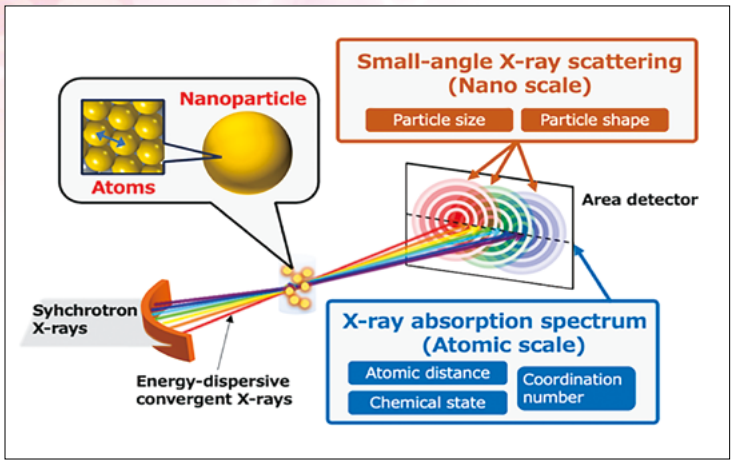
Development of a fast simultaneous XAS/SAXS measurement technique for multimodal analysis of nanomaterials

SHIRASAWA Tetsuro

The functions of nanomaterials, widely utilized in various industrial products such as fuel cells, generally originate from their nano-scale and atomic-scale structures. Small-angle X-ray scattering (SAXS) is used to analyze nano-scale structures such as the size and shape of nanostructures, while X-ray absorption spectroscopy (XAS) examines atomic-scale properties, including atomic distance, coordination number, and chemical state. These techniques are often used together to perform multiscale analyses of nanomaterials.

NMIJ has developed an innovative technique that simultaneously measures XAS spectra and SAXS distributions using an energy-dispersive convergent X-ray beam generated from white synchrotron radiation, along with an area X-ray detector. This breakthrough method has successfully observed the atomic- and nano-scale structures of precious metal nanoparticles, which form a fuel cell electrode, in just 0.1 s. Beyond the rapid characterization of nanoparticles, this technique is also suitable for operando observation—real-time monitoring in an operational environment that reveals correlations between nano-scale structures, atomic-scale properties, and material functions. Analyzing the resulting multimodal data can significantly improve the prediction of nanomaterial structures and properties, leading to optimized functionality.



Schematic illustration of simultaneous XAS/SAXS measurements

Reference: T. Shirasawa et al., *Phys. Chem. Chem. Phys.* **26**, 18493, 2024, https://doi.org/10.1039/D4CP01399A