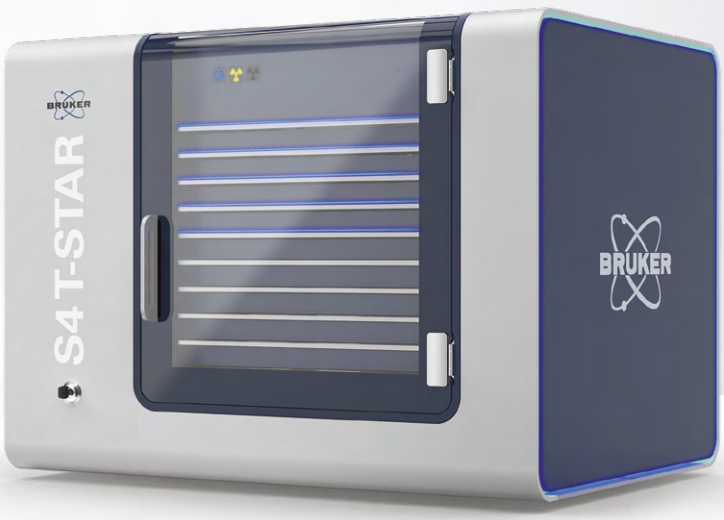

TXRF

GIXRF Option for the S4 T-STAR®

Advanced material characterization on the bench

What is Gracing Incidence XRF?

In TXRF (Total Reflection X-ray Fluorescence) geometry, a sample is measured at a fixed angle below the critical angle of total reflection.

A GIXRF (Gracing Incidence X-ray Fluorescence) configuration excites the sample by changing the beam angle in a range close to the angle of total reflection. Depending on the sample type, deposited mass and thickness, different signal profiles are measured.

The GIXRF option for the S4 T-STAR® is a unique tool for non-destructive material analysis with a compact benchtop TXRF spectrometer. Typical applications comprise the rapid qualitative evaluation of sample structures like nanoparticles, monolayers or stratified layers. This allows the control of diffusion processes in multilayer systems or the investigation of depth profiles of metal dopants in substrates.

Features

- S4 T-STAR® spectrometer equipped with a special monochromator for parallel beam forming (Mo-K, 17.5 keV)
- Minimum angular scan interval 0.001°
- Scan with two different interval settings allows the fine scan of a region of interest
- Use of square and round reflective carriers up to 2″ in size
- Standard samples for angle calibration

Benefits

- Save limited and valuable time on synchrotron beamlines by pre-qualifying samples
- Rapid screening thanks to automatic scan routines, data evaluation and export
- Large scan range, no shadowing effect, no spatial conflict of sample and detector

Applications

Angle calibration

The GIXRF option is delivered with a calibration standard set whose typical scan profiles are shown in Figure 1. The system performs angular scans with a stepper motor and the basic instrument settings are performed in steps. Conversion to angle values has to be done using standard elements with known critical angles of total reflection. Here, the intrapolation of the calibration results in a step value of 3376 for an instrument angle of 0°.

Nanoparticle analysis

The S4 T-STAR® performs GIXRF measurements on nanoparticles of different sizes successfully. The angular scans of gold nanoparticles in the range of 10 nm to 50 nm are in good agreement with simulated model calculations as shown in Figure 2.

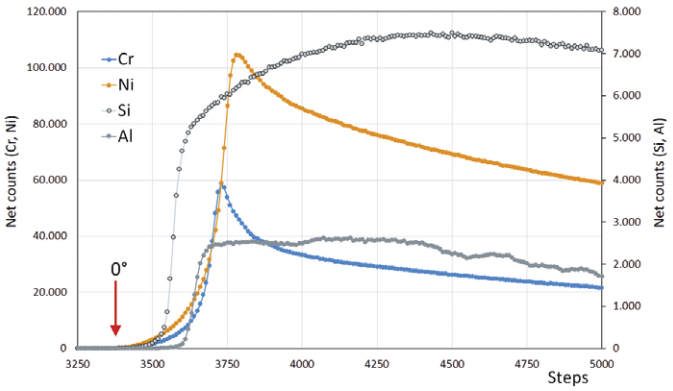

Figure 1 (top)
Angular scan of calibration standards, scan interval ~0.0025°, measurement time/point = 20 s, 200 measurements.

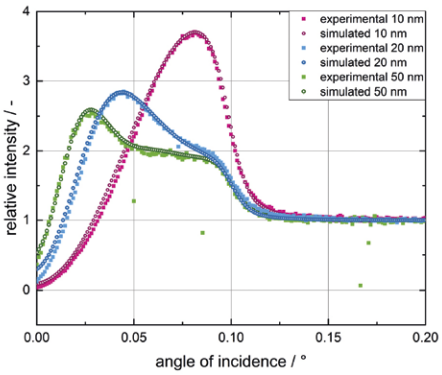

Figure 2 (left)
Angular scans of gold nanoparticles.

GIXRF specifications	
Element range	Mg – U
Excitation	Mo-K (17.5 keV), parallel beam optics
Angular scan range	± 3°
Scan interval	0.001°
Depth resolution	< 1 nm
Depth range	0.1 nm – 1 µm
Software	T-ESPRIT with GIXRF option
Installation requirements	100 – 240 V / 50/60 Hz, no cooling water or gases
Calibration standards	Sapphire (Al) disc, quartz (Si) disc, disc with Cr layer, disc with Ni layer

Literature

1. Laboratory based GIXRF and GEXRF spectrometers for multilayer structure investigations
doi.org/10.1039/c8ja00427g

2. Laboratory GIXRF as a tool for fast screening of stratified samples with sub-nanometer thickness – the example of CrSc multilayer water window optics
doi.org/10.1016/j.sab.2020.105995

All configurations and specifications are subject to change without notice.
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