Discovery Mode with Pilatus3 R 1M and SWAXS module

The Discovery Mode enables to reveal the full structure of your sample without changing sample-to-detector distance.

Introduction

Before starting a new SAXS/WAXS experiment on an unknown sample, it is advised to get prior information about its characteristic dimensions from complementary techniques or literature. Such information is required to determine the appropriate q_range to investigate. However, you might not always get the answer. Moreover, you may want to quickly investigate a sample set from the nanoscale to the crystalline scale.
The Discovery Mode offers the unique capability to cover a large and continuous q_range from 0.037 nm^{-1} up to 30.53 nm^{-1}, which allows identification of relevant domains. Sample screening can be performed in a time saving mode, since such angular coverage is achieved with one single measurement (without spending time in detector motion along beam axis).

Measurements & results

A block copolymer sample was investigated by a simultaneous SAXS and WAXS acquisition using the Xeuss 2.0 SAXS/WAXS system. The experimental set-up integrates two DECTRIS detectors: a PILATUS3 R 1M detector and a proprietary hybrid pixel SWAXS module. The SAXS sample-to-detector distance $d_{SD\ SAXS}$ is equal to 569 mm. A 10 min exposure time was performed. The obtained 2D patterns are depicted in Figure 1. The corresponding scattering curve (Figure 2) demonstrates several areas of interest over a large q_range (Table 1), enabling the measurement of structures at both the nanoscale and the crystalline scale of a sample simultaneously. The scattered intensity spans over nearly 5 decades, which emphasizes the capability to detect both weak and strong scattering signals.
Then, a specific q_range of interest can easily be defined for further analysis if required. Measurement at a longer sample-to-detector distance will provide a better angular resolution and flux/q_min compromise, while measurement at a shorter detector distance will cover a larger azimuthal angle of detection.

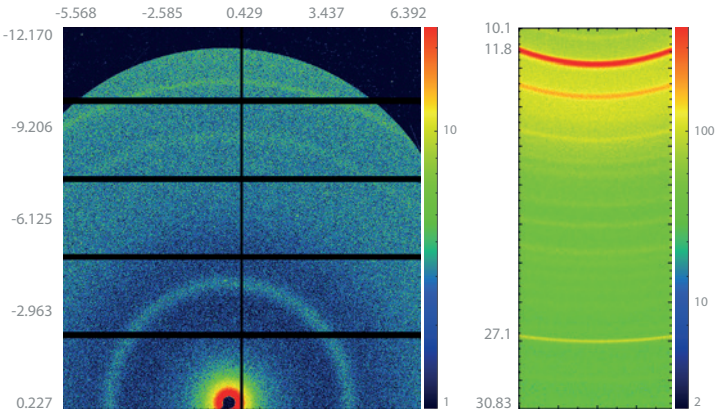

Fig. 1 - 2D SAXS (left - PILATUS3 R 1M detector) and WAXS (right - SWAXS module) patterns from a block copolymer sample obtained at $d_{SD\ SAXS}$ = 569 mm. Exposure time = 10 min. Axis unit = q [nm^{-1}].

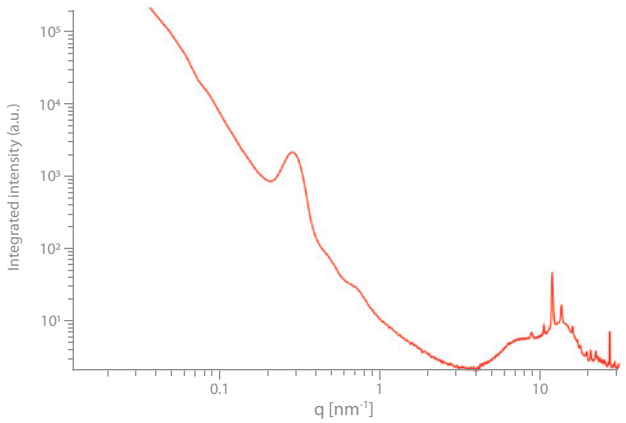

Fig. 2 - Scattering curve from a block copolymer sample resulting from simultaneous SAXS/WAXS measurement at $d_{SD\ SAXS}$ = 569 mm. Exposure time = 10 min.

To go further

The continuous extended data collection area with Discovery Mode could be sufficient to explore most samples and optimizes the Xeuss 2.0 throughput.
It allows the comparison of different processing conditions, the determination of structural organization at different length scales or reveals a totally disordered state, as a few examples. *In-situ* multi-scale dynamic studies and investigation of phase transitions are possible as a function of temperature, stretching force, electric or magnetic fields.

	q [nm^{-1}]	2θ [°]
min	0.037	0.052
max	30.53	44.00

Table 1 - q_range and corresponding 2θ range . The Discovery Mode of the Xeuss 2.0 provides structural information about unknown samples nearly 3 decades in q (typical d_spacing [0.2 - 170] nm) with a single measurement.

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