Application Note — *FOX2D CU 12_INF* collimating optics

SAXS (Small Angle X-Ray Scattering) applications

The SAXS technique is performed in transmission mode. The scattering features at these angles correspond to structures ranging from tens to thousands of Angstroms.

In this mode, polymer samples are typically 1-2 mm thick, leading to about 60% absorption of the incident x-ray (Cu K_α) beam.

The related experiments were performed in order to demonstrate the Xenocs mirror advantages for SAXS applications.

The FOX optics achieves very low values of minimum detectable scattering vector (q_{min}) while providing high flux on the sample and low background.

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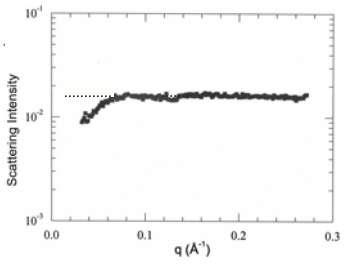
Courtesy of
Dr. A. de Geyer

X-ray generator	Nonius FR591 RAG
Point source	0.1 x 0.1 mm²
Working Power	1200 W (40 kV, 30 mA)
Xenocs optics	*FOX2D CU 12_INF*
3 slits configuration	vacuum tubes between the slits
source-sample distance	350 cm
Measured divergence (with a CCD camera)	V=0.88 mrad FWHM H=0.75 mrad FWHM

Flux improvement highlight

Figure 1

SAXS spectrum in absolute scale for a water sample (1 mm thickness) obtained after correction of the scattering from the empty cell (Kapton® windows).



Acquisition time: 1 hour

2D position sensitive gas (Xe - C_2H_6) detector.

Sample - detector distance: 108 cm

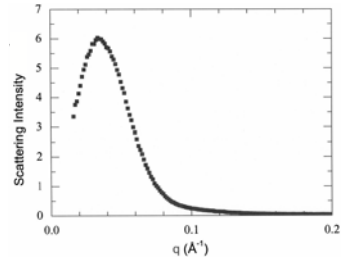
Beam size at sample position : 1.8 x 1.8 mm² (FWHM)

The dotted line corresponds to the expected value calculated for 1 mm water sample.

Flux on the sample : 10^8 photons/s
Flux improvement by a factor of 5 at equivalent resolution compared to previous setup with KB mirrors

Figure 2

SAXS spectrum in absolute unit obtained with a lupolen sample (2.8 mm thickness).



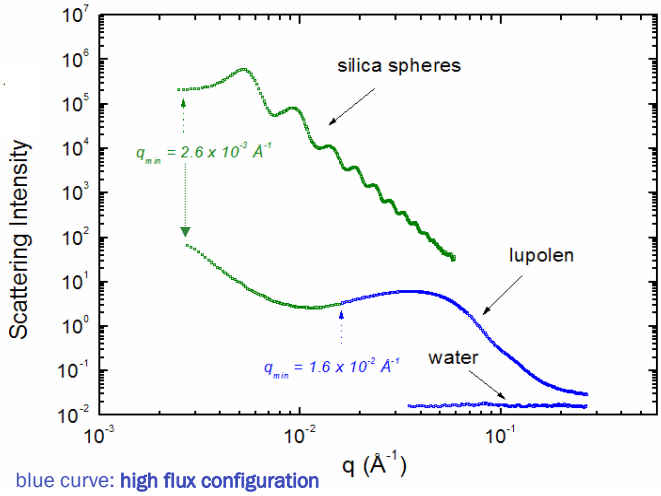
Acquisition time : 600 s

2D position sensitive gas (Xe - C_2H_6) detector.

Sample - detector distance: 108 cm

Beam size at sample position: 1.8 x 1.8 mm² (FWHM).

q_{min} reduction highlight



blue curve: **high flux configuration**

sample-detector distance : 108 cm

beam size at sample position : 1.85 mm (FWHM)

flux through sample : 8 x 10^7 counts/s (in detector units)

q_{min} : 1.6 x 10^{-2} Å^{-1}

The typical goal to reduce q_{min} (minimum scattered angle) for each configuration is mainly taking advantage from the following features :

- **low divergence and high reflectivity for high flux**
- **low background level and available flux at reduced slits aperture for high resolution.**

green curve: **high resolution configuration**

sample-detector distance : 354 cm

beam size at sample position : 0.45 mm (FWHM)

flux through sample : 5 x 10^6 counts/s (in detector units)

q_{min} : 2.6 x 10^{-3} Å^{-1}

As the flux was sufficient on his setup, Dr de Geyer added another focusing mirror behind the *FOX2D CU 12_INF* to reduce again the q_{min} range down to 1.8 x 10^{-3} Å^{-1}

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