BRUKER

S2 PICOFOX

● Benchtop TXRF Spectrometer

Innovation with Integrity
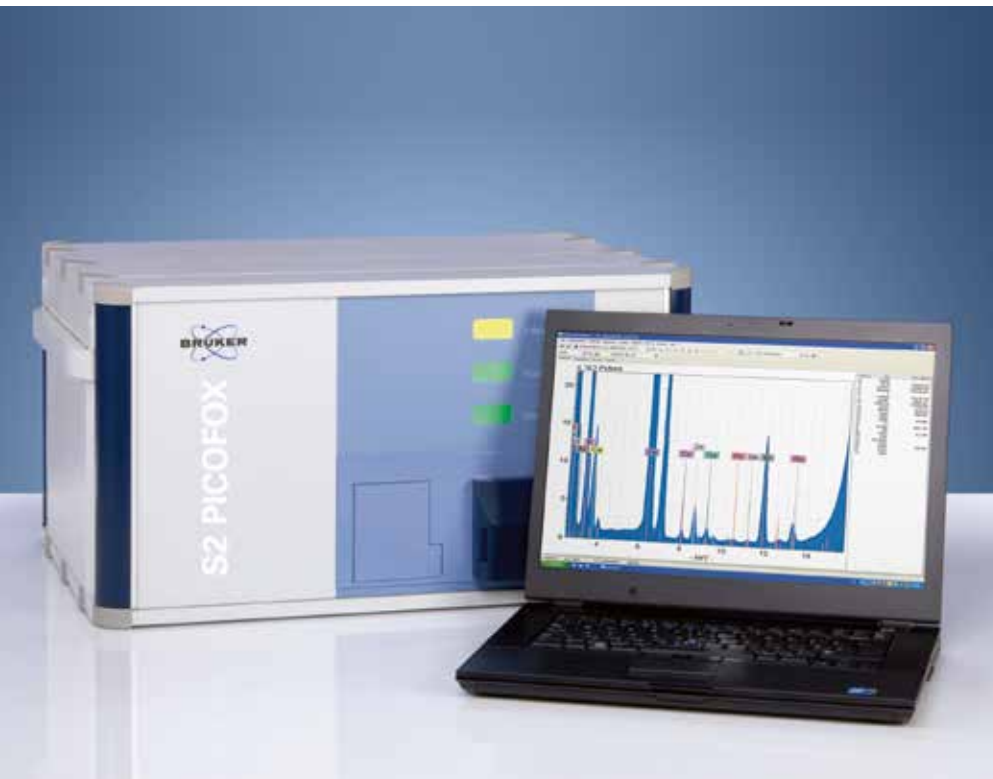
S2 PICOFOX - Fast Trace Element Analysis with XRF

The S2 PICOFOX is the world's first portable benchtop spectrometer for fast quantitative and semi-quantitative multi-element microanalysis of liquids, suspensions, solids and contaminations using the principle of total reflection X-ray fluorescence spectroscopy. Reaching detection limits in the ppb and ppm range, the S2 PICOFOX is optimally suited for trace element analysis.

You need to know the concentration of trace elements in environmental samples?

You only have the slightest amount of a biological sample available for analysis? No time for time-consuming sample preparation during industrial routine operation? The innovative S2 PICOFOX fits your needs perfectly.

The S2 PICOFOX uses the principles of X-ray fluorescence (XRF) analysis for the testing of liquids, powders and solid samples. The spectrometer detects trace elements in liquids down to 0.1 ppb. In contrast to most analytical methods, ng to μg sample amounts are sufficient for quantitative results.

Is TXRF a complicated element analysis method?

Not at all! The compact S2 PICOFOX instrument design allows even mobile use for measurements on site or in the field. First results are availbale within minutes.

The S2 PICOFOX works without expensive consumables, gases or liquid nitrogen. You can save your budget for the essentials - all the S2 PICOFOX needs is a power source.

System Configurations

Configuration	S2 PICOFOX 200	S2 PICOFOX 400	S2 PICOFOX 800
Basis system			
Benchtop housing with single sample changer, control unit w. electronics, HV generator	✓		
Benchtop housing with automatic sample changer control unit w. electronics, HV generator		✓	✓
Excitation			
Air-cooled fine focus X-ray tube, Mo target, 50 W + Multilayer monochromator 17.5 keV, flat	✓		
Air-cooled micro focus X-ray tube, Mo target, 50 W + Multilayer monochromator 17.5 keV, curved		✓	✓
Detector			
XFlash® Silicon Drift Detector, liquid nitrogen-free, < 149 eV, 30 mm²	✓	✓	
XFlash® Silicon Drift Detector, liquid nitrogen-free, ≤149 eV, 60 mm²			✓
Extensions			
Gas purge system for nitrogen		optional	✓
Computer			
Configured notebook, International Package	✓	✓	✓
Software			
Measurement software S2 PICOFOXControl	✓	✓	✓
Super Bayes Quantification routine	✓	✓	✓
Measurement job editor for automatic sample changer		✓	✓
Sample tools			
Set of 25 quartz discs	✓	✓	✓
100 disposable sample discs, diameter = 30 mm	✓	✓	✓
Sample cassette for 25 discs		✓	✓
Washing cassette	✓	✓	✓
Sample container for 1 disc, set of 25	✓	✓	✓
Tool for sample centering	✓	✓	✓

Key advantages compared to atomic spectroscopy methods (e.g. AAS, ICP-OES)

The possibility to measure samples directly, in most cases without digestion, provides fast results of even unknown samples.

- Simultaneous multi-element trace analysis including halogenides
- Extended linear concentration range from ppb to percent
- Simple quantification using an internal standard

- Portable system for fast in-field analyses
- Low operating cost, no need for any media, disposables or periodic maintenance
- Suitable for various sample types and applications, e.g. liquids, suspensions, solid materials, thin films, filters or contaminations
- Analysis of smallest sample amounts, partly non-destructive
- Robust technology, which can be used for students training

Challenging Samples - No Worries with S2 PICOFOX

Analysis of heavy metals in sewage samples

The discharge of sewage is strictly regulated throughout the world. Testing for heavy metals in sewage by conventional methods, such as ICP, requires complete digestion of the sample using hazardous chemicals. This time-consuming and destructive sample preparation step can be omitted with the S2 PICOFOX. Untreated sewage can be diluted with a detergent solution (1:10) and measured immediately after the addition of an internal standard.

Key elements (e.g. chromium, arsenic, lead) are detectable far below usual treshold values. The simple sample preparation leads to quick results and allows immediate, continuous monitoring of sewage treatment.

Investigation of metallo-proteins

Quite often, only very limited sample amounts are available for elemental analysis in protein research. In order to understand the biological function of a protein, its metal content must be carefully measured. While other analytical methods fail due to the small sample amount, a few microlitres are sufficient for the analysis with the S2 PICOFOX.

The stoichiometric relationship of metals in enzymes can be determined, resulting in the characterization of biological enzyme functions.

Authenticity tests of pharmaceutical samples

The characterization of brand drugs and their generics is an essential task in pharmaceutical analysis. The analysis through methods like AAS or ICP-OES is often restricted by sample quantity, the necessity of sample digestion and matrix-related difficulties, whereas TXRF/XRF allows for trace element analysis of samples in the microgram range. As this method is based on internal standardization, no standards for external calibration are needed.

For instance, a quantitative fingerprint analysis of various aspirin drugs will lead to a clear identification of brand products.

### Quality control of liquid nutrients and milk powder

The quantitative measurement of macro- and micronutrients is possible when using the S2 PICOFOX. Liquid samples can be analyzed directly. Any powder sample has to be suspended in a detergent and measured after internal standardization.

Measurements with the S2 PICOFOX provide accurate, reliable results and demonstrate detection limits below 300 ppb for micronutrients in milk and liquid nutrional products.

Further application fields

- Trace elements in river, lake and sea water

- Toxicological analysis of blood and urine*

- Monitoring of cancer medication in blood*

- Quality and origin control and of wine

- Elemental composition of nanoparticles

- Fast wipe tests for contamination control

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* For research use only. Not for use in diagnostic procedures.
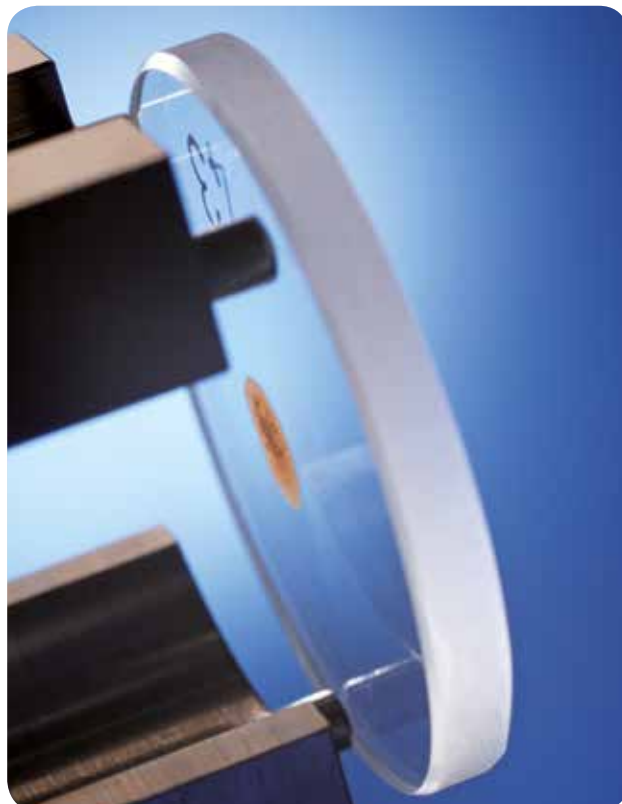
Minimum Sample Preparation - Maximum Results

TXRF Principle

XFlash® Detector

Multilayer Monochromator

Sample on Polished Carrier Disc
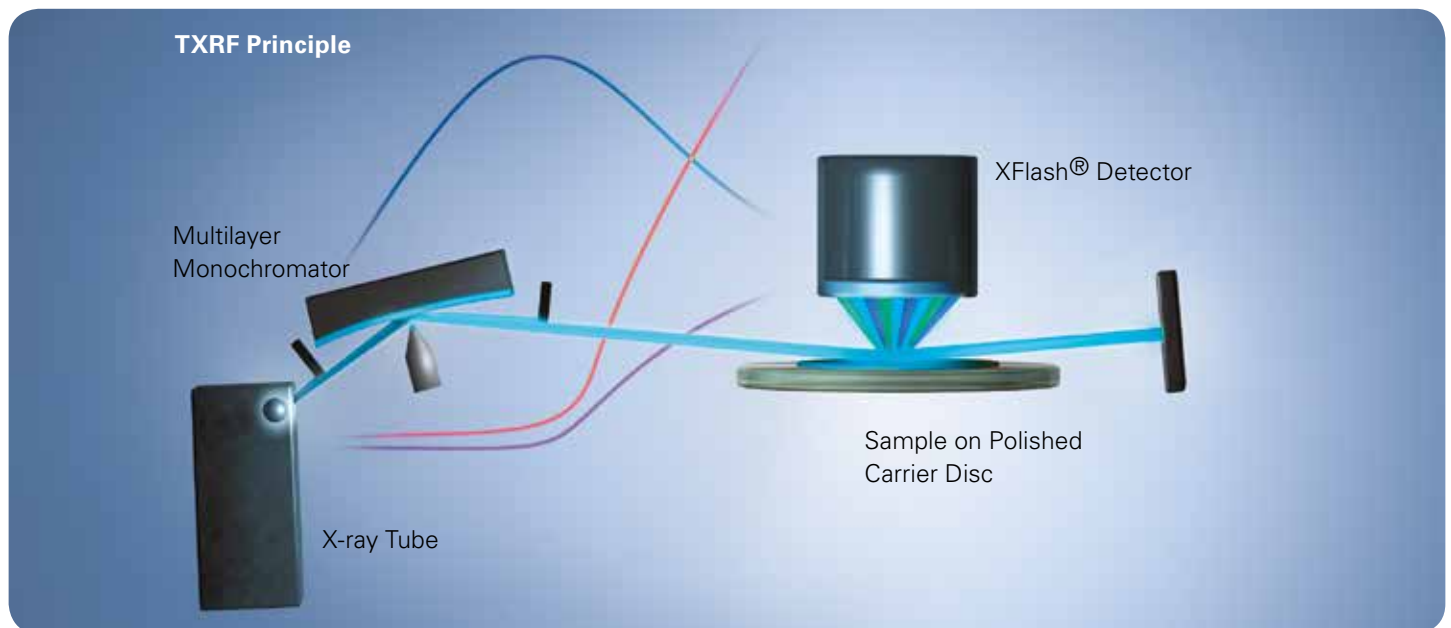
X-ray Tube

What is TXRF?

The S2 PICOFOX working principle is based on the method of total reflection X-ray fluorescence (TXRF) analysis. An air-cooled X-ray tube with molybdenum target generates an X-ray beam, which is reduced to a narrow energy range by a multi-layer monochromator. The fine beam impinges on a polished sample carrier at a very small angle (< 0.1°) and is totally reflected.

The characteristic fluorescence of the sample is emitted and measured in an energy dispersive X-ray detector. Due to the short distance to the carrier, the fluorescence yield is very high and the absorption by air is very low. The main difference between TXRF and conventional XRF spectrometers is the use of monochromatic radiation and total reflection optics. Illuminating the sample with a totally reflected beam reduces absorption and scattering of the beam in the sample matrix. Resulting benefits include a significantly enhanced fluorescence yield, largely reduced background noise, and consequently much higher sensitivities to elements that occur only in traces.

How often is a calibration required?

The S2 PICOFOX comes factory-calibrated and ready to use. Day-to-day quantification of unknown samples therefore only requires the additon of an internal standard element, such as gallium. Due to the thin sample layer, the fluorescence intensity of an element is directly proportional to its concentration in the sample. The quantitative analysis is highly accurate at all concentrations from ppb to 100 percent and requires no further calibration by the user.

Why Wait for Sample Prep!

Just a few steps are required for the sample preparation prior to an elemental analysis with TXRF. The most important advantages are:

- Direct analysis of liquids, suspensions and particles

- Precalibrated instrument – simple quantification by internal standardization

- Safe method – almost no hazardous chemicals needed

- Low cost of operation – no media or consumables required

The preparation procedures for the most common sample types are described here in detail.

Particles

Nanoparticles, contaminations, proteins, gunshot residue, aerosols.

Liquid samples

Wastewater, freshwater, beverages, urine and other body fluids, organic solvents.

- Micro reaction tube with liquid sample

Suspensions

Suspensions and matrix rich liquids: sludges, sea water, liquid nutrients, whole blood, blood serum, tissue homogenates, dyes.

- Tube with raw suspension

- Dilute sample with distilled water

Solid samples

Soils, sediments, tablets, polymers, food, lubricants, catalyzer, glass splinter, ashes.

- Fill powder in an agate mortar or micro mill and grind carefully

- Weigh about 20 to 100 mg, note exact amount

- Transfer quantitatively to a tube

● Sample Preparation

- Dab vacuum grease on carrier

- Pick-up some particles with (glass) rod

- Drop particles on grease

Dry 10 min

- Load the instrument

- Add internal standard

- Homogenize carefully

- Pipette 5 to 20 µl on carrier

Measure 5 - 15 min

- Add internal standard

- Homogenize carefully

- Pipette 5 to 20 µl on carrier

TXRF spectrum

- Suspend in 1 to 5 ml detergent solution and add internal standard

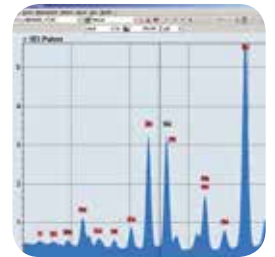

- Homogenize carefully

- Pipette 5 to 20 µl on carrier

Create a PDF file or print report

● Operation Time and Costs

How fast is TXRF?

Effective quality and process control requires the shortest time-to-result possible. This is the time needed from sampling to the final quantitative result. Avoiding several preparation steps will shorten your time-to-result significantly as shown on the chart on the right side.
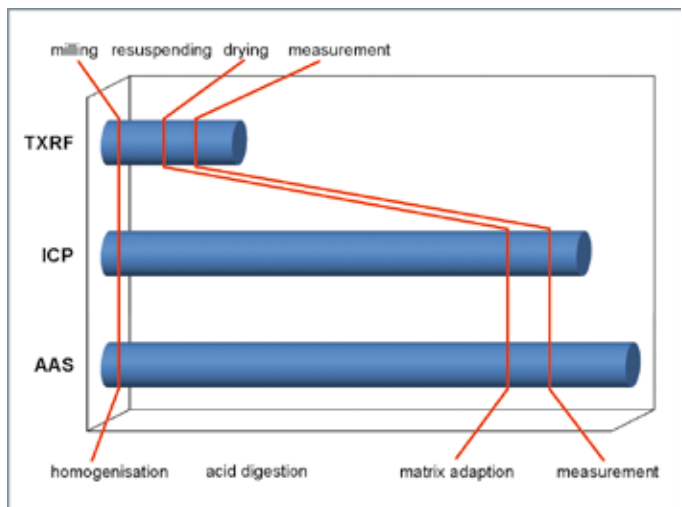
- Digestion is not required for most sample types.
- The instrument is calibrated ex works, which will save up to 30% of your daily work time.
- The one-point quantification procedure with an internal standard provides accurate results automatically, hence the effort for training and lab standardization will be minimized.

Comparison of the total process time for different analytical methods

### Lower operation costs with TXRF

TXRF displays the lowest operation costs in comparison to other atomic spectroscopy methods. The S2 PICOFOX spectrometer is almost maintenance free and modern low-power tubes are typically stable for several years.

- No use of expensive accessories (torches, cones, hollow cathode lamps)
- No need for consumables (carrier gas, reaction gas, collision gas, calibration standards)
- No equipment and hazardous chemicals for sample digestion procedures needed
- No expensive maintenance contracts required.

Comparison of the operation costs for different analytical methods
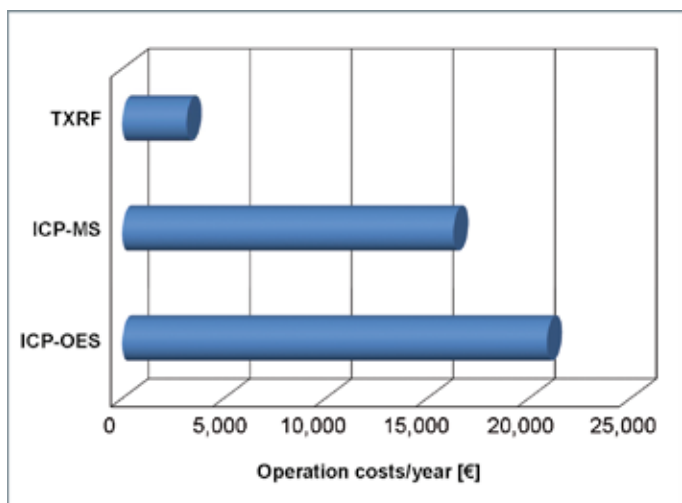
Technical Specifications

Element range	Mo excitation: Al to U (with exception of Nb to Ru)
Concentration	ppb to 100 %
Detection limit	<2 pg Nickel
Sample types	Liquids, suspensions, powders, particles, metals, thin layers, tissues, wipes, filters etc.
Sample volume	Liquids and suspensions from 1 µl to 50 µl Particles up to 100 µm in diameter, powders up to 10 µg
Sample carrier	25 quartz and 100 acrylic glass carriers (30 mm diameter) included in delivery
Sample changer	Manual version for single samples Automatic version with cassette for up to 25 samples
X-ray tube	50 W metal-ceramic, max. 50 kV, 1 mA air-cooled, Mo target
X-ray optics	Multilayer monochromator
Detector	Peltier-cooled XFlash® Silicon Drift Detector No need for liquid nitrogen 30 / 60 mm^2 active area Energy resolution <149 eV at 100 kcps (Mn Kα)
Interface	Data exchange by RS232 serial interface Sample changer with RS232 (automatic version)
Mains	100/240 V, 50/60 Hz, max. power consumption 180 W
Size	300 mm x 590 mm x 450 mm (height x width x depth)
Weight	39 kg
Accessories	Washing cassette for sample carriers Sample cassette for 25 carriers Starter set for TXRF (pipettes, tips, tubes, mortar, spatula)

XFlash® is a trademark of Bruker Nano GmbH

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