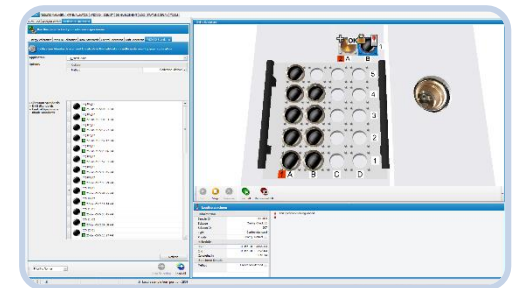
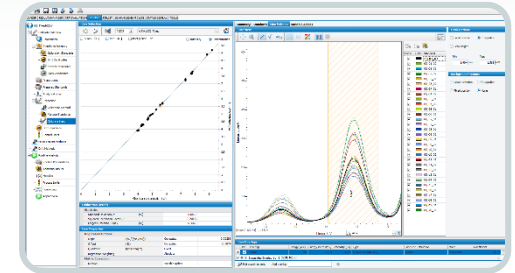
Next Generation Software



SPECTRA.ELEMENTS V3

The new standard in EDXRF

- **Faster & Stable**
 - Contemporary programming for rapid processing
 - Waiting and watching a spinning hourglass belongs to the past!
- **Powerful Feature**
 - Evaluation Plug-In: Re-evaluate **40%** faster!
 - Improved Post-Processing Tool
 - New Basic and Advanced Mode
- **Smarter**
 - Standardless solution, **SMART.QUANT FP**, based on state-of-the-art modeling approaches
 - Faster, more Flexible and more Accurate
- **Easier**
 - Improved User Interface
 - More Intuitive, More Flexible



S2 PUMA Series 2

Next Generation Software



Strict regulation?

No Problem!

- 21 CFR Part 11-compliant version for product quality applications in FDA-regulated industries
- Optional IQ/OQ procedures are offered with the installation of the instrument



Typical EDXRF Applications



Glass & Ceramics



Minerals & Mining



Metals & Slags



Academia



Pharma



Food & Feed



Cement & Building Materials



Material Research



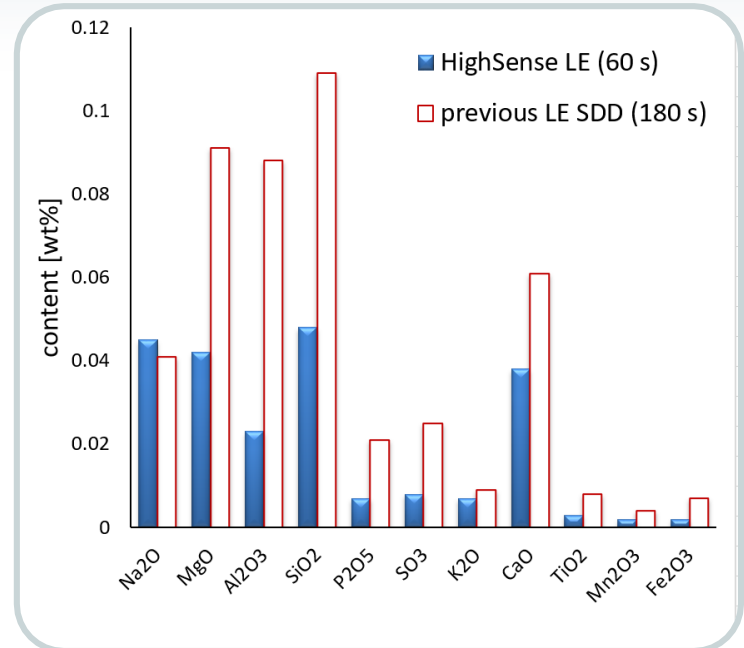
Petrochemistry

S2 PUMA Series 2 Industrial Applications



S2 PUMA Series 2

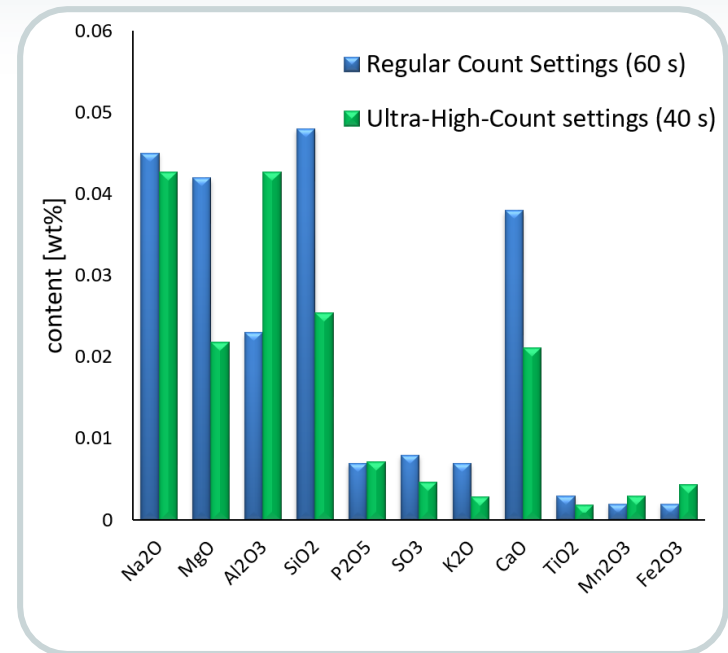
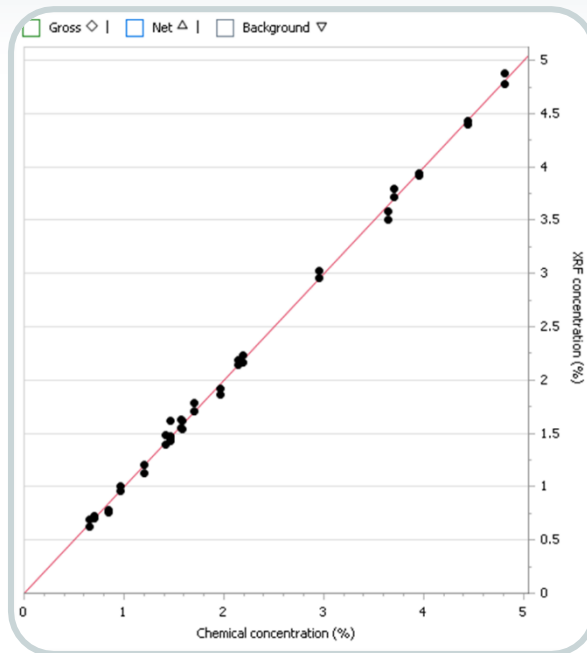
Best EDXRF Solution for Cement



- Professional integration into automated environments
- Boost in analytical performance with the new HighSense™ Detector
- Immediate payback: 3 x shorter counting time and better precision for most elements

S2 PUMA Series 2

Ultra-High-Count settings for Cement



- Allows to reduce the net measurement time by additional 30-40%!
- Similar precision

S2 PUMA Series 2

Ideal for Food and Feed



Requirements for Food and Feed analysis

Many elements:

- Na, Mg, Si, P, S, Cl, K, Ca, Mn, Fe, Cu, Zn, Se, Mo, ...

Wide range of concentrations:

- Low ppm to several wt%

Minimal sample preparation:

- Loose powder, 7 g of material placed in liquid cup with prolene thin film 3 μ m

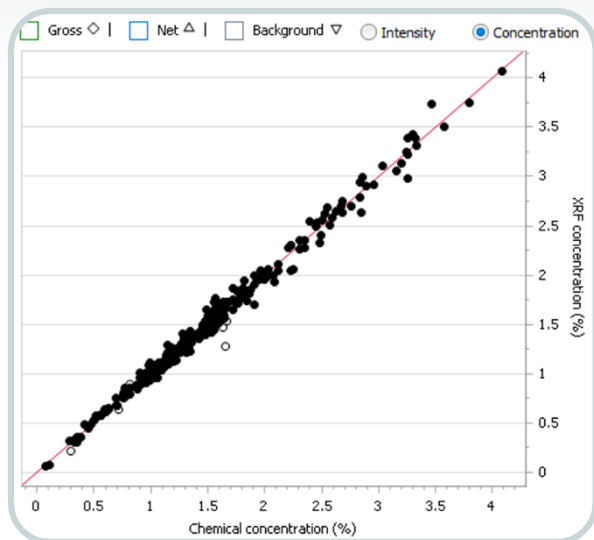
Several calibrations for different matrices

- Typically using large sets of reference materials and secondary standards which may not be very stable



S2 PUMA Series 2

Ideal for Food and Feed



Calibration curve K K α 1

- Excellent performance for loose powders
- We developed a transfer-kit in close collaboration with **Cumberland Valley Analytical Services**
- Allows the method transfer from one unit to another via analysis of few stable glass beads

	Compositional Ranges Master System [wt%]
Na	0 – 1.06
Mg	0.07 – 0.75
Si	0.16 – 4.75
P	0.06 – 0.74
S	0.06 – 0.56
Cl	0.04 – 2.67
K	0.11 – 6.07
Ca	0.01 – 2.65
Mn	3.9 – 288.6 ppm
Fe	20.9 – 2853.1 ppm
Cu	1.2 – 38.7 ppm
Zn	6.5 – 150.4 ppm
Se	0 – 586.5 ppm
Mo	0 – 27.7 ppm

S2 PUMA Series 2

Slag analysis made fast and reliable



There are different types for slags in steel production, e.g.:

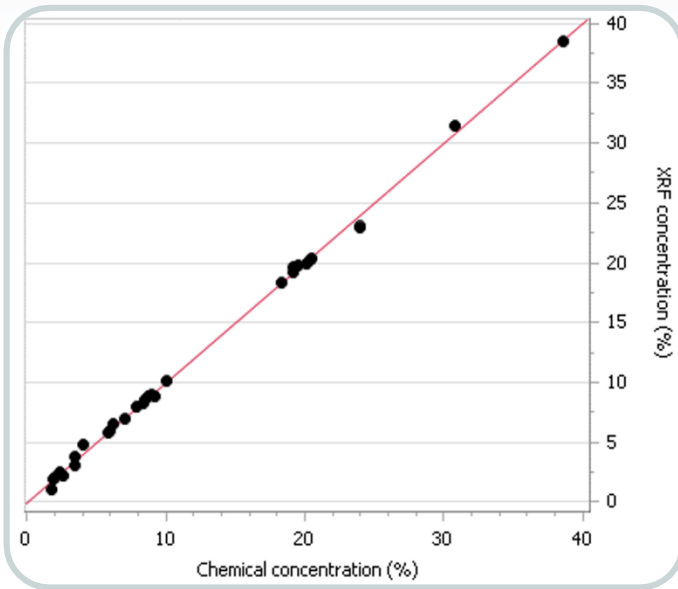
- Electric Arc Furnace (EAF) Slag
- Ladle Metallurgy Furnace (LMF) Slag

The difference in steel production procedure results in different slag compositions and, thus, in different requirements for analytical solutions.

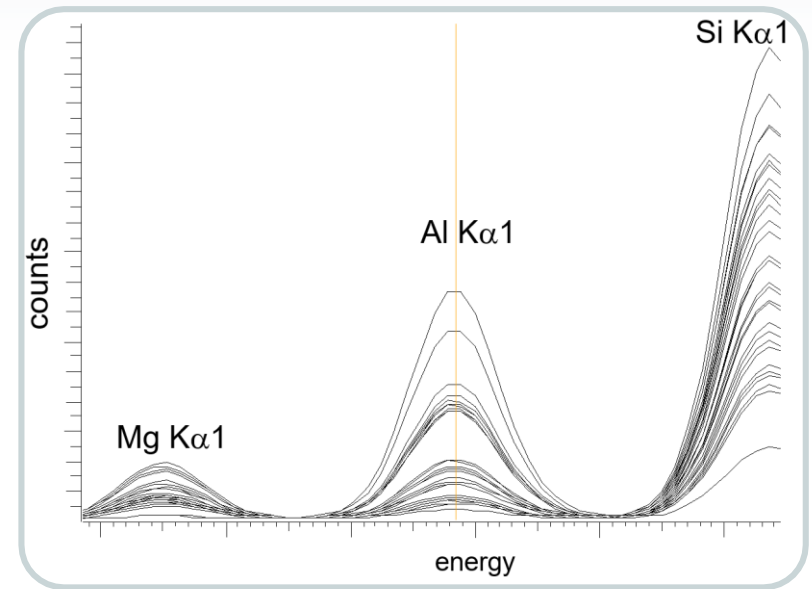


S2 PUMA Series 2

Slag analysis made fast and reliable



- Calibration curve for MgO



- Calibration peaks for Mg Kα1, Al Kα1 and Si Kα1

S2 PUMA Series 2

Slag analysis made fast and reliable



- Equipped with the HighSense™ LE detector, the S2 PUMA Series 2 achieves outstanding performance – even for light elements and with a single analytical range – in just **2 minutes** counting time!

Compound	EAF Slags [wt%]
MgO	2.4 – 23.5
Al ₂ O ₃	0.5 – 10.2
SiO ₂	4.7 – 48.7
P ₂ O ₅	0.01 – 16.7
S	0.03 – 0.2
CaO	1.2 – 42.9
TiO ₂	0.15 – 2.3
Cr ₂ O ₃	0.5 – 53.8
MnO	2.0 – 28
FeO	9.1 – 48.1

Elements	Voltage [kV]	Current [mA]	Measurement time [s]	Beam Filter	Mode
F, Mg, Al, Si, P, S, Ca, Ti, Mn, Fe	20	automatic*	120	none	Vacuum

*Current is maximized automatically for best count statistic.

S2 PUMA™ Series 2 Elemental Analyzer

Analyze. Everything. Faster.



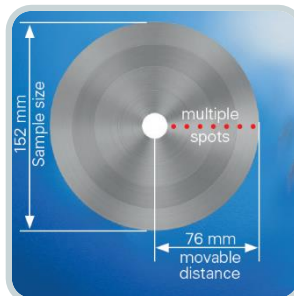
Enhanced Speed

- 3 x Higher Count-Rate
- 2 x Higher Pump-Rate
- Faster Software (e.g., 40% faster re-evaluation)



Enhanced Flexibility

- Mapping-Stage
- 18-Position Carousel Tray
- New Software Features



Enhanced Usability

- Improved User Interface
- Additional Maintenance Tools
- Powerful Post-Processing Options



Thank You!



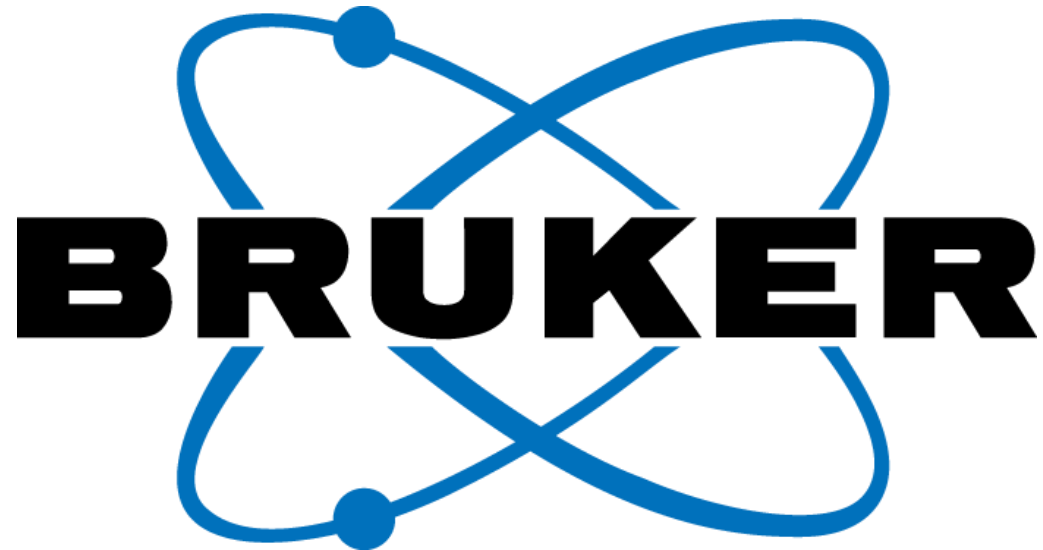
Questions?

- Please type any questions you may have in the Q&A panel and click *Send*

Feedback?

- Your comments will help us to improve future webinars.





Innovation with Integrity