

Conference Report of the 12th Annual Ambient Pressure X-ray Photoelectron Spectroscopy Workshop (AP-XPS 2025)

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1. Introduction

This is my third consecutive annual ambient pressure X-ray photoelectron spectroscopy (AP-XPS) workshop, including this one. The 10th AP-XPS workshop was held in Taipei, Taiwan, the 11th in Sendai, Japan, and this 12th took place in New York, where NSLS-II is located. Since this is my third AP-XPS workshop, I'm starting to recognize more familiar faces among AP-XPS researchers from the US and Europe. The fact that AP-XPS is held every year shows that this research is gaining popularity and recognition. Unlike the two previous conferences in Asia, this one was mainly attended by researchers active in the

US and Europe. This might be partly because Asian participants decreased due to overlap with MRM2025 in Japan and ICAMD2025 in Korea. Another reason could be the absence of researchers from China and Taiwan due to visa issues and long travel times. In any case, this conference took place from December 9th to December 12th at the Atlantis Hotel and Conference Center, located about an hour east of NSLS-II.

2. Conference

The 12th annual AP-XPS2025 workshop began at 1:30 PM on December 9th with an introduction from Dr. Jim Misewich, Associate Laboratory Director



Figure 1. Group photo of 12th Annual Ambient Pressure X-ray Photoelectron Spectroscopy workshop at the Atlantis Hotel and Conference Center.

for Energy and Photon Science at Brookhaven National Laboratory (BNL). 34 speakers delivered oral presentations on their research topics, including 24 contributed, 8 invited, and 2 plenary speakers. 29 researchers, including myself, also presented poster sessions. One of the conference's most notable features was the numerous presentations on traditional surface chemistry using single-crystal model systems. One plenary speaker and six invited speakers discussed model systems for studying surface reactions with single crystals. AP-XPS is an ideal tool for observing surface reaction mechanisms, and single-crystal model systems are the best options for examining specific surface chemical reactions. Additionally, the AP-XPS beamline at NSLS-II is recognized as the most active beamline for single-crystal research, so most invited speakers focused on related topics. Specifically, Dr. Miquel Salmeron of Lawrence Berkeley National Laboratory in USA delivered a plenary talk on designing a differential pumping system, which laid the foundation for AP-XPS research and showcased its practical applications. His presentation provided valuable insights into the significance of AP-XPS in surface chemistry and highlighted recent progress in single-crystal model system research using AP-XPS.

This conference stood out because of its focus on precise XPS analysis. XPS uses complex curve fitting techniques to identify and quantify chemical states efficiently. Since interpretation methods are not standardized, explanations of XPS results have varied widely. Presentations by Prof. Frank de Groot of Utrecht University in the Netherlands and Prof. Mark C. Biesinger of Western University in the UK offered valuable insights into how to interpret XPS spectra through core-level shape and peak fitting methods. Although many interpretive challenges still exist in XPS research, this discussion marked a step forward at the academic level toward more accurate interpretation of XPS spectra.

There was also a presentation on the development of the new AP-XPS techniques. Yu Murano, a doctoral

student at the University of Tokyo in Japan, presented on "The real ambient pressure photoelectron spectroscopy measured with soft X-rays." Previous research in the 1-bar range had been conducted at the AP-HAXPES of SPring-8 and PETRAIII. For the first time in the world, 1-bar XPS measurements were performed in He and H₂ environments using soft X-rays at the BL8U beamline of NanoTerasu. The impressive part was the effort to minimize the reduction of X-ray intensity due to gas scattering before reaching the sample, as well as the reduction of intensity caused by photoelectron scattering by the gas, by minimizing the distance between the X-ray beam and the sample, and between the sample and the nozzle, to obtain photoelectrons. I also presented research on simultaneously measuring HAXPES spectra and XRD in a chamberless setup. While the distance between the X-ray beam and the sample is not critical when using hard X-rays, minimizing the distance between the sample and the nozzle was a key point in this study. Air has a shorter electron scattering mean free path between photoelectrons and gas than He, resulting in a significant amount of background signal. However, by injecting He gas through a gas

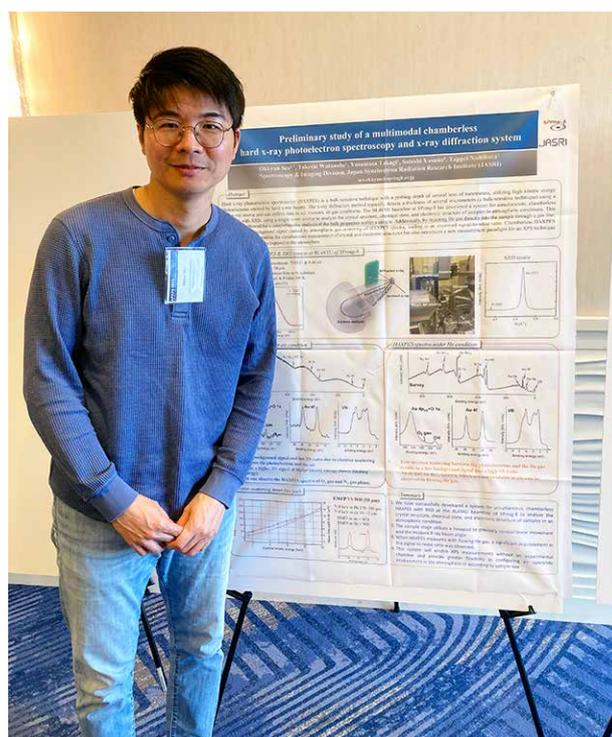


Figure 2. Photo in front of the research poster.

injection pipe, spectra with excellent signal-to-noise ratios, similar to those measured in a vacuum, can be obtained. Simultaneously, XRD data was also presented. Because this measurement method, one of the hallmarks of XPS, does not require a chamber, it offers a new opportunity for researchers to share and exchange research results.

A session titled “Facility Updates” provided updates on the Diamond Light Source in UK, ALBA synchrotron in Spain, Elettra in Italy, Japan’s synchrotron radiation union, and MAX-IV in Sweden, along with information on upgrades. MAX-IV was the first to introduce a fourth-generation synchrotron radiation facility, but its emittance has since fallen short of newer synchrotron facilities, leading to an announcement of an upgrade. Although SPring-8 has not yet been upgraded, news of upgrades to the operating fourth-generation synchrotron radiation provided a glimpse into the rapidly evolving field of synchrotron radiation. The ALBA synchrotron was also planning to build a new AP-XPS beamline,

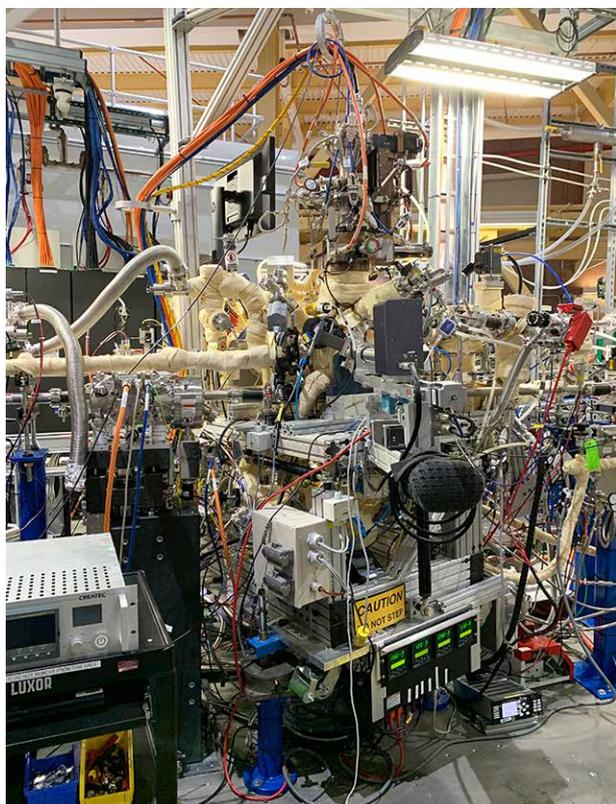


Figure 3. Photo of the AP-XPS apparatus at the *in-situ* operando soft X-ray spectroscopy (IOS) beamline of NSLS-II

specifically a surface structure and spectroscopy at 1 bar (3Sbar) beamline using HAXPES. The official meeting schedule concluded with the announcement that the next 13th annual AP-XPS2026 workshop would be held at the ALBA synchrotron.

After the AP-XPS workshop, we took a bus to BNL. All the participants used own ID card at the BNL Science and User Support Center to apply for access, then entered the Center for Functional Nanomaterials (CFN). This building houses lab facilities for analyzing nanomaterials with equipment like STM, APXPS, TEM, and Raman spectroscopy. Located next to the synchrotron radiation facility, it had the advantage of first examining nanomaterials at the lab source before measuring them directly at the beamline. After touring the CFN, we visited NSLS-II, where the AP-XPS beamline is located. Having previously studied bulk properties in high-pressure environments using hard X-rays at SPring-8, I became increasingly interested in surface chemistry with soft X-rays. I also explored other spectroscopy beamlines. I met my friend, Dr. Akhil Tayal, who works at the Inner Shell Spectroscopy (ISS) beamline, where he studies hard X-ray absorption fine structure and emission. Dr. Tayal was a colleague of mine during my postdoctoral year at the BL15XU NIMS beamline of SPring-8. I had the chance to hear from him about the high-resolution XAFS setup and the advanced technology used at the ISS beamline. The beamline tour reminded me that while synchrotron radiation facilities are large and spread around the world, the researchers working in them are connected and small. After the BNL tour, I wrapped up the conference excited for a new meeting at the 13th AP-XPS2026 workshop next year in Spain.

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