Short abstracts of invited speakers SISS-23

Development of new ion sources for mass spectrometry

Ahsan Habib (*University of Dhaka*)

Development of ambient ion source would be the choice to fabricate miniature MS. Attempts have been made to develop ambient ion source for analysis of various compounds with better limits of detection. In this talk, alternative current-atmospheric pressure chemical ionization, homemade helium dielectric barrier discharge ionization, hollow cathode discharge ionization, low pressure-alternating current glow discharge ionization sources have been developed to analyze a variety of compounds including explosives, drugs of abuse, steroids, sugars, herbicides etc. at trace to ultra-trace levels. Ion formation mechanism using the various ion sources is also discussed.

Combination of oaToFMS and QIT-ToFMS for Imaging and Tandem Mass Spectrometry in ToF-SIMS

Chang Min Choi (*Korea Basic Science Institute*)

Over the past few decades, ToF-SIMS has been widely used as a powerful instrument for a surface analysis. QIT-ToF-SIMS has been developed to resolve the problem assigning a peak having a similar mass due to a poor mass resolving power of ToFMS. And oaToFMS was additionally installed to perform an imaging mass spectrometry. The newly developed ToF-SIMS would help us study a surface in a new perspective.

Visualizing cellular processes with high throughput imaging mass spectrometry based spatial biology.

Ron M.A. Heeren (*Maastricht University*)

Molecular analytical technologies in spatial biology are rapidly evolving. New innovative technologies improve sensitivity, resolution, content and throughput at an ever increasing speed. Mass spectrometry is also undergoing a revolution in spatial biology. Innovative “omics” & imaging technologies, based on these MS innovations have impacted many fields of research. More and more interest is generated for the development of local analytical techniques in metabolism throughout biomedical science for various applications. The possibilities of high throughput targeted and untargeted MSI are seemingly endless, and will revolutionize spatial biology. The lecture will discuss the state-of-the-art and provide glimpse of the future.

Advance single-cell and spatial multiomics using giant water cluster ion beam secondary ion mass spectrometry

Hua Tian (*University of Pittsburgh*)

Tissue is highly organized with diverse cells. However, achieving high chemical sensitivity at high spatial resolution and multiomics are challenging. To overcome these analytical hurdles, we have developed high energy water cluster ion beam secondary ion mass spectrometry ($(H_2O)_n$-GCIB-SIMS) and cryogenic multimodal imaging pipeline. $(H_2O)_n$-GCIB, operating at high energy of 70 kV, images the intact biomolecules (~m/z 10,000) with enhanced sensitivity and reduced chemical damage at 1 μm resolution. Cryogenic imaging is to reveal pristine chemical gradients, which are otherwise difficult to preserve. This new development provides a powerful approach to understanding cell type-specific metabolic activities in diseases.

Visualizing therapeutics at the subcellular level with nanoscale secondary ion mass spectrometry

Haibo Jiang (*The University of Hong Kong*)

Subcellular localization is a key determinant of therapeutic effectiveness. The capability of nanoscale secondary mass spectrometry (NanoSIMS) to map elemental and isotopic distributions at high resolution enables the visualization of therapeutics within subcellular compartments without the necessity for traditional labelling. This talk will cover our recent work in visualizing a range of therapeutics, including small molecules, nucleic acids, and proteins, through the combination of NanoSIMS analysis with complementary microscopy techniques. Additionally, we will present our observations on how the subcellular drug compartmentalization impacts overall drug efficacy.

SIMS U-Pb dating on the Chang'e-5 basalt and glasses

Qiu-Li Li (*Chinese Academy of Sciences*)

This talk will focus on the SIMS U-Pb dating on basalt clasts and glasses from Chang'e-5 mission. The main issues are about the terrestrial lead contamination and matrix effect for glasses with highly variable chemical compositions. A ~3 μm diameter beam size was used to precisely dating the Zr-bearing minerals in Chang'e -5 basalt. The Pb-Pb age of 2030 ± 4 Ma and rather low μ ($^{238}U/^{204}Pb$) of mantle source suggest that Chang'-5 basalt, the youngest volcanism has a non-KREEP origin. The U-Pb age spectrum peaks from impact glasses corresponds well to the terrestrial major stratigraphic boundaries. Further detailed dating work may reveal extraterrestrial cause for terrestrial habitability fluctuations.

Atom Probe Tomography of Small-Molecule Organic Materials

Jeramy D Zimmerman (*Colorado School of Mines*)

Understanding if the light emitting guests cluster in organic light-emitting diode (OLED) emissive layers is a question that has evaded measurement for decades. Atom probe tomography (APT) of small-molecule materials is a promising technique for identifying if this clustering occurs, but presents unique challenges. We will discuss solutions and techniques that enable APT analysis of these molecular materials. We will present APT results of OLED materials and compare them to images taken with transmission electron microscopy to understand advantages of each technique and discuss clustering in these materials.

Features and future challenges of laboratory developed atom probe tomography

Masato MORITA (*Kogakuin University*)

Atom probe is a very unique method for high resolution microscopy and mass spectrometry. The method has been restricted for only metal samples, but an introduction of laser-assisted function became to analyze for many materials. However, atom probe has still problems such as a sample destruction, a high background in mass spectrogram, multiply charged ions, and complicated reconstruction calculations. The flexibility of the laboratory developed atom probe can be led to solve the problems by multiangled results of evaluation of field evaporation mechanisms and improving reconstruction algorithms. I will introduce our recent improvements and future challenges of atom probe in order to spatialize our originalities from commercial machines.

Latest applications of ToF-SIMS in our R&D activities ～Analysis of liquid products and biofilms～

Tsubasa Yabuchi (*Kao Corporation*)

In our laboratory, ToF-SIMS has been used for various studies, including materials and biological samples such as polymers, surfactants, human hair and skin. Furthermore, Ar gas cluster ion beam (GCIB) and Cryo-systems have been introduced in order to expand the application fields of ToF-SIMS. For example, there are many liquid products in our research targets, Cryo-ToF-SIMS is a powerful tool for the understanding of solution properties. In this talk, the applications of Cryo-ToF-SIMS/SEM system, which is combined with Cryo-ToF-SIMS and Cryo-SEM, for morphology and components analyses of fabric softener solutions, and GCIB-ToF-SIMS depth profiling of biofilms will be presented.

The development of an atom probe system cooperating with a field ion microscope

Masahiro Taniguchi (*Kanazawa Institute of Technology*)

To cooperate with a field ion microscope (FIM) and an atom probe (AP) mass analyzer, the authors introduced ion deflectors between the phosphor screen and the specimen, enabling the FIM observation of the field of analysis region in AP. A toroidal lens energy filter blocks the helium ions continuously emitted from the sample to reach the ion detector. In this system, just after the detection of the desorbed sample ion during AP analysis, the helium ions are shifted to show the probed region without changing the configuration of the specimen. The difference between the sequentially acquired FIM images shows the desorbed ions from the sample. The estimation of the ion detection efficiency in AP and its application to molecular systems will be discussed.