
# High resolution capabilities with the Xeuss 2.0 SAXS/WAXS system

The ability of the Xeuss 2.0 SAXS/WAXS system to reveal the sample nanostructure is directly related to its ability to achieve low detected wave vector ($q_{min}$) values, without compromising angular resolution.

## Introduction

Study of nanostructures (such as nanoparticle powder, suspension,…) aims to determine their characteristic lengths (diameter, interparticle distance,…). In SAXS investigation, such parameters are deduced from mathematical model fitting of the collected data. Therefore, accurate data are required to allow relevant and correct data modelization.

Large nanostructures with characteristic lengths up to 250 nm can only be defined using a SAXS instrument configuration that displays a low $q_{min}$ value. However, the number of available data points at low q values must be sufficient to enable accurate fitting. This feature is directly related to the angular resolution Δq of the SAXS system. In the case of nanoparticle investigation, their signature appears as oscillations in the 1D scattering curve. The minima and maxima definition is dependent on the incident beam size, and a compromise between the collimating aperture and the downstream photon flux must be defined by the operator.

SAXS measurements have been performed on a $SiO_2$ powder and demonstrate the capability of the Xeuss 2.0 SAXS/WAXS system to provide a low $q_{min}$ value combined with a high angular resolution.

## Measurements & results

SAXS measurements have been performed on a $SiO_2$ (Ø 150 nm) powder, using various slit apertures.

The scattering curves collected with the Very High Resolution (VHR) and High Resolution (HR) settings demonstrate the capacity to achieve low q values, as shown on Figure 2. Thanks to the Scatterless 2.0 technology , the beam is extremely clean at the edge of the beamstop. For these reasons, such ultimate $q_{min}$ values down to 0.025 $nm^{-1}$ are enabled by shifting the beamstop, as depicted in the 2D pattern (Figure 1).

Switching between different slit settings is performed by one single instruction in the acquisition software and no further intervention is required. This same ease of use is available to control the beamstop position.

Both scattering curves display a typical $q^{-4}$ dependence as it is assumed on dry powders. The intensity spans over more than 6 decades, allowing complete characterization of large particles.

One can observe the particle signature up to approximately 6 oscillations or more, associated local minima being emphasized with the VHR setting. Hence, one can choose between higher peak definition using the VHR setting to enhance data analysis, while samples screening can be performed using the HR setting.

At a sample-to-detector distance equal to 2.5 m, more than 14 experimental data points (no over sampling) between two local maxima of the scattering curve are displayed, as shown on Figure 3. The associated pixel resolution is equal to Δq = 0.003 $nm^{-1}$. This ensures the ability of the system to investigate particles up to 250 nm and probably beyond.

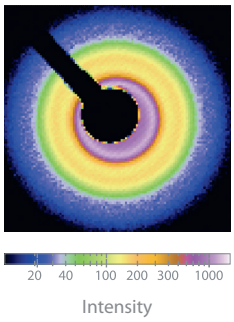


**Fig. 1** - 2D SAXS pattern of $SiO_2$ powder with beamstop offcentered.

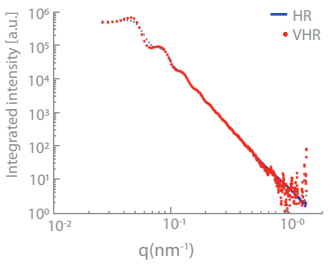


**Fig. 2** - Scattering curves from $SiO_2$ powder. Influence of the collimation setting on the data quality. Exposure time = 600 s.

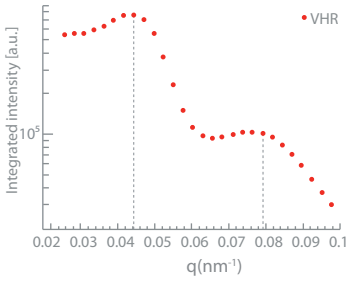


**Fig. 3** - Inset in low q_region of the scattering curve for VHR setting

## To go further

In application fields such as colloids and polymer materials, high quality SAXS investigation of much larger nanostructures with characteristic lengths of 500 nm is of interest. It requires a $q_{min}$ value down to 0.01 $nm^{-1}$ or below. High quality data analysis can only be performed with an associated nominal resolution equal to Δq = 0.001 $nm^{-1}$. This ensures data with a sufficient number of data points and enables accurate model fitting procedure. The USAXS version of the Xeuss 2.0 SAXS/WAXS system provides such features.



Xenocs SA - 19 rue François Blumet - 38360 Sassenage - France
Phone: +33 (0)4 76 26 95 40 - Fax: +33 (0)4 76 26 95 49
E-mail: sales@xenocs.com - www.xenocs.com