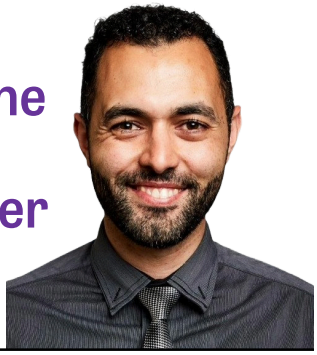
WESTERN SYDNEY UNIVERSITY

February 2024

MASS SPECTROMETRY FACILITY NEWSLETTER

From the Facility Manager



Welcome to 2024! As we settle into another year, I wanted to take a moment to reflect on the progress and achievements of our facility throughout 2023. Our dedicated team was thrilled to meet and work with many new researchers last year from all over the university. It has been a pleasure to collaborate with so many people and provide our LCMS expertise to so many varied projects. We were able to expand our discovery omics capabilities, including a rapid and robust protocol for large-scale proteomics research on the Synapt G2-Si system.

Many new protocols were developed for targeted analyses such as Short Chain Fatty Acids, Steroid hormones and Polyamines. This has largely been thanks to the extraordinary efforts of the facilitiy's technical officer Sonyia Juarez, who has worked with several researchers to develop, optimize and validate methods on the Sciex 7500 system as well as ensuring it is running as efficiently as possible.

We trained dozens of new users over the year and it is great to see that so many students are now proficient with the instrumentation and capable to operate independently. The facility also organised several workshops and events which have greatly helped to boost users understanding of LCMS operation and data analysis.

As always, I encourage you to share your feedback, suggestions, and accomplishments with us. Your contributions are invaluable in shaping the future direction of our facility.

On behalf of the Mass Spectrometry team, thank you for your continued support and dedication.

Meena Mikhael
Facility Research Manager

LC-MS/MS Workshop with Western Sydney University Mass Spectrometry Facility and SCIEX

For Mass Spec beginners and above

We are excited to invite you to our beginner friendly workshop on conducting LC-MS experiments using the SCIEX QTRAP 7500 on 22 February 2024.

It is an excellent opportunity to enhance your understanding of mass spectrometry and its potential in your research projects.

Please email the facility manager, Meena Mikhael (M.Mikhael@westernsydney.edu.au), if you are interested in attending this full day event.

Recent Activities

Waters Bioinformatics Seminar and Workshop - 4 May 2023

The facility was thrilled to be able to host Dr Tyren Dodgen (Waters Australia) as he detailed Progenesis QI and Progenesis QI for Proteomics. Topics explored included metabolomics and lipidomics analysis and proteomics data processing. We were also delighted to hear from special guest Speaker Dr Muhammad Zenaidee (APAF) presented "Ion mobility enhances proteoform characterisation in top-down and native protein mass spectrometry."

Sciex Mass Spec Seminar and Workshop - 23 May 2023

Dr Charlie Liu (Sciex) presented at the Sciex & Mass Spectrometry Facility workshop, detailing Sciex Mass Spec Technology and QTRAP applications and Thusi Rupasinghe (Sciex) discussed Metabolomic and Lipidomic workflows.

Dr Morven Cameron (WSU) presented on "Quantification of neuromodulator release from neuronal tissue".

Australian and New Zealand Society for Mass Spectrometry (ANZSMS) Conference

Meena Mikhael (Facility Research Manager) and Sonyia Juarez (Technical Officer) attended the ANZSMS July 2023 conference in Wollongong. Many scientists from around Australia shared their cutting edge Mass Spectrometry research for new and improved analysis including proteomics, metabolomics and MS Imaging. Facility staff were able to get first hand details of the latest advancements in LCMS techniques and enhanced strategies covering complex samples and data analysis.

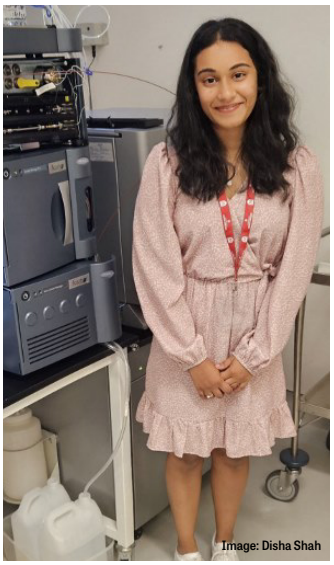


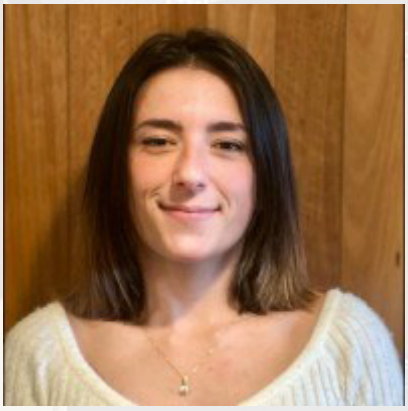
Image: Disha Shah

Staff News

The facility welcomes Disha Shah who commenced working at the facility as our new casual Technical Officer late in 2023. Disha has a strong background in Biomedical applications of Mass Spectrometry including lipidomics, metabolomics and proteomics based Mass Spec as well as MS imaging. She has been able to rapidly apply her skills and knowledge to assist users to improve the efficiency and quality of LCMS acquisitions in the facility.

Researchers at the Mass Spectrometry Facility

Marie Amigo



Research
School of Medicine (Supervisor: Associate Professor David Mahns)

Marie Amigo is undertaking her PhD on the onset of Multiple Sclerosis (MS). She is currently investigating the human proteome from brain and blood samples to highlight the immunological changes associated with the disease. She is looking at different stages of the pathology to compare the molecular and functional signatures and examine the MS-specific alterations and unravel crucial insights into onset of the disease's pathogenesis.

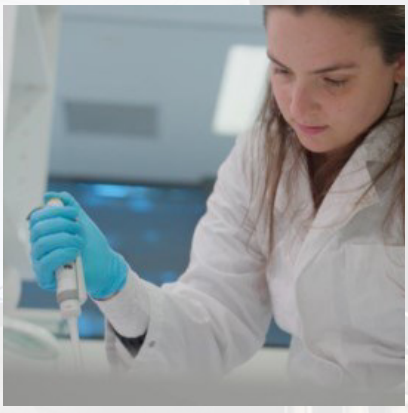
Impact

In-depth proteomics analysis aims to understand the molecular pathways affected at different stage of the pathogenesis. The identification of the MS-associated immunological characteristics is a key to identify the spectrum of autoantigens that potentially contribute to the onset and progression of the disease. Therefore, proteomic-based studies, combine with transcriptomics and genomics could provide a broad understanding of the disease's aetiology and a more precise diagnosis and treatment during its early stages. It is anticipated that early and targeted intervention will provide the best opportunity to arrest if not reverse the progression of MS.

Instrumentation

Marie is using the Synapt G2-Si to acquire proteomics with data independent acquisition (DIA) combined with ion mobility to give a greater depth of analysis. She is also taking advantage of the new microflow LC method to run large batches of samples more efficiently, enabling higher throughput and providing greater reliability for her proteomics results.

Sonyia Juarez



Research
School of Science (Supervisor: Dr Feng Li)

In addition to being the Technical Officer at the Mass Spectrometry Facility, Sonyia is also a Master of Research student in the field of metallosupramollecular chemistry. Supramolecular chemistry is often referred to as 'Lego Chemistry', as it is the study of the association of chemical building blocks to make larger functional architectures. Sonyia uses inorganic and organic building blocks to synthesis metal organic cages (MOCs), which are large molecules with three dimensional structures and internal cavities.

Impact

The building blocks for the MOCs are carefully chosen to have functional units resulting in the synthesis of functional material. The chemical environment of the internal cavities of MOCs are distinct from the external environment leading to interesting host-guest interactions between chemicals inside of MOCs cavities. Guests can also change the physical and chemical properties of the MOCS. The functional units and unique 3D structure enables their potential use in a variety of applications including chemical sensing, gas and chemical trapping, catalysis, chemical purification, and much more.

Instrumentation

Sonyia has utilised the Synapt G2-Si and SCIEX 7500 for her research. The Synapt G2-Si TWIM-MS experiments provide information on the elemental composition, structure, and conformation of her coordination cages. She has also utilised the SCIEX 7500 to explore host-guest adsorption of pollutants (PFAS) by these coordination cages.

Researcher Focus - Dr Morven Cameron

Background

Dr Morven Cameron is a Senior Lecturer at the WSU School of Medicine in Anatomy and Cell Biology. She specialises in retinal physiology with a focus on how vision changes under different lighting environments. She started at WSU in 2010 but she did not start including Mass Spectrometry into her research until 2016. Being able to accurately measure neurotransmitters and neuromodulators in the eye has revolutionised what we understand about the impact of light on the physiology of the retina.

Research

Dr Cameron's work primarily focuses on the release of dopamine in the retina. While we might think of dopamine as the "happy chemical" it is simply a neuromodulator that affects the function of neuronal circuits. The retina is a part of the brain and thus functions in a similar way. However, the main function of the retina is to detect, process and transduce light so that we can perceive the world around us, but also to tell our internal body clocks when the sun rises and sets. If you have ever visited a country in a different time zone you will have felt "jet-lag", however, after a few days (usually a day for each hour difference in time zone) your body clock aligns with the new time zone. The retina is able to detect the new light environment and tell your body clock to shift. To do this task, and indeed, to allow us to perceive the world well under different light environments, the retina must adapt to very different light intensities. Bright Australian sunlight is over a billion times brighter than starlight on a moonless night, and yet our visual system operates well under both conditions. When exiting a dark room on a sunny day we feel the effects of this adaptation; at first everything feels too bright, we squint and shade our eyes. However, after a few minutes we are adapted to the bright light, although Australian sunlight still often feel too bright (especially to those with European light eyes – Dr Cameron is originally from Scotland!). During those few minutes of adaptation, dopamine is released in the retina in response to the bright light and that dopamine acts on neuronal circuits within the retina so adapt the neuronal circuitry to the bright light environment.

Dr Cameron's research directly measures this dopamine release in response to light in rodents. Using the Sciex 7500 mass spectrometer, she is able to measure dopamine accurately down to 1 pg/ml (~65 pM). Since rodent tissue is so limited (size-wise), this impressively high sensitivity allows accurate quantification of dopamine (and now many other neuromodulator/transmitters) in just 2 µl of vitreal fluid from a mouse.

Impact

Dr Cameron's research has wide implications for both basic science and investigating the underpinnings of pathological conditions such as myopia, Parkinson's disease and other disorders involving dopaminergic function (ADHD, schizophrenia, etc.).

Myopia is known to be strongly linked to both environmental lighting conditions and dopamine release. Dr Cameron's lab is currently investigating the use of commonly used eye drops on dopamine release to determine why compounds such as atropine appear to protect against myopia. Further, Parkinson's disease patients show altered visual function and death of dopaminergic neurons in the retina, as well as in the main area known for dopaminergic cell loss in these patients, the substantial nigra. Dr Cameron's research will identify ways to potentially diagnose and track the progression of Parkinson's disease by measuring dopamine levels in the retina.

Finally, since dopamine is released faithfully in response to light, i.e. more dopamine is released as the light gets brighter, examining dopamine function in the retina will allow us to determine how dopaminergic cells of the whole nervous system function. While much is known about dopamine in the brain, the actual release of dopamine from dopaminergic cells is not well understood, likely due to the fact that circuits in the rest of the brain are complex and difficult to isolate. The retina, on the other hand, is a much simpler and better understood system and therefore provides the potential to understand the basic science of these enigmatic neurons in much more detail.

2023 Publications

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