

News from the Applications Lab.

25 years @ Kratos, Users' Meetings & ESCApe 1.5

i-work

Tony Fleetwood

The Crucial Role of Users in Instrument Innovation

Sharing feedback, suggestions & requirements

Meet our Users

Dr Sang-hwa Lee, Senior researcher, AICT, Korea



Leading Surface Analysis

Welcome to the Summer Newsletter.

We're having a push to make sure that all AXIS Supra / Supra⁺ Users have installed the latest version of acquisition and processing software, **ESCApe 1.5**. This version has a number of important updates to support hardware that benefit all Users. It's also important as future upgrades planned for the Autumn assume that you're running version 1.5, so take a moment

to read how to confirm which version of ESCApe you're using.

In our **i-work** staff interview we meet one of our Mechanical Design Engineers. Find out a bit more about the role and it's challenges in our interview.

Our **User interview** is with Dr Sang-hwa Lee from AICT, South Korea who uses his AXIS

Supra for materials analysis supporting semiconductor companies in Gyeonggi-do.

The longer read article focuses on the important role that our Users and the wider surface analysis community play in the development of our products. As you will read, your input and feedback through

Custom Engineering projects contributes to the development of next generation accessories and instruments. So, let's hear those ideas!

Enjoy the read.



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UPDATES FROM THE APPLICATIONS LAB.

25 years service @ Kratos

In April, Shimadzu hosted a ceremony for employees recognising 25 years of continuous service at Shimadzu and Shimadzu Group companies. A total of 290 employees were recognised for reaching this milestone, including 6 Kratos colleagues.



Kratos colleagues at 25 years service awards, Kyoto. (left-right) K. Shimazu, K. Oswald, I. Bolizof, P. Wilson, President Yamamoto, A. Roberts.

As one of those that started in 1998, I was asked to give a speech as a representative of the Presidents of Group Companies. It was an opportunity to reflect on some Kratos milestones. When I started, Kratos had been acquired by Shimadzu 9 years earlier and we had just launched the AMICUS and AXIS Ultra X-ray photoelectron spectrometers. As we approached the new Millennium, there was significant focus on anticipated problems of software not coping with rolling from 19 hundred's to the 2000's, the so-called **Y2K bug**, which in the end passed without serious incident. 2002 was a memorable year for those working at Kratos, not least Koichi

Tanaka. At the time of the announcement of Koichi sharing of the Nobel Prize in Chemistry, he was seconded from Shimadzu to Kratos. For a couple of days there was a whirlwind of international press on site at Kratos in Manchester. It was truly staggering that our own colleague had been awarded the Nobel Prize for developing a novel method for mass spectrometric analyses of biological macromolecules.

2003 saw the launch of the AXIS Nova, with automated sample handling and the new delay-line detector. This was followed by the AXIS Supra's launch in 2014. Despite challenges of BREXIT and the global covid pandemic Kratos Analytical remains firmly established as a global presence in both academic and industrial laboratories.

The past 25 years has seen huge strides in technology. The pace of change is likely to increase as we move into the era of artificial intelligence, machine learning and automation. In his speech Shimadzu President, Mr. Yamamoto, reminded us all 'to share freely our rich expertise and experience with younger generations.' He continued 'in speaking with new employees joining Shimadzu today, I have said that the secret to a wonderful corporate life is "the capacity to take a step forward" and "enjoying conversation with a great many people."'

Unable to attend the 2023 celebration were J. Chippendale, P. Bennetts and J. Teesdale.

2023 Users' Meetings

Even years, European Users' Meeting, odd years German & North American. That's how it's worked for the last decade or so. Meaning that 2023 will see us host both our German and US & Canadian Users' Meetings.

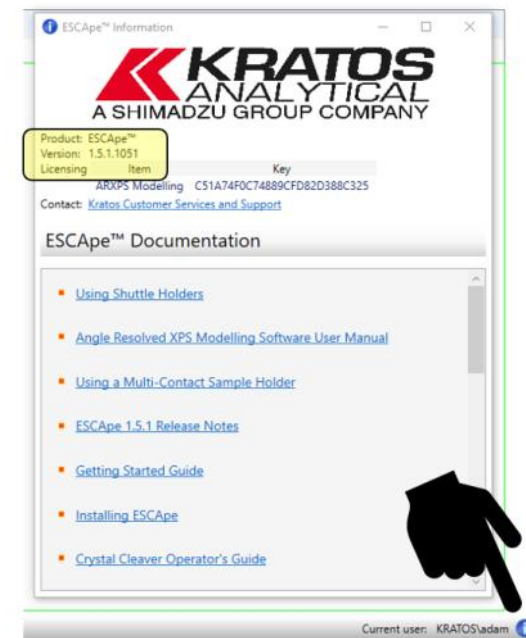
The German Users Meeting will be a 1-day, in-person meeting at Fraunhofer IZM, Berlin. As the meeting is held in German, we limit attendance to 'invitation only'.

We're still at the planning stage of the North American meeting and are seeking **User feedback** on format and location. One idea is to link it to the AVS International Symposium & Exhibition in Portland, Oregon.

Upgrade to ESCApe 1.5 now

The current release of acquisition and processing software is available to all ESCApe Users. Running the latest version of software is important for a number of reasons. ESCApe 1.5 contains a number of important 'under the hood' updates that ensure your AXIS Supra/Supra⁺/Nova is optimally controlled. Using the latest version also ensures that all the expected engineering tools are available for our service support engineers. This means that they can perform all correct diagnostic and calibration sequences ensuring that the spectrometer fully optimised.

Step-by-step User instruction for upgrading from ESCApe 1.2 or 1.4 to ESCApe 1.5 are provided. The upgrade is simple and takes less than 20 minutes.



It is easy to confirm which version of ESCApe is currently running, by clicking the button on the bottom right of the main window.

Contact us to request the software.



i-work : *interview with an employee*

what they needed. This type of project is also constrained by a fixed delivery date, so we have a fixed window to complete the design, procurement of parts, assembly and testing. Throughout the process I'm working with a lot of colleagues, including Fitters, Test Engineers, Technical Authors and Physicists. Seeing the spectrometer leave the factory on its way to the customer gives a real sense of satisfaction.

I also like working closely with suppliers. I've known many of them for years and it helps having that type of working relationship. They have expertise in best practice for material selection, or new manufacturing capabilities that can be applied to our manufactured items. They also add value by highlighting improvements in the design for ease of manufacture. I would always encourage younger mechanical design engineers to work as closely as possible with the suppliers.

Another great thing about the job is that, even after nearly 40 years, I'm still learning. We've recently been using 3D printing of some components. This allows quick prototyping and design of much more complex components than would be possible by conventional machining.

What is your background and experience?

I have always enjoyed fixing or repairing items so I served a 4-year mechanical engineer apprenticeship for Philips Electronics. There I learned how to use milling machines, lathes, grinding machines and basic fitting skills to allow the build for the tools and instruments used for semiconductor manufacturing. From there I moved to a role as an electro-mechanic draughtsman for battery powered vehicles. I spent about 8 years on day release at my local Technical College of Further Education and qualified with an HNC in mechanical engineering and HTC in electrical/electronic engineering. I then moved to VG Analytical working on magnetic sector mass spectrometers. At that time competitors to AEI (which went on to become Kratos Analytical). That was my first experience of working with UHV

instruments. After that I worked in a couple of other manufacturing design companies before I started at Kratos. What's interesting is that I'm still working with some people that I have known at previous mass spec. companies as they are now either colleagues or suppliers of components that we use on Kratos instruments.

What have you learnt working at Kratos?

In mechanical engineering you're always learning. It's a job that evolves all the time. It's also a job that involves contact with numerous people within the Company so good communication skills are needed. I've also learned that mechanical design is about teamwork listening to other people's ideas – the fitters within Kratos who assemble the parts will often provide very useful input into the design of new accessories or improvements to existing ones. The Fitters joke saying that 'I've designed it for you, just go away and document it'.

Your favourite line from a film?

I'm a big Clint Eastwood fan, in my younger days I was nicknamed Clint Fleetwood. My favourite quote is "Go ahead. Make my day" which is a catchphrase from the 1983 film Sudden Impact.

What is your motto or personal mantra?

Don't put off until tomorrow what you can do today!

What keeps you busy when you're not at work?

My wife and I breed Pomeranian dogs. We've exported show dogs around the world. We also judge the breed at a very high level at UK dog shows, even being invited to officiate at international shows. You wouldn't believe the backstabbing and rivalry in dog show world.

Tell us one thing that we don't know about you?

I once worked for a company designing sun beds and spray-tanning booths. Going to the exhibitions to promote and sell the products was an eye-opening experience!

Name **Tony Fleetwood**

Job title Mechanical Design Engineer, working within the Physics Group, R&D.

How long have you been at Kratos?

I joined Kratos in 2006, so 17 years.

How would you describe your job to a 5-year-old?

My job is to get ideas from the Physicists brains and translate this into a product. They may have the ideas and knowledge on what is required, but it's my job to turn the ideas into a set of parts that will do the job.

Best part of your job?

I really enjoy the challenges that the role throws up. One of the most complex projects I worked on recently was a surface science station for an AXIS Supra⁺ that was equipped with a bespoke cryo-cooling system. The specifications meant that we had to do a lot of one-off designs to provide the customer with

THE CRUCIAL ROLE OF USERS IN KRATOS' INSTRUMENT INNOVATION

User feedback, suggestions, and requirements

At the end of this article, there's a link to a feedback form. If you have any feedback on improvements or developments to any aspect of Kratos hardware, software or service, please let us know.

The AXIS generation of XPS instruments has been an essential tool driving innovation and discovery across various materials science fields. The spectrometers have contributed to over 26,000 publications [1]. While Kratos' scientists and engineers are primarily responsible for developing these instruments, the role of Users in the innovation process should not be underestimated. Users, including scientists, researchers, and technicians, play a crucial role in shaping the design, functionality, and effectiveness of our scientific instruments. This article explores the significant contributions of Users in scientific instrument innovation.

The current generation of AXIS instrument is extremely sophisticated, requiring knowledge of electrical, mechanical, optical, software, data acquisition and sample-mounting techniques. Within Kratos we have experts in each of the required disciplines. All contribute to the innovation and development of the current and next generation XPS instruments. However, our Users bring a wealth of knowledge and experience to the table. Their deep understanding of the scientific process, experimental protocols, and data analysis needs allows them to provide invaluable input during the development phase. By actively involving Users, we can gain insights into the specific requirements of researchers, leading to the creation of instruments that meet their needs more effectively.

Kratos Users often encounter challenges and limitations while

using existing scientific instruments. These obstacles can be related to functionality, ergonomics, data output, or any other aspect of the tool. By actively engaging with our Users, Kratos has been able to identify unmet needs and areas for improvement. Users can provide feedback based on their practical experience, pinpointing specific pain-points and suggesting potential solutions.

Users often possess application-specific knowledge that can contribute to improving the functionality of scientific instruments

Custom engineering, internally referred to as CE's, are an important route to driving our instrument development. They are often driven through the sales process, where a specific requirement is defined as necessary to allow a prospective User to justify purchase of an instrument. In some cases, the innovation is essential to allow us to tender.

An example of this is a CE project that has recently drawn to a successful conclusion to improve sample cooling to below -150 °C. Users of an older generation of AXIS spectrometer had developed novel cryo-methods that avoided freeze-drying bacteria samples prior to XPS analysis [2,3]. The current specification of -100 °C was not low enough for them to continue this line of research if they replaced their 20-year-old AXIS instrument with an AXIS Supra⁺. The Users requirement was essential in defining an improved specification. Internal collaboration between Physicists and Mechanical Design Engineers has delivered revised designs to the stage and sample holder, allowing the improved cooling specification. With

involvement by the Production Engineering team, this product is now available as an optional accessory. This example clearly demonstrates that Users play a critical role in enhancing the performance of scientific instruments. Their feedback and suggestions can help identify and rectify potential flaws or inefficiencies in instrument design. Through continuous interaction and collaboration, Users and Kratos can work together to optimize instrument performance, accuracy, and reliability.

Furthermore, Users often possess application-specific knowledge that can contribute to improving the functionality of scientific instruments. Their expertise allows them to provide valuable insights into the interpretation of data generated by the instrument, enabling our Software Engineers to refine algorithms or data analysis techniques.

As previously outlined, the complexity of the AXIS spectrometers means that Users are rarely skilled enough to 'build' the instrument their research requires. This places the challenge onto the User community of how to best disseminate their innovations. In an academic setting, the cost and time required to develop a prototype instrument or accessory must be leveraged through patenting and subsequent commercialisation via start-ups or licencing. This route can be productive in terms of reaching a larger audience, but it comprises several steps, each of which has a substantial chance of failing. An alternative approach is through mutual collaboration with

THE CRUCIAL ROLE OF USERS IN KRATOS' INSTRUMENT INNOVATION *cont.*

User feedback, suggestions, and requirements

Kratos. This was the mechanism by which the Ag La transmission function and relative sensitivity factors were generated and released through ESCAPE software. The UK Innovate funded project was a collaboration between Kratos Analytical, the National Physical Laboratory and Teer Coatings.

A radical approach could be to take inspiration from the open-source software movement. Termed open-hardware instrumentation, the idea is that the lab in which the invention is devised also takes care of the first steps of its dissemination. Several early adopters have taken this approach and have been successful in developing instrumentation [4]. The likelihood that an open-hardware AXIS instrument will be available in the next decade is remote, but Kratos colleagues remain receptive to the concept.

The involvement of users in scientific instrument innovation does not end with the initial development phase. Users continue to play a pivotal role in driving continuous improvement and evolution of the instruments throughout their lifecycle. By using the instruments in their research, users gain valuable experience and insights that can lead to further enhancements and refinements. This is also recognised within our parent company, Shimadzu. In a recent communication, Mr Tomita, Managing Executive Officer of Shimadzu Analytical and Measuring Instruments Division stated 'to achieve our goals, we must be in daily contact with our customers and listen to their needs, but not just when it comes to sales, but also when it comes to R&D and manufacturing. Our aim is to become a true partner that works with our customers from development to implementation and provide customer focused solutions, as opposed to solely being equipment experts.'

Users often share their feedback, suggestions, and requirements with us, leading to software updates, hardware modifications, or the creation of new instrument models. This user-driven approach ensures our instruments remain relevant and effective in addressing the evolving needs of researchers.

Published nearly half a century ago in 1975, in an overview of the innovation process in scientific instruments, von Hippel [5] determined that a central fact which emerged from the study was that it was a user-dominated process. He was able to attribute over 80% of major improvements in instrument innovation were linked to the User. Similarly, we conclude that the role of our Users in scientific instrument innovation is fundamental to creating instruments that effectively address the needs of researchers. By actively involving Users in the development, Kratos and the wider surface analysis community can benefit significantly.

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Agree with what you've read ?

We'd be interested to hear your feedback on improvements or developments to any aspect of Kratos hardware, software or service. To provide feedback, please use this [Microsoft Form](#).

User Feedback Regarding Kratos
Hardware, Software or Services

* Required

Your feedback relating to Kratos products or services.

4. Does your feedback relate to:

Hardware

Software

Other

5. Please indicate which instrument you are using *

Please select at most 3 options.

AXIS HSi / 165

MEET OUR USERS

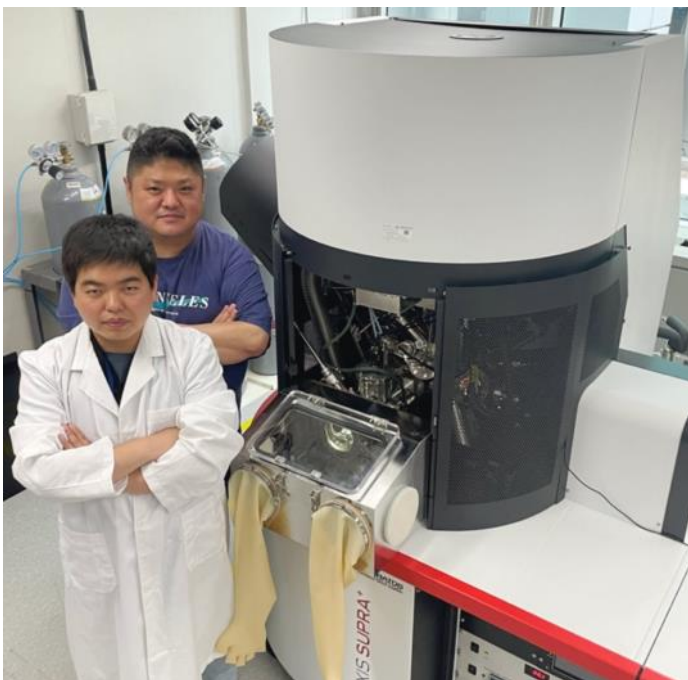
Dr. Sang-hwa Lee, Senior Researcher, AICT, Korea

Name:

Sang-hwa Lee, Senior researcher, Ph. D.

Affiliation:

Gyeonggi-do Semiconductor Innovation Center, Advanced Institute of Convergence Technology, Gyeonggi-do, Korea.



Quick outline of your career to date?

I received my Ph.D. degree in Physics in Feb. 2017. During the Ph.D. course, I analyzed the quasi-periodic structure by X-ray and neutron diffraction. As a postdoc from Mar. 2017 to Jan. 2019, I developed the high pressurization

tools, for the in-situ X-ray diffraction to apply to the synchrotron facility and studied the properties of materials under extreme condition. Then, I moved to KAERI (Korea Atomic Energy Research Institute) as a senior researcher and developed the NDP (Neutron Depth Profiling) system, which provides the absolute quantification and depth distribution of trace elements by neutron absorption reaction from Feb. 2019 to May 2021. Currently, I have been working as a senior researcher at AICT (Advanced Institute of Convergence Technology) since Jun. 2021.

What is your role in the Advanced Institute of Convergence Technology?

I am a senior researcher to set up various sample analysis to support the semiconductor companies in Gyeonggi-do. I am managing the XPS (X-ray Photoelectron Spectroscopy) and XRD (X-ray Diffractometer). In addition, our group, which is a semiconductor analysis development team, continuously does the whole work for the setup of various equipment to support the companies for the development of materials, components, and equipment of semiconductors in Gyeonggi-do.

Can you describe a typical day at work?

My day always starts with a discussion about the reservation schedule of users and an analysis of the measurement results with the operators. I usually check the current state of the XPS and XRD with colleagues in

the morning. Both instruments are located in the X-ray analysis facility. Therefore, our X-ray analysis team can provide the quantitative and qualitative measurements based on the particle-wave duality analysis of the interaction between X-ray and target materials.

How do you use your AXIS Supra in your role?

The AXIS Supra is applied for the surface analysis of the various elements of materials. We use the ARXPS (Angle-Resolved X-ray Photoelectron Spectroscopy) capability for the near-surface analysis, depth distribution of elements, and chemical state of the ultrathin film. Also, REELS (Reflection Electron Energy Loss Spectroscopy) is attached to our system, which is for the band gap measurement of the semiconductor materials. In addition, our AXIS Supra provides UPS (Ultraviolet Photoelectron Spectroscopy) and GCIS (Gas Cluster Ion Source), used for the analysis of the work function and the depth profiles of complex multilayers, respectively.

What's the most useful (or most used) feature of your instrument?

The AXIS Supra in our institution provides an analytical service for open users. Therefore, normal XPS measurements including the survey and narrow scan are most commonly used for the analysis of the binding energy, chemical shift, and atomic concentrations. The hemispherical analyzer is useful to separate the chemical

Continued over page

MEET OUR USERS *continued*

Dr. Sang-hwa Lee, Senior Researcher, AICT, Korea

shift and the element with similar binding energies due to the high-resolution data. For my research purpose, I employed the ARXPS to analyze the depth distribution of elements of thin film, which is deposited by ALD (Atomic Layer Deposition). A complete reaction of the precursor and reactant should be obtained during an ALD cycle and its evidence can be found from the narrow scan data of the hydroxyl group depending on the tilted angle. In addition, *in-situ* temperature function is also very useful for Mott MIT (metal-insulator transition), metal oxide transistors and reliability failure analysis.

What do you see as the value of surface analysis?

Analysis of the chemical state, composition, and structure of the surface is very important for the development of new materials or functional improvement of current materials. We know the structural stability and electronic band structure of the multi-layered thin film and the low dimension materials depend on the interface materials. It is important that the evaluation of the next-generation semiconductor materials to achieve the highest performance. The AXIS Supra is a convenient and powerful tool to analyze the chemical bonding, depth distribution, atomic concentration, and electronic band structure (work function, band gap) using non-destructive measurements.



Moss garden at Gioji temple in Kyoto

Welcome to our new Managing Director

In June Kozo Shimazu retired after 13 years as Managing Director of Kratos Analytical. His tenure at Kratos saw stabilisation and growth of the Surface Analysis business group. Users who attended our European Users' Meetings will have had the opportunity to meet Kozo and will have undoubtedly heard his slogan that Kratos colleagues must work with *speed and accuracy*. He is replaced by Norio Mukai who joins Kratos Analytical after previously being Head of Mass Spectrometry Business Unit in Shimadzu Corporation, based in Kyoto. He comments 'It is an exciting move to Kratos and to be based in Manchester UK. I look forward to working with colleagues in both MALDI-ToF and Surface Analysis business groups and aim to make a meaningful impact on the company's growth and overall performance.