SHIMADZU
Excellence in Science

LCMS & MALDI Newsletter

Mass Spectrometry Imaging

Contents

Excellence in Science

Introduction

Dear Mass Spectrometry Enthusiasts,

Welcome to Shimadzu's mass spectrometry imaging (MSI) newsletter. I am delighted to release this year's edition which is filled with exciting information about Shimadzu's new MSI solutions alongside inspiring user stories and interviews from our European MALDI imaging teams.

Following Shimadzu's success in MSI with our Axima series and MALDI-7090, we are continuing to build our MSI portfolio for any laboratory. MSI is a well-established technology used in research as well as routine environments. The applications for MSI are broad and range from medical imaging, drug discovery, environmental monitoring to forensic investigations. Shimadzu's MSI solutions make this technique accessible for any laboratory with the aim to support the crucial research and diagnostics our society requires.

This year, we are proud to introduce two new MALDI imaging solutions: the MSI starter kit for our established benchtop MALDI-8030/8020 instruments and the new iMScope QT for high precision MSI.

Our MALDI-8020 and MALDI-8030 can now be equipped with the new imaging starter kit. Our benchtop MALDIs are class-leading regarding sensitivity and mass resolution. In addition, these instruments allow for FastMS meaning samples can be introduced in less than 3 minutes. Images are recorded at up to 15 pixels per second at 50 µm spatial resolution. Therefore, the imaging option for the MALDI-8020 and MALDI-8030 make MSI accessible, cost- and space effective.

For highest spatial (≤ 5 µm) and mass resolution at unrivalled acquisition speed and mass stability, Shimadzu introduces the iMScope QT, our new flagship for MSI with a QToF-MS. The iMScope QT is a unique fusion of two analytical techniques: an optical microscope with a MALDI imaging high resolution accurate mass (HRAM) spectrometer.

The iMScope QT revolutionises morphology studies and MALDI MSI analysis by enabling simultaneous measurements in one analysis. In addition, this instrument is a truly versatile system. The imaging device can be easily detached and exchanged with a chromatography system or different ionisation source to cover a broad analytical and chemical range. This ensures fully comprehensive analysis of local as well as total analyte presence and concentration and future proofing the laboratory for any analytical challenge which may be encountered.

Shimadzu's innovations do not stop with the MSI instruments. The MSI workflow is completed with two sample preparation devices (iMLayer™, iMLayer Aero™) as well as dedicated MSI processing software to guarantee a fantastic user experience, easy operation and make MSI a more mainstream analytical technique in both research and routine environments.

Both, the imaging options for the benchtop MALDIs and the iMScope QT provide previously missing technology links and therefore, contribute to advancing science in the UK and worldwide.

Sincerely,

Christine Hinz, PhD
Senior LCMS Specialist – High Resolution Accurate Mass, Shimadzu UK

Enhancing analytical capabilities in Biomedical Research – the Shimadzu iMScope QT enables spatial resolution and assists to uncover subtle spatially localized metabolite differences unseen by LCMS

Image *Dr Ruth Gordillo, Director of the Metabolic Phenotyping core at the UT Southwestern Touchstone Diabetes Center.*

Dr Ruth Gordillo was born in Badajoz, Spain. She earned her B.S. and Ph.D. degrees in Chemistry from the University of Extremadura. She came to the USA as a postdoctoral researcher at the University of California in Los Angeles in the Department of Chemistry and Biochemistry. Dr Gordillo joined UT Southwestern Touchstone Diabetes Center faculty in 2011 and became the director of the Metabolic Phenotyping core in 2015.

The Touchstone Diabetes Center is devoted to the study of the cells and tissues that contribute to or are affected by diabetes and its comorbid diseases. Research in the Touchstone Diabetes Center focuses on both basic and clinical aspects of Type 1 and Type 2 diabetes, and questions related to the impact of diabetes and obesity on cardiovascular disease, renal disease, and cancer progression.

Dr Gordillo specializes in the development of LC-MS/MS technologies for the determination and quantitation of metabolites. Our analytical portfolio includes the exploration of sphingolipids and phospholipids, water soluble cellular metabolites, diastereomeric separations of carbohydrates and nucleotide sugars, and therapeutic antibodies.

Summary of my work

I am the director of UT Southwestern Metabolic Phenotyping Core and Dr Syann Lee is the co-director. Together we manage the facility operations which provides analytical and phenotypical measures to the scientific community, both inside and outside UT Southwestern Medical Center. Our portfolio of services includes chemistry clinical metabolic panel using a clinical analyzer, colorimetric assays immunoassays, targeted metabolomics using LC-MS/MS technologies, mice body composition (TD-NMR and micro-CT scanning), rodent metabolic chambers, rodent treadmills, mouse surgeries, and RNAscope and Base Scope hybridization.

Our goal is to expand the scope of techniques available to investigators, standardize key methodologies, and expedite the completion of research on diseases related to metabolic disorders (specifically diabetes and obesity), cancer, aging neurological disorders, etc. Amongst a large portfolio of phenotyping techniques, our laboratory allocates extensive mass spectrometry resources to metabolomics studies.

I specialize in the development and implementation LC-MS/MS methodologies for the determination and quantitation of metabolites. Our analytical portfolio includes the exploration of sphingolipids and phospholipids, water soluble cellular metabolites, diastereomeric separations of carbohydrates and nucleotide sugars, and therapeutic antibodies.

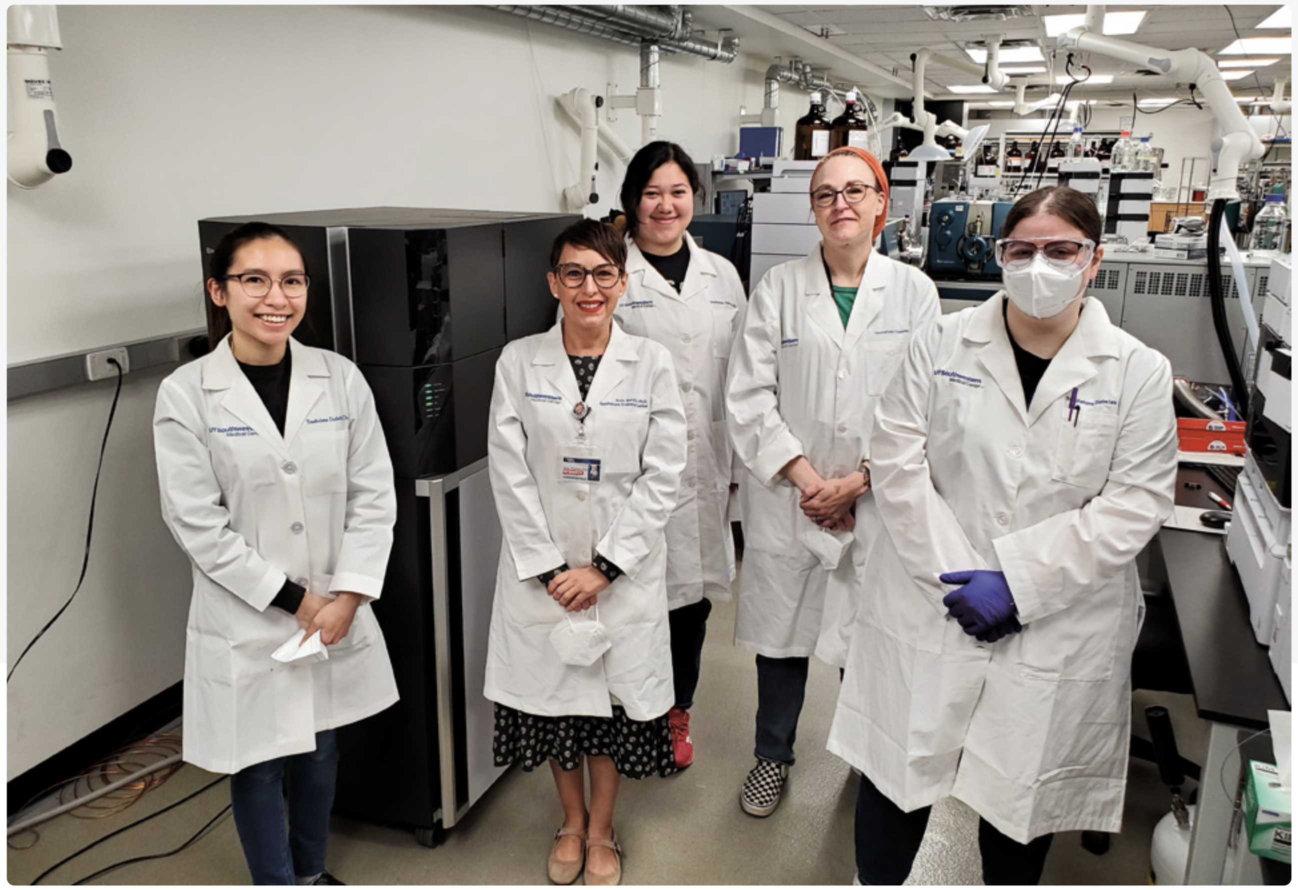


Image *Dr Gordillo with her team: from left to right: Jannine Irel Gamayot, Ruth Gordillo, Sarah Rico, Shannon Hacker, Allison Walker*

Instrumentation and applications

Amongst a large portfolio of phenotyping techniques, our laboratory allocates extensive mass spectrometry resources to metabolomics studies.

We have several Shimadzu liquid chromatography triple quadrupole mass spectrometry systems dedicated to the analysis of lipids and water-soluble primary metabolites. A supercritical fluid chromatographer coupled to a LCMS-8060 for more challenging separations such as diastereomeric glycosphingolipids and phosphatidic acids. In addition, we have allocated an LC/Q-TOF-MS dedicated to the analysis of free fatty acids profiling and global lipidomics studies. A fully automated sample preparation module coupled to a LCMS-8060 LC-MS/MS system. An important percentage of our data is obtained using the ready to use method packages developed by Shimadzu such as the library for phospholipid profiling, cell culture profiling, primary metabolites, and bile acids quantitation.

Very recently we have installed a mass spectrometry imaging system, a Shimadzu iMScope QT, expanding our mass spectrometry resources dedicated to metabolomics. Imaging mass spectrometry is a very necessary and logical step in our laboratories to be able to answer many questions related to our studies on preclinical models of disease. When we perform LC-MS/MS metabolite analysis on tissue extracts we lose the spatial resolution and subtle spatially localized metabolite differences are also lost. We are currently embarked on the method implementation and optimization processes for MS lipidomics and bile acids imaging. Our immediate plans include studies focusing on liver, kidney, and pancreas.

In the future we hope to expand the applications to proteomics imaging and therapeutic drugs in collaboration with UTSW Proteomics Core and the Preclinical Pharmacology Core. iMLayer sublimation and iMLayer AERO automatic sprayer satellite instrumentation have been very powerful tools in our method implementation journey assisting with sample preparation and reproducibility. Having a straightforward and reproducible processes is of utmost importance in our facility since we provide services to the scientific community and many of the steps are performed by different research technicians.

What do I like about working with Shimadzu?

There are many aspects I like regarding working with Shimadzu. Their extensive catalog of analytical instrumentation allows us to have a large number of fully compatible systems in our laboratories. They have a modular design concept facilitating laboratory expansions and rearrangements. Shimadzu mass spectrometers have ultra-fast-scanning capability, are very sensitive and very robust. We have been able to apply our analytical methods to all kind of complex biological matrices as well as perform metabolomic studies on samples with a very small amount of biological material such as mouse and human pancreatic islets preparations and small extracellular vesicles preparations. But what I appreciate the most about collaborating with Shimadzu is the support I get from their team of engineers and scientists. I am extremely fortunate to work with very talented professionals from Japan, Europe, and the USA.

INTERVIEW

Dr Ann-Christin Niehoff is a Product Manager Imaging at the European Innovation Center, Shimadzu Europe

Please tell us more about your role at Shimadzu Europe

I'm project manager in the European Innovation Center of Shimadzu, taking care of the European collaborations in the field of Imaging and Clinical. Furthermore, I am responsible for the product management of our imaging products in Europe including the MS Imaging and fNIRS portfolio.

The first part of my job contains mainly R&D from fundamental research to application development with various collaborators at universities or other research companies. The second part contains training of our Shimadzu colleagues and marketing of our products all over Europe.

What do you like about your job?

I really like the variety and flexibility of my work. Since the projects regularly change, the topics of course also change. No day is like the one before, and it covers areas from R&D, marketing to sales. Furthermore, I have great colleagues and collaborators all over the world, with whom I like to work and discuss current and future projects from different perspectives.

What fascinates you about MS imaging?

MS Imaging gives great new options to take a closer look into biological, clinical, or pharmaceutical questions. A picture is worth a thousand words, and with MSI you get a lot of pictures. The technology continually changes and has developed over the last decade from a pure research technology to applications being used in routine. Since it is more routinely used, MSI isn't just used by MS imaging labs which further develops this technology, but also in applied science labs which are now using MSI for their research fields.

Additionally, the community is great. It's a young society with a focus on supporting young researchers and international collaborations. There have been several programs supporting exchange of students between the labs or dedicated MSI workshops.

How do you envisage working with the MS imaging community in the UK?

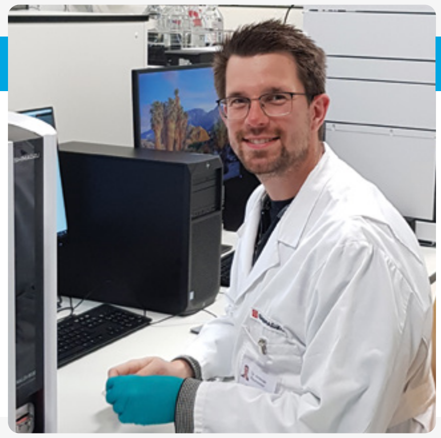
For my fNIRS project I already have a great collaboration with University Colleague London, so it would be of course, great to extend further collaborations in the UK. Due to my work with the MS Imaging Society and all the conferences also taking place in UK, I already have great connections to some of the research labs. But now with our new instruments for sample preparation, data acquisition and data analysis, especially the iMScope QT I am looking forward to working with a lot of new labs and supporting them to do their research.

Tell us something about Shimadzu not everybody knows

Shimadzu is a great research company. There are only a few companies which have such a big variety of instrumentation like Shimadzu is offering. Just in 2020, ~650 patent applications got through. One big part which plays a big role in current development is to reduce emissions and waste, not only in our instruments but also in our labs and factories. Shimadzu group is taking the lead in drastically reducing CO_2 emissions by joining RE100 in March 2021 and committing to switching to 100% renewable electricity at our plants, laboratories, and other major sites. As a result, 85% of the Group's electricity usage across the enterprise group is now from a renewable energy source, while the European headquarter and the Shimadzu UK offices are already at 100%.

Where can we find you in your free time?

With my family! I like to cook and eat, so when I have enough time, we cook all together with a lot of different things and enjoy the food. Also hiking and travelling around, which nicely fits also to my job, is what I like to do whenever possible.



INTERVIEW

Dr Andeas Baumeister is a MALDI Product Specialist at Shimadzu Europe

Please tell us more about your role at Shimadzu Europe

I'm a product specialist for the MALDI product line. A big part of my job is the customer support. Starting from the first meeting to find out which of our products could fit to their samples. Then running some tests or demonstrating the instrument and finally training users on the equipment.

Other parts of my job are training of colleagues within the Shimadzu group, presenting of our recent developments in fairs and conferences and developing new applications. In summary, my job is diverse: office, laboratory, and travelling.

What do you like about Shimadzu?

The people working for Shimadzu: I'm so happy about my colleagues. Not only in my department or within Shimadzu Europe but also the ones working for our subsidiaries, our distributors, or our factory in Manchester. The atmosphere of working together and supporting each other is very motivating. The work environment is very supportive and motivating which results in a great work atmosphere.

What is your favourite instrument and why?

Hard to say, all instruments have their benefits. However, the MALDI-8020 will always be a special instrument for me as it was the first MALDI instrument that was installed in our Laboratory World in Duisburg. It arrived during my first days at Shimadzu and it felt like having my own instrument.

What do I like about the MALDI-8020? The software is very user-friendly. All functions are easy to find and the instrument control works intuitively. In addition, you can use the MALDI-8020 for a lot of applications: Intact proteins, peptides, oligonucleotides, sugars, nanoparticles, it really is an all-rounder.

What advantage can MS imaging bring to the analytical lab?

In contrast to LCMS, your analysis is not limited to knowing how much of an analyte is in the sample.
You can also differentiate where your analyte is located.
For example, in hair analysis, mass spectrometry imaging is able to locate drugs: if the drug or drug metabolite is surrounding the hair it suggests that the owner was in contact with the drug but did not take it. In contrast, if the drug can be monitored inside the hair this indicates drug intake/abuse. In addition, you can determine the distance between drug to the root of the hair to estimate when it was consumed. You can even check if the drug intake was regular or in one particular case.

As part of your job, you have come to the UK many times. What do you like about it?

I like travelling in general: Visiting cities, meeting people, viewing the countryside. Even though on business trips the time is often limited, at least I get an idea if I want to come back for vacation. London convinced me to come back because there was so much to see, Cambridge was nice with all those old buildings and I will definitely come back to Scotland, not only for sightseeing but also for hiking. I am really curious where my next trip will go to and what can be discovered there.

One thing I am passionate about is…

MALDI. Even though it is the most obvious answer. But of course, there is also a life besides work and so I would like to share another passion: games, especially the German card game Doppelkopf which could be translated as twin-head. It's a game for four people and two of them are playing against the other two. Who is playing together will be revealed during the course of the game. It's not only the game itself but also meeting friends, mapping out a strategy and winning or losing together.

Next-Generation Mass Spectrometry

Imaging Created by iMScope™ QT

Inheriting the concept of a mass spectrometer equipped with an optical microscope from the iMScope series, the iMScope QT is also Shimadzu's Flagship model for MS imaging with a Q-TOF MS.

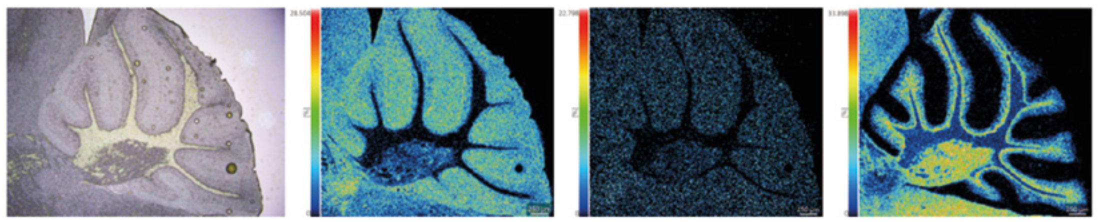
The iMScope QT boasts not only fusion with morphology studies but also excellent speed, sensitivity, and spatial resolution, clearing the way to next-generation mass spectrometry imaging.

Combined Analysis

Fusion of MS images with optical microscope observations.

Measurement Results for the Cerebellum with 5 µm Spatial Resolution

- Sample: mouse cerebellum
- Matrix: 9-AA
- Measurement region: 662 × 595 (393,890 pixels)
- Measurement time: around 2.2 hours



Optical microscope image | m/z 885.55 | m/z 888.57 | m/z 888.63

Murine cerebellum was measured with a resolution of 5 µm. High-resolution MS imaging and morphological observations with the optical microscope support cutting-edge research.

Quantification and Distribution

Obtain both qualitative and quantitative information from LC-MS and define analyte location using mass spectrometry imaging with a single instrument.

High Resolution, Speed and Accuracy

Acquire high-resolution MS images with excellent mass accuracy and high-speed. Analyse data with comprehensive and efficient data processing software.

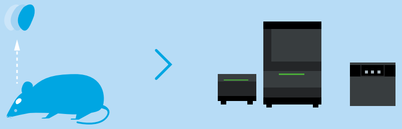
Total System for MS Imaging Analysis

Mass spectrometry imaging is performed in three steps: pretreatment, data acquisition, and data analysis. At each step, the optimal approach accelerates research, while improving the reliability of the results.

Key Points for MS Imaging

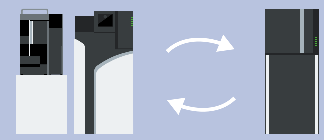
Pretreatment

Repeatability
Automation
Crystal Refinement



Data Acquisition

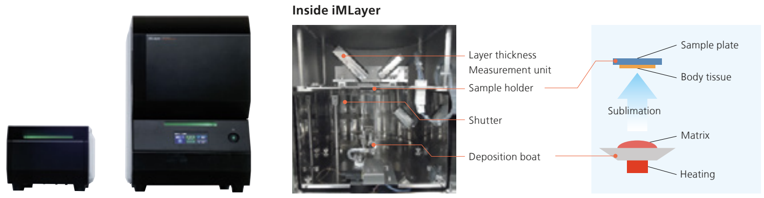
High Spatial Resolution
High Speed
Quantification



Data Analysis

Convenience
Diversity
Universality

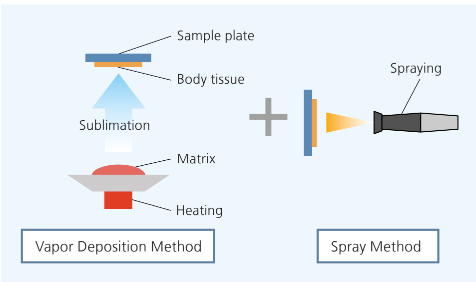
Matrix Spray



Matrix Vapor Deposition System
IMLayer™

Pretreatment, which normally requires know-how to increase ionization efficiency, has been automated.

Automatic for MALDI imaging
IMLayer™ AERO

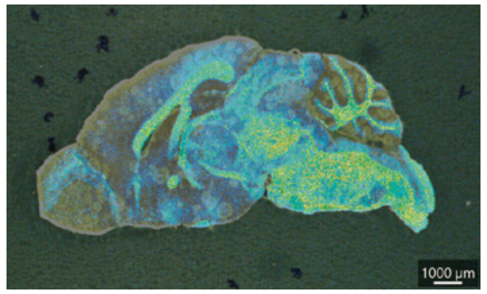


Two-Step Vapor Deposition Method for Simultaneous Spatial Resolution and Sensitivity

Imaging Mass Microscope
IMScope™ QT

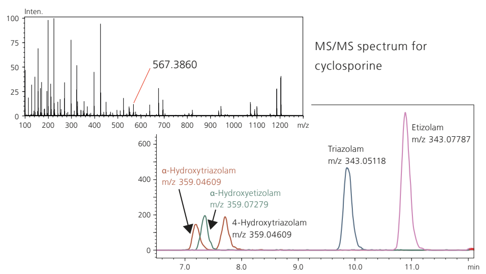
Users can **easily switch** between imaging analysis and LC-MS analysis.

Quadrupole Time-of-Flight Liquid Chromatograph Mass Spectrometer
LCMS 9050



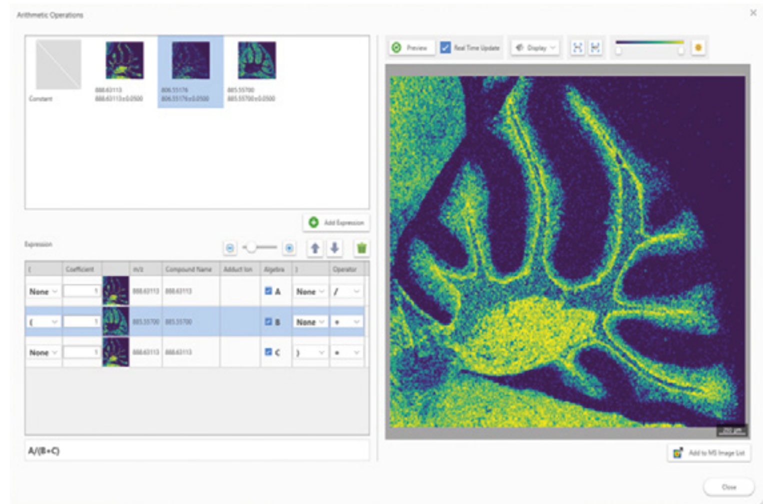
Overlaying optical microscope images with MS images

The Mass Spectrometer is equipped with an optical microscope, so data analysis can **match the optical microscope images** to the MS images.



Mass chromatogram of etizolam, triazolam, and their metabolites, added to whole blood at a concentration of 10 ng/ml

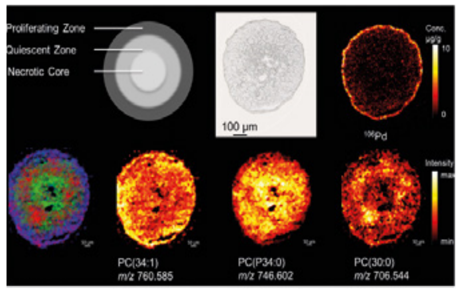
Quantitative Analysis

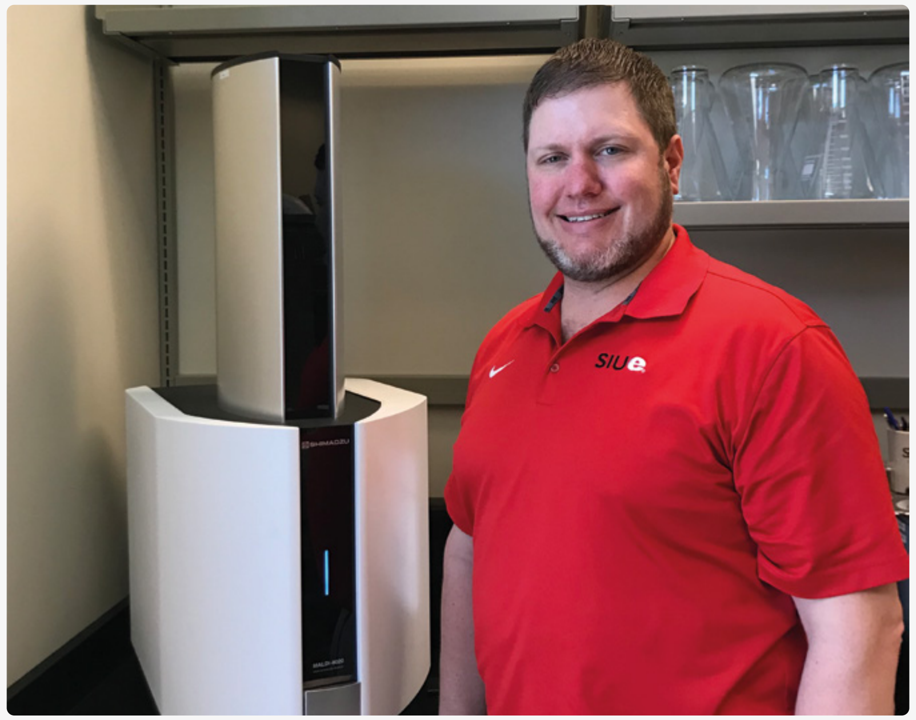


Data Analysis with
IMAGEREVEAL™ MS

Analyze both distribution information acquired using the IMScope QT and quantitative information obtained with LCMS-9050 (ideal for quantification)

- Basic statistics
- PCA
- PLS
- Image Classification
- Similar image Extraction
- Segmentation
- Arithmetic Operations
- Quantification
- Multimodal Imaging





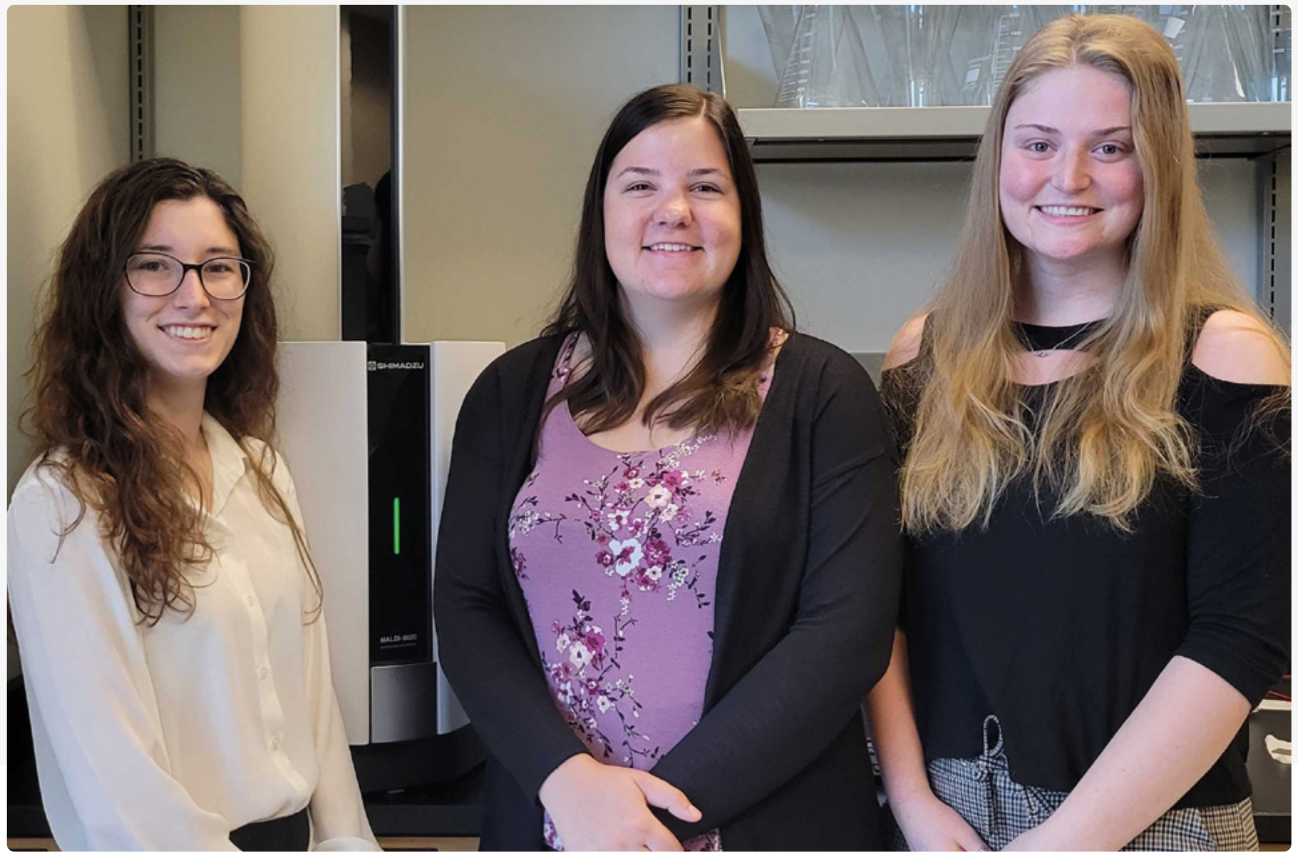
Easy to use MALDI-8020 imaging reveals local differences in analyte concentrations and makes this technique a cornerstone in analyte quantitation workflows

Dr Kevin Tucker, Associate Professor at Southern Illinois University Edwardsville, tells his story of using complementary mass spectrometry analyses to understand localization and concentration of analytes in a variety of matrices.

Images *Dr Kevin Tucker and his students next to their MALDI-8020 at their lab at SIUE (Southern Illinois University Edwardsville). His grad students are (left-to-right): Kendra Selby, Emily Hubecky and Stephanie Shan*

Summary of my work

In 2005 when I started at the University of Illinois at Urbana-Champaign, I became enamored with the future possibilities of mass spectrometry imaging (MSI) even though at the time MSI was still a burgeoning technology. While studying under Prof. Jonathan Sweedler, I grew as a mass spectrometrist and an analytical chemist, focusing my time and skills on method development specifically for MSI based techniques. My time spent in the lab and my dedication to bolstering my MSI knowledge led me to becoming proficient in improvising techniques and improving data quality for MSI. After matriculating from my Ph.D. in 2011, I found myself performing qualitative and quantitative analyses on a variety of samples that spanned the gamut from nucleotides to ground corn to concrete. I had become adept at method development for a very broad range of applications. My independent research career began in 2016 and has focused on the application of method development for LC-MS and MALDI MSI to a variety of sample types and sample matrices. Utilizing an LC QqQ MS, I have performed targeted quantitative analysis on samples including wastewater, corn-to-ethanol fermentation broth, and homogenate tissue samples. However, the most exciting work has come from marrying my two areas of expertise: LC-MS quantitation method development and MALDI MSI method development.



Instrumentation and applications

I lead the work that is performed at Southern Illinois University Edwardsville's Shimadzu Innovation Lab, which currently houses a HPLC iSeries, a LCMS-2020, a LCMS-8060NX, a GCMS-TQ8050, a MALDI-8020, an EDX-8100, and a UV/Vis 3600i. I have been able to leverage these analytical tools against a plethora of applications: antibiotics in freshwater, wastewater, soil, and dried distiller's grains with solubles; pesticides and herbicides in fresh water, plants, and foods; pharmaceutical toxicology in flatworms, fathead minnows, leeches, and earthworms; targeted metabolomics in gynecological cancers and blood; and the application of qualitative MALDI MSI whenever appropriate to guide the quantitative studies. The recent addition of the MALDI-8020 has been remarkable as it allows me to train undergraduate and graduate students with little to no experience with MSI and produce publication quality data within the first couple of months. My students found the software to be easy to follow with very little training required. As a result, I have had three students using the instrument consistently for imaging work related to earthworms, human cancer, and mung beans. We have employed the MALDI MSI to inform our studies on where the analytes of interest are most concentrated in the tissue. We then perform careful dissections of the samples to maximize the concentrations of our analytes. Performing MALDI MSI is now the cornerstone in our workflow to quantifying those analytes that are present at high local concentrations, but low global concentrations and are thus diluted in homogenate sampling protocols.

What do you like about working with Shimadzu?

In addition to Shimadzu's excellent instruments, their work force is what sets their organization apart from other manufacturers. I know that I can get everything I need out of my instruments because I have direct contact with the experts at Shimadzu anytime I need help. Whether by email or phone, Shimadzu's employees have not only provided the tools that researchers need on their journey to excellence in science, but are willing to walk beside you to help you along the way as you encounter new challenges that even they may not be familiar with yet. Working with Shimadzu for me means that I am working people who are invested in my success.

MALDI Applications Manager at Kratos Manchester

INTERVIEW WITH **MATT OPENSHAW**

Please tell us more about your role at Kratos

I am the MALDI Applications Manager. I look after the MALDI Applications Lab and manage the applications team. I see my role as a facilitator – I ensure that the applications team have everything they need to do their jobs.

What do you like about your job?

The variety of tasks within the role. The Applications role at Kratos is a lot more varied than I imagine at some companies. We are not shoe-horned into a role to do the same job every day! We are fortunate enough to be able to attend conferences, meet Shimadzu customers/end-users of our systems, contribute to requirements for new products/applications and work on developing new applications. I have a great team of Applications Specialists working for me and I am grateful to have this resource available to work on new projects. It's a great feeling when we launch a new product and to be able to say "we (the Applications team) were part of making that happen."

What is your favourite instrument and why?

When I started at Kratos as an Application Specialist, the newest instruments were the AXIMA range. Over the years, these instruments underwent several iterations, improving the performance. The AXIMA products are still part of our current product line-up although they now constitute our mid-range products. They are real workhorses and are very robust and reliable. I worked on them for many years and I am so familiar with them and the software that they are my go-to instruments if I want to quickly try something out.

What fascinates you about MS imaging?

It is amazing how much detail one experiment can reveal. Also, how far this application has developed. It's a simple concept but there are so many aspects that need to be controlled. For example, people have gone from using an airbrush to manually coat tissue sections with matrix to fully automated, highly reproducible sublimation systems which can reveal fine detail during image analysis. The reproducibility is important for projects involving multiple samples.

What advantage can MS imaging bring to the analytical lab?

MALDI imaging provides an extra dimension to traditional imaging techniques. Rather than identifying simply visual differences in the samples e.g. tissue sections, MS imaging can help identify and understand the changes at the molecular and biological levels. We are working to make this technique more amenable to routine analysis so that, one day, it may be used in diagnostic applications.

Tell us something about Kratos not everybody knows

Kratos is a subsidiary of Shimadzu Corporation (Japan). The current Managing Director at Kratos is a descendant of the founder of Shimadzu – Genzo Shimadzu, Sr.

How do you envisage working with the MS imaging community in the UK?

We are very fortunate in that at our facility in Manchester, we have everything under one roof: physicists, software engineers, service engineers, applications specialists. This has obvious advantages when it comes to collaborating on new projects with UK-based scientists. We are always looking for new collaborations as they are a great way to get feedback from experts on how we can improve our systems to deliver what users really want.

One thing I am passionate about is…

Food and cooking. A good recipe is like a SOP – during the 'development' phase, there is some optimisation of ingredients and quantities but once it is perfected, don't deviate from the recipe or you may end up disappointed!

Where can we find you in your free time?

At home doing DIY jobs around the house. Or at the gym – I recently re-joined a local gym and I am making a real effort to go a few times each week.

Who is your scientific hero?

I am fascinated by Da Vinci's anatomical drawings. The level of detail is incredible and you can imagine how fascinating and exciting it must have been for him (and his analytical brain) as he tried to understand how the human body worked.

Senior MALDI Applications Specialist at Kratos Manchester

INTERVIEW WITH **SIMONA SALIVO**

Please tell us more about your role at Kratos

As a Senior MALDI Applications Specialist, I bring my long-term mass spec background to promote our wide range of MALDI instruments, through working with collaborators on new project ideas, or developing application notes to help our Shimadzu Sales colleagues with delivering the right solution to customers. I also work closely with the R&D Team to continuously improve, identify and develop new products.

What do you like about your job?

Working on exciting and scientifically attracting projects with collaborators is probably what I like most and where I feel I express myself at best, because together we generate a powerful product, whether it is a paper or applications note.

Secondly, I love to work with R&D and be part of the incredible and passionate process behind the development of our products. There is never a day that is same as another one.

What is your favourite instrument and why?

I would say I am a big fan of the MALDI-8020/MALDI-8030, because they are versatile, easy to use and can deliver as much as the floor standing fellows.

What fascinates you about MS imaging?

MS imaging allows you to get what other well-established techniques can't, i.e., the molecular information. Obtaining the molecular signature of a key area of a tissue can give a massive contribution to the understanding of a physio/pathological process. With MALDI-TOF instruments being nowadays faster and robust, MALDI imaging is gaining growing attention by the scientific community.

What advantage can MS imaging bring to the analytical lab?

MALDI imaging is a versatile technique that is not just used for biological purposes, as we all probably used to think, but has a great potential in many more applications such as environmental, forensic, materials etc. I believe it can make a useful, complementary tool to a lot of techniques.

Tell us something about Kratos not everybody knows

People may have forgotten but Koichi Tanaka who won the Nobel Prize for high MW analysis using MALDI used to work at Kratos.

How do you envisage working with the MS imaging community in the UK?

MALDI imaging is continuing to grow and gain trust by the scientific community. It is already a mature technique. We at Kratos are happy to support new imaging users who want to embark on new imaging journeys.

One thing I am passionate about is…

Photography. When I take photos, I aim to capture special moments more than the general context. Whether it is a family occasion or a beautiful landscape, when I look back at those photos, I want to picture in my mind those moments and evoke the same emotions.

Where can we find you in your free time?

I will be doing outdoor activities, particularly hiking in beautiful countryside places, or cycling.

Who is your scientific hero?

Probably Rita Levi-Montalcini. She was undoubtedly one of the greatest scientific minds of the 20th century. She devoted her life towards research, and part of what we know nowadays of neurodegenerative and cancer diseases is thanks to her. Besides, her scientific role, she fought through deeply entrenched sexism and the staggering anti-Semitism of WWII to do the thing she loved most. The awards were never the goal. After learning that she won the Nobel Prize in 1986, she commented that "It was a great honour. Still, there is no great thrill as the moment of discovery."

Global MALDI Applications Specialist at Kratos Manchester

INTERVIEW WITH **MICHAEL NAIRN**

Please tell us more about your role at Kratos

As a Global MALDI Applications Specialist, I represent Shimadzu when visiting conferences and customers and, in return, provide feedback from the customers to the design and manufacturing team.

In the factory, we work on projects on the instruments to identify new ways to use MALDI technology, and work with R&D to improve our systems.

What do you like about your job?

There are two aspects I love about my job. One is the varied work we perform and the other is working with my colleagues at Shimadzu. I can honestly say that Shimadzu has been the best company I have been a part of.

What is your favourite instrument and why?

I have been a big fan of the MALDI-8020 since its release, but now I would have to say the MALDI-8030. It is basically the same instrument but now with the added benefit of negative ion mode. Because these benchtop instruments are quick to load samples, it makes method development a breeze.

What fascinates you about MS imaging?

MS imaging is an incredible tool. In every MS imaging image you see, there is a story of colossal detail. Each pixel contains a mass spectrum. At each point of the image, the peptides and proteins can be identified. For every peptide and protein of interest, images of their exact distribution can be generated with only a few clicks. The addition of MALDI Imaging to the benchtop series is ground-breaking, as now this immensely powerful technique becomes much more accessible.

What advantage can MS imaging bring to the analytical lab?

Imaging is a massive benefit to most labs. This technique can provide:

Spatial distribution of pharmaceuticals and their metabolites. Determine if a compound diffuses into tissue

Visualise compounds expressed in biofilms and that is just the beginning.

Being fast and affordable, this technique will find ever increasing applications with time.

Tell us something about Kratos not everybody knows

Kratos have a long pedigree of manufacturing high quality scientific instruments. In fact, Kratos developed the first benchtop MALDI, the Kompact MALDI I in 1994!

How do you envisage working with the MS imaging community in the UK?

I believe we are going to see a shift in the use of MALDI imaging. With rapid and affordable MALDI imaging, there will be a massive growth in the field and we at Kratos aim to support these new users and give them the confidence to try out new ideas.

One thing I am passionate about is…

Recycling. I see so many devices with built in obsolescence, or people replacing perfectly good items with the newest model, even if there is no real benefit. This is one of the things I love about our instruments. They are built to last! As far as I am aware, there are users still using old Kratos Kompact instruments to this day!

Where can we find you in your free time?

I will be outside gardening, tinkering with old vehicles or taking my children into the countryside.

Who is your scientific hero?

Democritus. He was known to be calm, tenacious, and cheerful. Known as the ‘laughing philosopher’, Democritus developed an atomic theory featuring tiny particles always in motion interacting through collisions; he believed the universe is governed entirely by natural, mechanistic laws rather than gods; he described a universe containing an infinity of diverse inhabited worlds and he asserted that nothing is actually something.

It is incredible to believe that these ideas were being proposed some 2400 years ago!

Imaging Upgrade

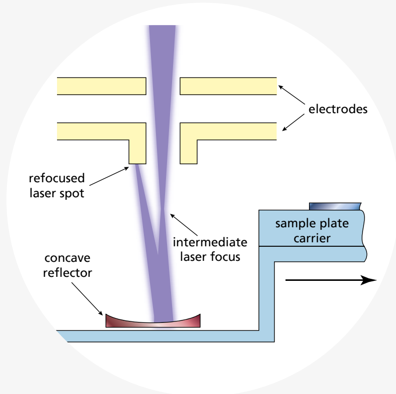
The Benchtop MALDI-TOF Imaging Starter Kit provides a complete MALDI imaging application solution to your existing Shimadzu MALDI-8020 and MALDI-8030 benchtop MALDI-TOF instruments*. The kit has been developed and robustly tested to the highest quality standards to provide reliable imaging mass spectrometry results.

*requires MALDI Solutions 2.8 or later; some changes may be required to PC hardware on existing MALDI-8020 or MALDI-8030 instruments

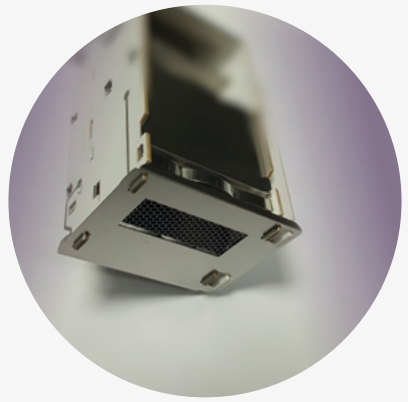
Shimadzu benchtop MALDI instruments are IDEAL FOR IMAGING

- Class-leading sensitivity and mass resolution of the MALDI-8020 and MALDI-8030.
- FastMS feature - with the 200 Hz laser, fast sample slide introduction (<3 min) and quick sample stage – provides the speed to attain up to 15 pixels per second (lipid imaging acquisition (100-1200 m/z) at 50 µm spacing using an accumulation rate of 10 shots/profile).
- Robustness provided by the class-leading long-lasting laser lifetime of 2 billion shots†, the self-cleaning ion optics using the patented TrueClean™ one-click laser technology – for reduced engineer call-outs, and the long-life, slow-ageing *Aeon*Detector™ which means less intervention even after continuous use in imaging experiments.

† or 12 months warranty



Schematic of TrueClean one-click laser technology



The *Aeon*Detector has up to 7x longer life and reduced ageing rate

MALDI imaging simplified

Imaging Created by MALDI-8020/8030

There are three main steps in the MALDI imaging workflow after collection of tissue sections:

1. **Sample pre-treatment and MALDI matrix coating**
2. **MALDI data acquisition**
3. **MALDI data processing**

Solutions are provided in each step to make an otherwise typically difficult imaging workflow into a simple user-friendly application with a successful outcome for your laboratory.

1

Matrix Coating

- Automated MALDI matrix coating devices available
- Easy to use
- Simple selection of pre-set methods
- High reproducibility
- Refined crystal size improves mass and spatial resolution and ionisation efficiency

iMLayer™ matrix sublimation device: ideal for intact molecule imaging

OR

iMLayer AERO™ automated sprayer: ideal for on-tissue digestion imaging

2

Data Acquisition

- Easy to use imaging acquisition wizard
- FastMS offers speed
- *Aeon*Detector offers robustness
- TrueClean means easy to clean ion source

MALDI-8020 linear MALDI-TOF mass spectrometer

OR

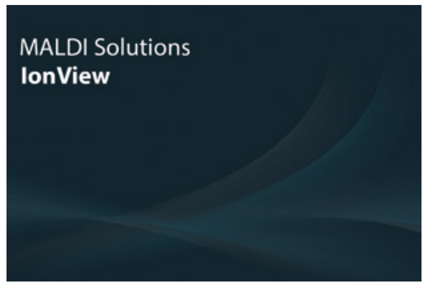
MALDI-8030 linear MALDI-TOF mass spectrometer with dual-polarity

2

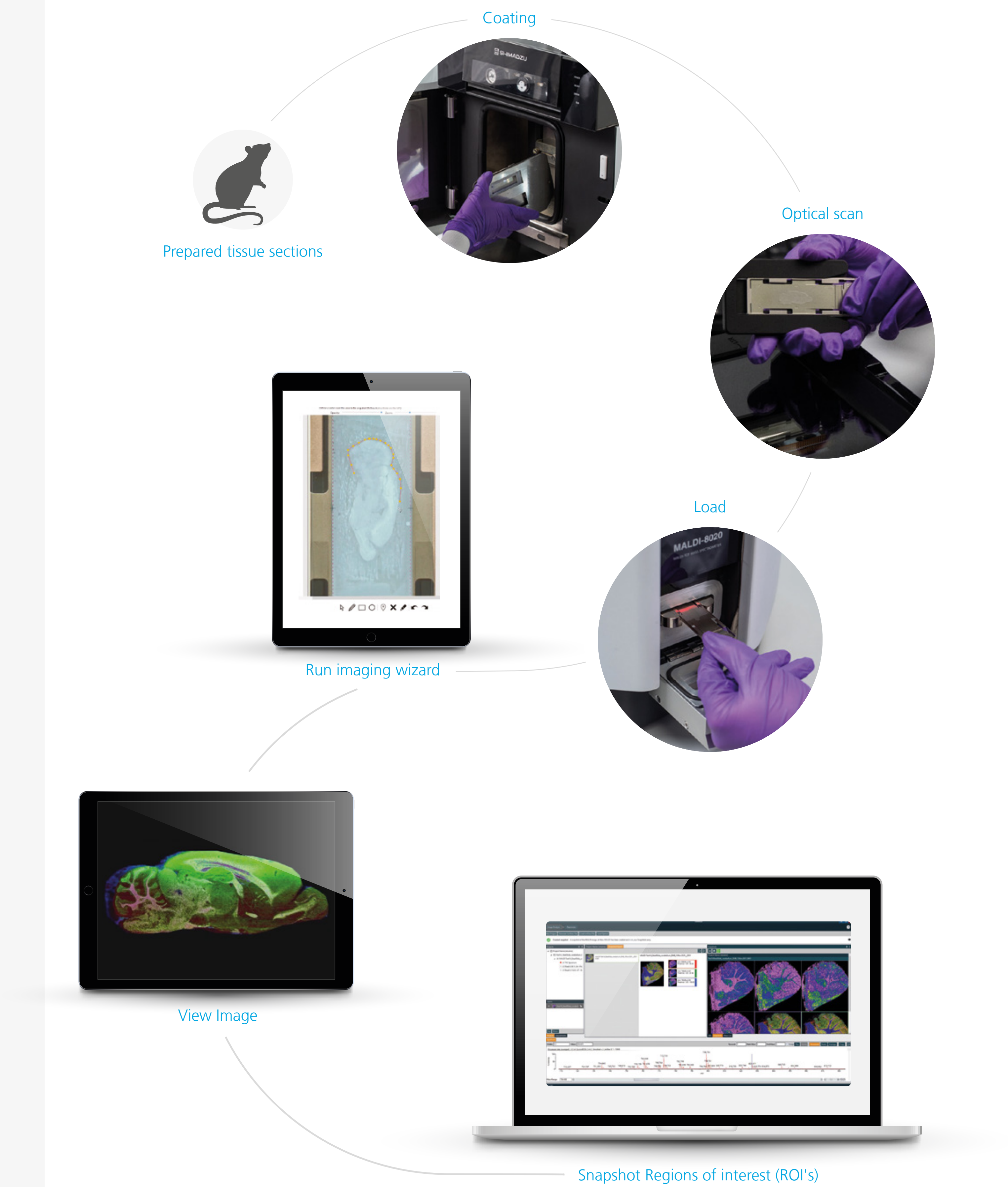
Data Processing

- IonView imaging viewing software is easy to use
- Reads data directly from instrument
- Quick to reload generated IonView files
- Separate workstation available for user convenience
- Export to imzML (for statistical analysis in IMAGEREVEAL™ MS*imaging software)

* Not included in Benchtop MALDI-TOF Imaging Starter kit



IonView imaging viewing software



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