A SAXS/WAXS laboratory instrument for nanomaterials characterization

Olivier Taché, Antoine Thill, David Carriere, Fabienne Testard, Olivier Spalla

A SAXS/WAXS LABORATORY INSTRUMENT FOR NANOMATERIALS CHARACTERIZATION

Olivier Taché, Antoine Thill, David Carrière, Fabienne Testard, Olivier Spalla
LIONS, NIMBE, CEA, Université Paris Saclay, CEA Saclay, 91191
Gif-sur-Yvette, France.

Abstract:
Small Angle X-ray Scattering (SAXS) allows traceable measurements of size, size distribution, surface area, concentration and shape of nanomaterials in solutions, powders and in bulk materials.
We present here a custom-made state-of-the-art SAXS laboratory instrument (see Figure 1) based on Mo X-ray generator. Its design has been thought and optimized for the wide angles (WAXS) for investigate nanostructured material in particular in the size range from below 1 nm to above 20 nm.
The X-ray generator is a molybdenum (17 keV) rotating anode. A combination of a multilayer collimating mirror and a patented hybrid slits gives us a very sharp and high purity beam for a laboratory setup, with a size of 1x1 mm2 and a flux of 10^8 photons/s.
The motorized sample holder can load 20 capillaries, a temperature controlled system or a circulation environment system for kinetic studies.
A vacuum chamber is placed behind whose output window diameter is designed for the 2D image plate Mar345 detector. The accessible q-range is qmin = 0.03 Å-1 to qmax = 3 Å-1.
A special attention was given to the complete data treatment processing (absolute intensities, uncertainties, reference samples, calibration,…), enable us to make traceable measurements.
Combining molybdenum energy and the state-of-art experimental setup provide us with a very powerful tool for nanomaterial studies [2][3].
We present here some results obtained with this experiment for inter-laboratories characterization studies in particular of silver nanoparticles, and Si nanoparticles.

Keywords: nanomaterials, nanoparticles, characterization, size and size distribution, nanoparticles concentration, inter-laboratories studies

Figure 1: photographic view of the SAXS-WAXS setup.

Figure 2 : SAXS datagram of silver nanoparticle (blue) and the fit model (red)

References:

Taché O. and al.
MOMAC: A SAXS/WAXS laboratory instrument dedicated to nanomaterials
Reviw Sci. Instr., In Press.

Fleury B. and al.
Gold Nanoparticle Internal Structure and Symmetry Probed by Unified Small-Angle X-ray Scattering and X-ray Diffraction Coupled with Molecular Dynamics Analysis
Nanoletter 2015