Development of a compact Low-Temperature Polarization-dependent Total Reflection Fluorescence XAFS (LT-PTRF-XAFS) measurement system using liquid nitrogen as a cold agent

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Understanding governing factors in heterogeneous catalysts, XAFS could be the most practical tool though it gives only one-dimensional information in general. This limitation has been resolved by PTRF-XAFS, which allows determining the metal-support interfacial bonds.[1] This state-of-art technique is still scope for improving S/N ratios in a higher *k*-range (~13 Å^{-1}), which is essential for precise structure determination in EXAFS.

Generally, a low-temperature measurement with a conventional cryostat is a simple solution obtaining a high S/N ratio EXAFS oscillation due to suppressing thermal Debye-Waller factors. However, the cryostat's mechanical vibration problems disturb Total Reflection, a crucial technique for a high signal-to-background ratio. For the issue, we have proposed the first LT-PTRF-XAFS measurement system with a liquid He-flow cryostat.[2] The prototype successfully improves the S/N ratios in EXAFS oscillations, but practical issues arise from a high cost of liquid He, the size and weight of the system.

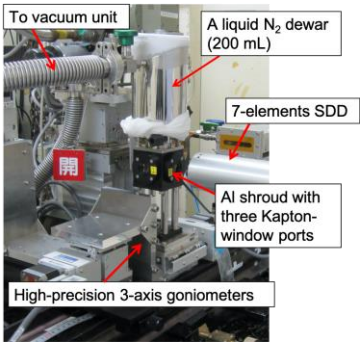

Fig. 1 LT-PTRF-XAFS system

This report introduces our recent progress in a simple, cheap, and compact LT-PTRF-XAFS system (Fig. 1) while satisfying the improvement in S/N ratios. The new system cooled with liquid N_2 requires only 15 min to 80 K and can keep the temperature for two hours.

Fig. 2 shows k^3-weighted Au L_3 PTRF-EXAFS spectra of Au nanoparticles (NPs) on TiO_2(110) surface. We found a dramatic improvement in the S/N ratio appeared from k = ~10 Å^{-1}. In the presentation, we will also demonstrate other case studies of PtOx NPs, PCP/MOFs thin films on TiO_2(110) or Si(100) surfaces.

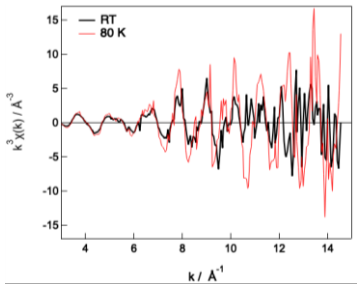

Fig. 2 Au L_3 PTRF-EXAFS spectra

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1)W.-J. Chun *et al.*, *X-ray and Neutron Techniques for Nanomaterials Characterization*, Springer-Verlag Berlin Heidelberg (**2016**). 2) W.-J. Chun et al., *PF Act. Rep.* **2018** #36.