SOLARIS NEWS

SAXS BEAMLINE FUNDED

SYLINDA INDUSTRY WORKSHOP

FOOD AND AGRICULTURE RESEARCH

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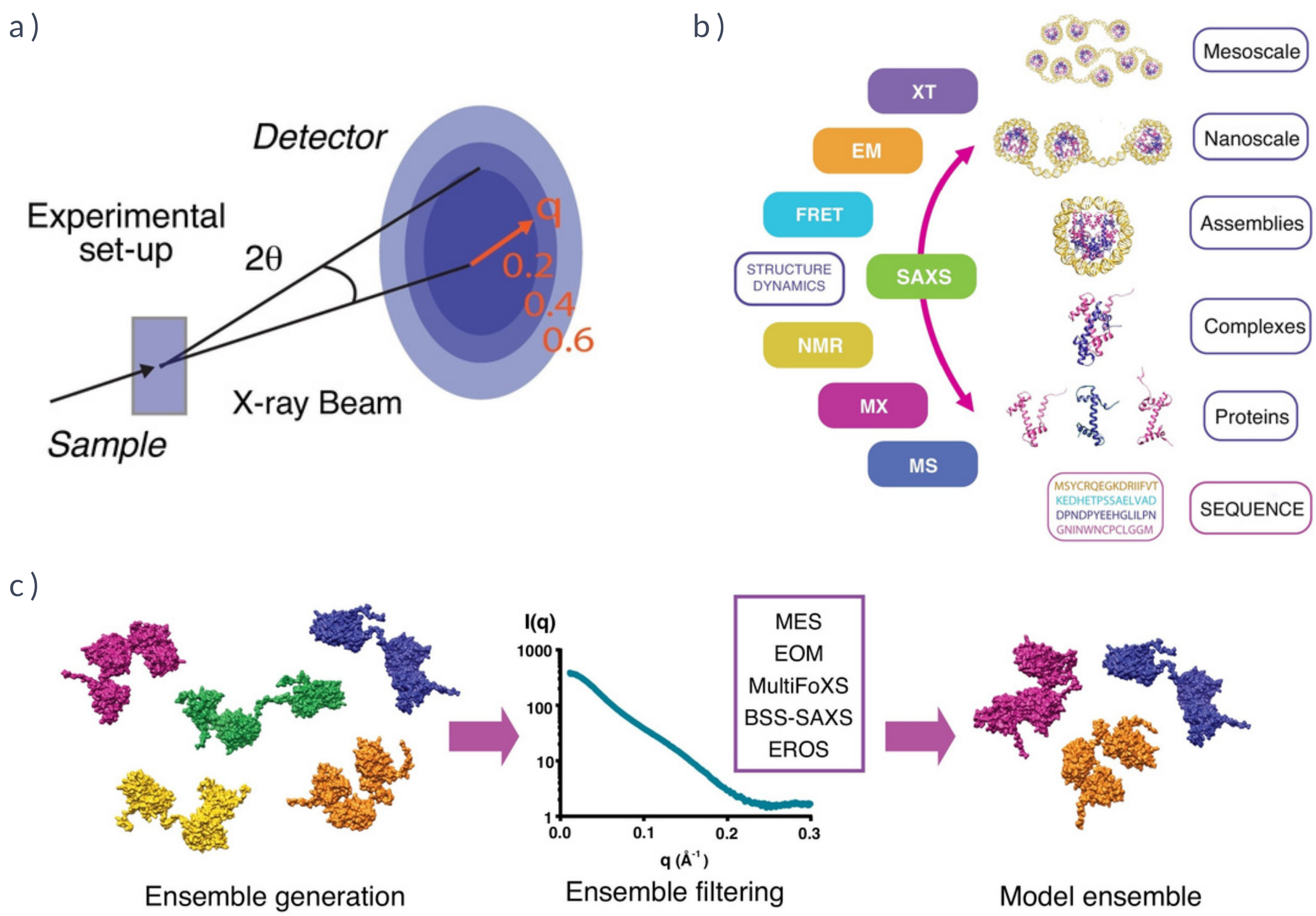
FUNDING OF THE SAXS BEAMLINE

In cooperation with Adam Mickiewicz University in Poznań, National Synchrotron Radiation Centre SOLARIS has received funding from the Polish Ministry of Science and Higher Education, for the development of the new Small Angle X-ray Scattering (SAXS) beamline. The technique allows for the structural characterization of non-crystalline materials.

The beamline will be situated in the newly expanded experimental hall of the synchrotron. The project is led by prof. Maciej Kozak and has a total value of around 8 million EUR. The beamline, first of its kind in Central and Eastern Europe, will be focused on the characterization of biomolecules, including proteins, polymers, functional and composite materials, as well as nanoparticles and surfactants.

Beamline development and comissioning is expected to conclude within three years, allowing first users to use the capabilities of the new infrastructure in the second half of 2026.



(a) A scheme of a typical SAXS experiment, (b) functional potential of the SAXS technique, compared to other structural biology methods. (c) SAXS-based ensemble modelling

Adapted from: Chris A Brosey, John A Tainer, Current Opinion in Structural Biology 58 (2019), 197-213, under CC BY 4.0 license (https://creativecommons.org/licenses/by/4.0/)

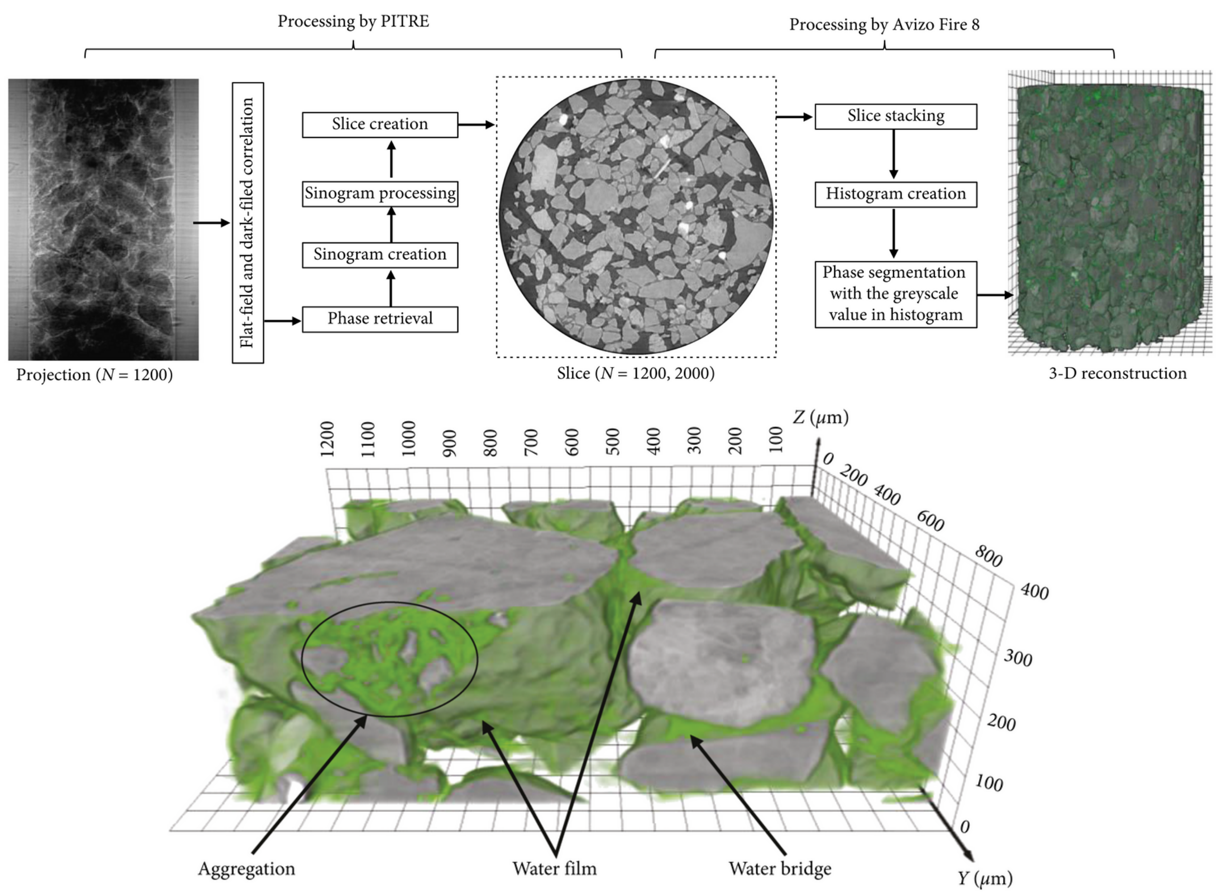
FOOD AND AGRICULTURE RESEARCH

Characterization methods utilizing synchrotron radiation are very well suited for the industrial research in the area of food and agriculture.

The most important methods available at SOLARIS, in this research context, are: X-ray absorption spectroscopy, infrared spectroscopy, X-ray microtomography, X-ray fluorescence spectroscopy, cryo-electron microscopy and scanning tunelling X-ray transmission microscopy.

These methods can be used to obtain a variety of physical, chemical and structural information about biological samples, such as: elemental composition, chemical speciation (with information about differend oxidation states and coordination chemistry), 3D structures, with the spatial resolution ranging from sub-nm to mm. Application examples include: quantifying trace elemnents in foods, studying nutrients uptake by plants, characterizing the oxidation state of various elements, such as chromium, and studying the potential of phytoremediation of contaminated soils.

In particular, the ability to reconstruct 3D structure of soils, often with chemical sensitivity, has raised interest in the scientific and industrial communities.



An example of data processing of X-ray microtomography experiment, resulting in the 3-D reconstruction of a compacted soil sample (above) and an enlarged distribution of water in the Zhuhai sand sample (below)

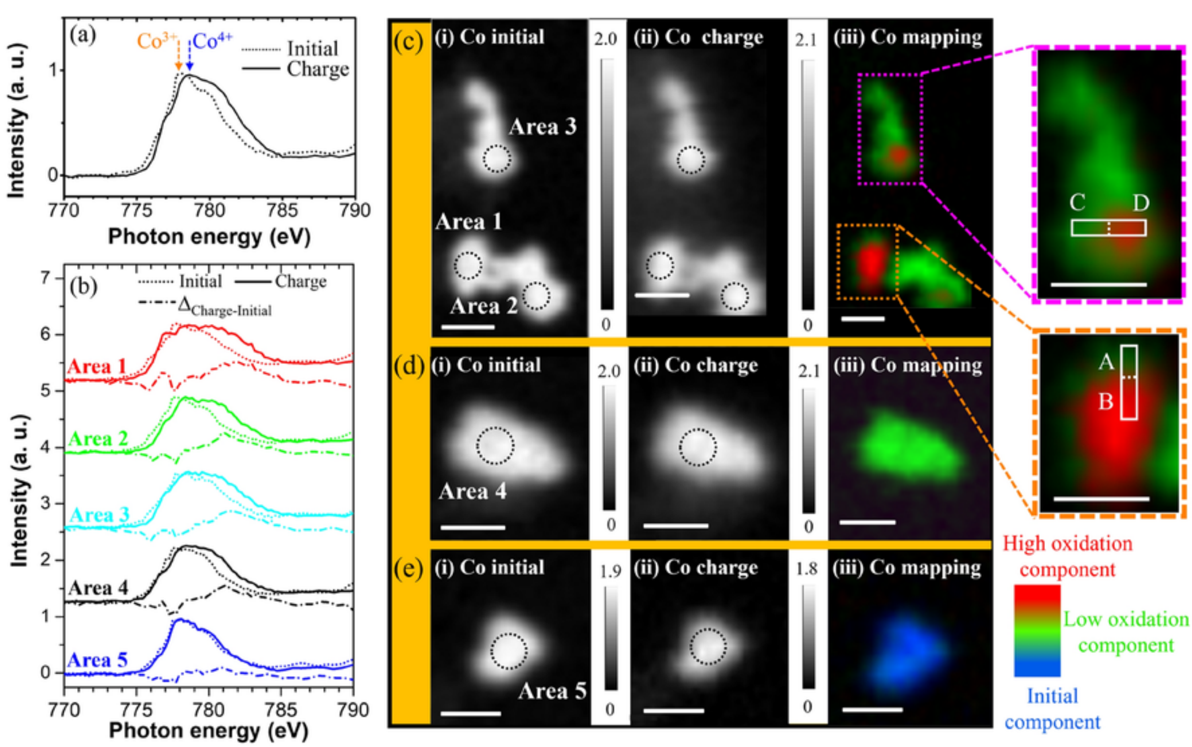
Adapted from: Zhong-Sen Li, Lian-Sheng Tang, Advances in Materials Science and Engineering 2019, 7147283, under CC BY 4.0 license (https://creativecommons.org/licenses/by/4.0/)

SCANNING TRANSMISSION X-RAY MICROSCOPY

Scanning transmission X-ray microscopy (STXM) is a powerful technique, allowing for microscopic characterization of various samples with elemental and chemical sensitivity. It is based on measuring the intensity of the X-ray beam after passing through a very thin sample and scanning its area point - by - pont in a raster - fashion. The X-ray beam is focused typically using zone plates and the resulting image resolution can be as low as tens of nanometers.

At each point of the sample, X-ray absorption spectrum is recorded, by varying the photon energy and measuring the dependence of the absorption coefficient. This allows researchers to gain information about chemical composition of the sample, oxidation and chemical states of different elements and combine them with spatial, microscopic information.

One of the most powerful applications of STXM is focused on *in-situ* or *operando* studies, where the characterized specimen undegrgo chemical or electrochemical reactions in a special reaction cell, while STXM images are being recorded, allowing for the time-resolved studies. At SOLARIS, we offer access to our academic and industrial partners to STXM on the DEMETER beamline.



An example of STXM characterization of LiCoO2 particles used as cathode material in lithium-ion batteries, in their initial state and after charging (lithium intercalation), showing redox reaction occuring for Co atoms

Reprinted from: Zhang, W., Hosono, E., Asakura, D. et al., Sci Rep 13 (2023), 4639,

SYLINDA INDUSTRY WORKSHOP

Between 14.06.2023 and 15.06.2023 the first Sylinda Industry Workshop was held at the SOLARIS National Synchrotron Radiation Centre in Kraków, Poland. The event attracted over 50 participants and speakers from industry and academia and was focused on two main industry sectors: (1) chemical & materials and (2) agriculture & biotechnology.

In addition to numerous presentations of world-class scientists, agenda of the event also included talks given by industry leaders, such as Harry Zumaque from Lanxess, or Kang Wei Chou from Henkel. Topics covered both the scientific basis of advanced measurements, offered by synchrotron radiation facilities and their applications in solving real-life problems faced by the companies.

Early stage researchers, from the partner institutions of the Sylinda project, had the chance to present their industry-relevant research during poster sessions. 14 posters were presented, which described themes ranging from functional, selenium - enriched foods studied by X-ray absorption spectroscopy to the analysis of how synchrotrons can help startups and industry.

Numerus fruitful discussions were held during the meeting and several collaborations have already been initiated. The event was highly rated by the participants and will undoubtely lead to enhancing the potential of the SOLARIS Centre, and the whole Sylinda project consortium, in applied and industrial research and attracting industrial users to the facilities.

PHOTO: PIOTR CIOCHOŃ


PHOTO: JOANNA KOWALIK

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