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IN ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

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AWARD RECIPIENTS & INVITED SPEAKERS

2025 Graeme Batley Medal Recipient
Wednesday 5 November 2025

DRUG CHECKING: GETTING IN BEFORE THE HARM

Malcolm McLeod[1]

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Abstract

Drug use results in serious harm: more Australians die from unexpected drug overdose than in road traffic accidents.[1] However, addressing this is difficult as drug markets are unpredictable, and drug users are stigmatised. Collaborating with community organisations, government and the public, Professor Malcolm McLeod has pioneered the development of Australia's first drug checking services. Drug checking, also called pill testing, reduces the harms of drugs through analytical chemistry and public health education.[2,3] It is currently the principal means though which drug users can obtain quality information on drug purity, adulteration, or substitution, empowering them to make more informed decisions about drug use to prevent harm, overdose, and death. It is also a powerful way to monitor drug markets and detect the emergence of new psychoactive substances.

This Graeme Batley Medal award presentation will provide give a chemistry perspective on the development of drug checking in Australia. It will describe the analytical technologies employed, some of the lessons learned through service delivery, and a selection of the more interesting findings to date including several 'first' detections of new psychoactive substances.[4,5]

Biography

Professor Mal McLeod is a chemist with research interests that include the development of chemical and analytical technologies to study drugs and drug metabolism. He has worked extensively with local and international laboratories on the anti-doping analysis of steroids and their metabolites, and since 2018, has pioneered the development of drug checking as a harm reduction intervention in festival and city settings in Australia. He serves as scientific advisor to Harm Reduction Australia and the CanTEST Health and Drug Checking Service. He uses caffeine as stimulant and alcohol as depressant, but never at the same time.

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2025 Environmental Chemistry Medal Recipient
Thursday 6 November 2025

BRING AGGREGATION-INDUCED EMISSION LUMINOGENS TO SMALL AQUATIC ORGANISMS FOR ENVIRONMENTAL MONITORING

Youhong Tang[1]

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Abstract

The Ocean is regarded as a giant dumping area for many types of toxic chemicals and the ocean ecosystem is currently under enormous stress from a variety of pollution sources. There is an urgent need to monitor biological responses and quantitatively evaluate the change of environmental health. Microalgae are vitally important to the food web in the aquatic ecosystem and can be an important indicator to monitor water pollution due to their sensitivity to chemical changes in the environment. Zooplankton is an important trophic link between primary producers and predators in an aquatic system as they are widely distributed in water and mainly consume microalgae and are subsequently fed by fish, shrimp and crab. Algae and zooplankton can be used to assess bioaccumulation and biomagnification of the building-up process of a chemical in living organisms along the food chain. Aggregation-induced emission (AIE) is a photophysical phenomenon where light emission of a fluorogen is activated by aggregate formation to nanoparticles, which can be used as a sensing method in biological applications for toxic chemicals. This talk updates the recent research advance on the use of AIE as a biosensor to quantitatively detect and evaluate bioaccumulation and biorelease of mercury in algae and zooplankton in an attempt to explain the mechanism and interactions between heavy metal ions and small organisms in the aquatic ecosystem.

Biography

Dr Youhong Tang is a Matthew Flinders Professor of Engineering and a Research Leader in Institute for NanoScale Science and Technology, Flinders University. He was elected as a Fellow of Royal Society of Chemistry (FRSC), UK in 2018, a Fellow of the Royal Australian Chemical Institute (FRACI), Australia in 2021, and a Fellow of International Association of Advanced Materials in 2024.
Youhong obtained his PhD degree in the Hong Kong University of Science and Technology in 2007 and moved to Flinders University in 2012 from the University of Sydney. His research interests mainly focused on (1) Structure-processing-property relationship of fibre-reinforced polymer composites and structures; (2) Chemo and biosensors and their devices with aggregation-induced emission features and (3) Triboelectric nanogenerator based energy harvesters and sensors.

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[3] SF Rakhi, AHMM Reza, B Davies, J Wang, J Qin, Y Tang. Improvement of growth and lipid accumulation in microalgae with aggregation-induced emission-based nanomaterials towards sustainable lipid production. Nanoscale 17 (3), 1308-1316, 2025

Invited Speaker
Thursday 6 November 2025

THE CHEMICAL EXPERIMENT: THE HIDDEN COST OF CONVENIENCE

Brad Clarke[1]

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Abstract

This presentation will discuss the pervasive use of chemicals in modern society and research efforts to combat the urgent health threat posed by 21st-century synthetic chemicals. Alarmingly, children across the planet (including in Australia) are born with hazardous substances in their bodies, impacting development and long-term health. Per- and polyfluoroalkyl substances (PFAS) serve as a case study for understanding the broader issue of chemical production and its hidden environmental costs. PFAS, introduced in the 1940s, remained in use for decades before their adverse health effects and persistence in the environment were realized. Current Australian and international regulations focus on a small subset of PFAS, but thousands of variants exist with limited data on their production or health impacts. This talk will examine the presence of PFAS in the Australian environment, including analysis methods such as targeted LC-QqQ-MS and non-targeted analysis (NTA) using high-resolution mass spectrometry (LC-QTOF). A particular focus will be placed on the challenges of detecting and analyzing PFAS in biological tissues, which is crucial for understanding human exposure and health risks. The discussion will also cover the environmental sources of PFAS in Australia, including wastewater treatment plants (WWTPs) and novel sources like warehouse fires and high-performance motor vehicles.

Biography

Brad Clarke is currently an Associate Professor of Environmental Science and Analytical Chemistry at the University of Melbourne (Australia) and chief investigator at the Australian Laboratory for Emerging Contaminants (ALEC). Brad's research focusses on assessing the risk to public health and the environment from pollution, focussing on synthetic per and polyfluoroalkyl substances (PFAS), microplastics and flame retardants as well as advanced mass spectrometry techniques. Brad is passionate about industry-engaged, conducting applied and fundamental research to address real-world problems. Brad has published over 77 peer-reviewed journal articles and book chapters that have attracted >7000 citations and an h-index of 38. His work is published top environmental science journals that includes Environmental Science and Technology, Journal of Hazardous Materials, Environmental International, Water Research amongst others. Previously, Brad was the Environmental Science degree senior program manager at RMIT University and has held postdoctoral positions at Imperial College London and the University of Arizona.

2025 Original Research Publication Award Recipient
Friday 7 November 2025

DIRECT DETECTION OF MICRORNA IN LIQUID BIOPSIES FROM SINGLE CANCER SPHEROIDS

Chen Hu,[1] Essam M. Dief,[1] Bram G. Soliman,[1] Jiuyu Cui,[1] Yu-Nan Lu,[1] Sara Romanazzo,[1] Kristopher A. Kilian,[1,2] Richard D. Tilley*[1,3], J. Justin Gooding*[1]

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[2]School of Materials Science and Engineering, University of New South Wales, Sydney, NSW 2052, Australia
[3]Electron Microscope Unit, Mark Wainwright Analytical Centre, University of New South Wales, Sydney, NSW 2052, Australia

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Abstract

Exploring cancer heterogeneity is crucial for both understanding cancer and developing prognostic tools to monitor cancer progression during treatment through the liquid biopsy concept. Currently, the challenge in linking liquid biopsy with cancer progression is to develop a method that allows for quantifying changes in biomarker expression levels at the single cancer spheroid level. Herein, a nanoparticle based “dispersible electrodes” biosensor was used to detect ultra-low concentrations of microRNA-155 (miRNA-155) from a single breast cancer spheroid for the first time. The results from the sensor were comparable to the standard real-time polymerase chain reaction analysis, but in a much shorter detection time and without any sample purification or amplification. Owing to the unique ability of the sensor to measure biomarker expression from unaltered and undiluted cancer liquid biopsy from a single cancer spheroid, we tracked dynamic changes in miRNA-155 expression in a single spheroid treated with the anti-cancer drug doxorubicin. Then we combined with the 3D bioprinting techniques to move from unconfined spheroid to confined spheroid, to understand how the confinement regulates cell behaviour and its miRNA-155 expression. We further studied how miRNA-155 varies upon treated with different amount of doxorubicin at various timepoints to correlate biomarker changes to cancer growth and drug response. This work opens the door to understanding key biological processes such as response to treatment on the cellular and molecular levels, paving the way for adapting liquid biopsy insights to guide oncologists and more personalised treatment strategies.

Biography

Chen Hu received her master’s degree in analytical chemistry at Shaanxi Normal University, China, in 2022. She is currently pursuing her PhD at the University of New South Wales under supervision of Scientia Prof. J. Justin Gooding and Prof. Richard D. Tilley. Her research in the design and surface modification of biosensors for the detection of biological samples. She is passionate about biosensor innovation, surface engineering, and the translation of advanced sensing technologies into biomedical applications for early cancer diagnosis and therapy monitoring.

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Invited Speaker
Friday 7 November 2025

THE USE OF METABOLOMICS IN ENVIRONMENTAL SCIENCE. CAN WE BRING OMIC SCIENCE OUT OF THE LAB AND INTO THE FIELD?

Oliver (Oli) Jones[1]

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Abstract

Traditional environmental monitoring techniques are well-suited to resolving the effects of acute toxicant exposure on organisms, but they lack the resolution needed to assess subtle shifts in ecosystem function(s) resulting from chronic exposure(s) to pollutants. Metabolomics is the study of small-molecule metabolites present in biological systems. An organism's metabolic response can change in response to interactions with the surrounding environment and/or arising from biotic or abiotic change or perturbation(s). Metabolomics, therefore, has the potential to assess the chronic effects of things like climate change and exposure to contaminants and chemical mixtures, and the field has generated much interest in the last 15-20 years. However, despite its promise and ability to provide mechanistic insight into toxicology, metabolomics has struggled to get out of the lab and omics data is not routinely applied or accepted in environmental regulation. In this talk, Oliver will introduce the science of metabolomics and show how it can be used in environmental toxicology. He will discuss the concept of the dark metabolome and what is needed to bring metabolomics out of the lab and into regulatory toxicology. He will also present his work linking metabolomics with the other 'omic sciences as part of the systems biology approach to environmental assessment and management.

Biography

Professor Oliver (Oli) Jones grew up in Manchester, England. He obtained his PhD in Environmental Chemistry from Imperial College London in 2005. He also holds a Master's from Imperial and a Bachelor's (with honours) from Queen Mary University of London. Following his PhD, Oli worked at the University of Cambridge as a postdoctoral fellow in Biochemistry until 2009 and then as a junior lecturer in Environmental Engineering at the University of Durham, before moving to RMIT in 2012 to get a few years' experience working abroad.

Oli's research focuses on analytical chemistry and environmental pollution, with interdisciplinary applications in biochemistry (metabolomics), water technology, and forensic science. He concentrates on tracking the fate and behaviour of pollutants in the environment and determining their potential effects on biological systems. He has almost 150 peer-reviewed publications with an h-index of 44 and 9988 total citations.

Oli is also very keen to communicate science to the public and debunk myths around chemicals in the environment. He has featured widely on TV, radio, podcasts and newspapers, discussing topics as diverse as drugs in water to plastic-eating enzymes, and everything in between. He can be found promoting science on X (formerly Twitter), BluseSky, Threads, Mastodon, Instagram, and TikTok as @dr_oli_jones.

PLATINUM SPONSOR TALKS

Platinum Sponsor Talk
Wednesday 5 November 2025

ADVANCING CHROMATOGRAPHIC PERFORMANCE FOR ACIDIC MOLECULE ANALYSIS USING WATERS PREMIER TECHNOLOGY

Sviat Eliseenko[1]

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Abstract

Chromatographic analysis of molecules containing acidic functional groups, such as carboxylates, phosphates and sulphates, often encounters challenges due to unwanted interactions with metal surfaces. These interactions can lead to peak distortion, analyte carryover, and compromised sensitivity and reproducibility. [1,2]

Conventional mitigation strategies, including system passivation with concentrated analytes or strong acids, offer only temporary relief. The use of chelating agents like EDTA in mobile phases provides another workaround, but can interfere with LC-MS workflows by suppressing ionisation efficiency. [3,4]

New technology introduces a cutting-edge chromatographic solution that integrates a low-dispersion ultra-high-performance liquid chromatography (UPLC) system with a column featuring a proprietary surface technology known as the MaxPeak™ Premier Surface. This innovation is specifically engineered to minimise metal-analyte interactions, thereby enhancing performance for metal-sensitive compounds.

Implementation of this technology has demonstrated substantial improvements in chromatographic outcomes, including a 3-10-fold increase in analyte recovery, narrower peak widths, and significantly reduced tailing. These enhancements mark a meaningful advancement in the reliable analysis of molecules and their acidic fragments.

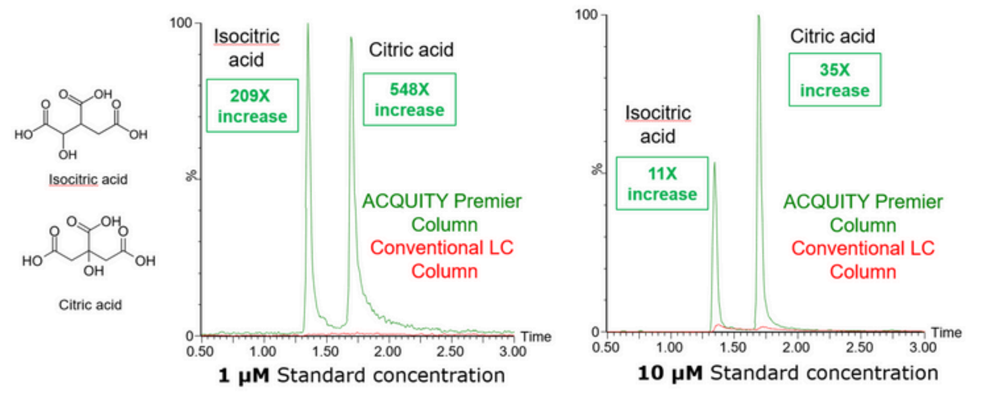

Figure: Recovery improvement of small carboxylic acids using Premier Column.

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GOING ANYWHERE: CAREERS OUTSIDE OF RESEARCH

Caroline Noble[1]

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Abstract

There are many well known and obvious career paths that can be pursued utilising the skills and knowledge obtained during postgraduate studies.There are some perhaps less well known ones at instrument companies – like Agilent – where these skills can be applied in many different ways, either within Australia, or around the world.

Across the Agilent business there are many varied roles requiring highly specialised skills, from precision scientific glass blowing, to service engineers, sales, application specialist, or R&D scientist helping develop the next generation of products.

This presentation will delve into some of the many varied opportunities that can exist and then briefly describe the journey of some of the Australian Agilent team.

Biography

Caroline is an Adelaide based Total Account Manager with Agilent Technologies Australia with over 17 years sales experience. Studying Forensic and Analytical Chemistry at Flinders University then completing Honors and working the Australian Wine Research Institute (AWRI). Caroline relocated to Perth and begun her sales career with Agilent. Caroline has since returned to Adelaide where she uses her account management skills to represent Agilent for instrument, consumable and service contract sales.

Platinum Sponsor Talk
Friday 7 November 2025

ORTHOGONAL SELECTIVITY WITH POROUS GRAPHITIC CARBON: A METHOD DEVELOPMENT ESSENTIAL

Karen Duong[1]

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Abstract

Porous Graphitic Carbon (PGC) is a unique chromatographic material that offers distinct retention properties and excellent chemical stability, making it a valuable tool for method development. PGC provides an alternative to traditional stationary phases, offering unique selectivity and robust performance. Its ability to retain polar, non-polar, and structurally related compounds makes it particularly suited for analytical and environmental applications.

SESSION 1:

PROCESSES FOR ENVIRONMENTAL REMEDIATION

[19]

ENZYMATIC DEGRADATION OF ENVIRONMENTALLY TOXIC RESIN ACIDS

Delroy Sheng Yu Huang[1], Stephen G. Bell[2]

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Abstract

Gum rosin (colophony) is an environmentally toxic constituent of bark exudate of pine trees toxic to microorganisms and aquatic life 1. Over half of the content within colophony consist of tricyclic monocarboxylic diterpenoid abietane and pimarane-type resin acids. Together, these higher terpenes are potent toxic insoluble antimicrobials and as such are used as a protective natural defence mechanism2. Despite this, some bacterial species naturally contain genes encoding enzymes for resin acids decontamination and have been reported to use the constituents of colophony as essential sole carbon sources for growth2. Oxidation of resin acids may be performed by the bacterial CYP226 family of cytochromes P450 (P450) enzymes in the initial steps of biodegradation. Typically, P450s require redox partners for catalytic activity, however we have engineered CYP226A enzymes into peroxygenases which use H2O2 as an alternative source of electrons. CYP226A3 and CYP226A31, identified from the thermophilic Zestomonas thermotolerans have been selected and their activity characterised. Turnover reactions with gum rosin with near-complete substrate consumption produced a complex mixture of metabolites which from analysis from the HPLC and GC-MS could arise from the oxidation of multiple substrates or the generation of multiple products from these substrates. These newly identified engineered CYP226 enzymes provide a green alternative to detoxification and valorisation of bark biomass. Future studies are centered around product isolation and characterization of the oxidized resin acids and further enhancement of CYP226 enzymes as versatile biocatalysts with greater catalytic efficiency and a wider substrate scope.

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A GREENER METHOD FOR QUANTIFYING EPOXIDE GROUPS IN GRAPHENE OXIDE

Gimhani Danushika[1], Pei Lay Yap[1], Dusan Losic[1]

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Abstract

Epoxy groups, or oxirane rings, in Graphene Oxide (GO) play a vital role in enhancing surface reactivity, enabling covalent bonding with other molecules, and improving compatibility with polymers and composite materials. Conventional Boehm titration quantifies functional groups such as carboxyl, hydroxyl, carbonyl, and lactone but does not account for epoxide functionalities, which are critical to many GO applications.

This study presents a catalyst-assisted, acid-based aqueous titration method for reliable epoxy group quantification in GO, applicable to powders, pastes, and dispersions. To minimise hazardous reagents, the method eliminates acetone from the existing procedure, replacing it with the environmentally friendly compound magnesium chloride, aligning with green chemistry principles and offering a sustainable analytical approach.

The method demonstrated high precision and reproducibility, with epoxy group concentrations ranging from 1.13 ± 0.020 to 1.38 ± 0.056 mmol/g in commercial GO samples. Validation was performed using a well-characterised reference GO and a commercial epoxy resin of known epoxide content. Complementary Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Photoelectron Spectroscopy (XPS) analyses confirmed the robustness of the proposed method.

Furthermore, two innovative quality control parameters are introduced: Epoxide Index (EI) and Equivalent Epoxide Weight (EEW), providing a standardised framework for assessing and comparing epoxide content in GO materials. These metrics enhance the method's application in quality assurance, material classification, and environmentally conscious development of advanced GO-based materials.

Biography

I am currently engaged in the development of novel and simplified methods for the characterisation and quality control of graphene-related two-dimensional materials (GR2Ms) under the supervision of Professor Dusan Losic and Dr Pei Lay Yap. My current research focuses on GR2MS characterisation techniques, emphasising low-cost, accessible analytical methods to support the sustainable development and applications.

I hold a B.Sc. (Special) degree in Environmental Management from the University of Sri Jayewardenepura, Sri Lanka, and earned my M.Sc. (by Research) in Environmental Engineering in 2020 from the Department of Civil Engineering, University of Moratuwa, Sri Lanka.

[35]

VARIATION, SOURCE IDENTIFICATION AND APPORTIONMENT OF ULTRAFINE PARTICLES IN AUCKLAND

Abdullah Aloufi[1,3], Congrong He[2,3], Hamesh Patel[3,4,5], Lidia Morawska[2,3], Rohan Jayaratne[2,3], Godwin Ayoko [1,3]

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Abstract

Air pollution has a major impact on human health and the environment. Exposure to particulate matter has been shown to have a positive correlation to mortality and chronic ailments. While continuous monitoring of airborne particles is important to reduce or eliminate the sources of these threats, this results in the generation of large amounts of data that need to be processed, analysed, and interpreted. Therefore, utilising modern technologies and software capable of handling large datasets is crucial, and receptor model programs designed to identify various types of pollutants have been particularly useful.

In this study, we used Positive Matrix Factorisation (PMF) to analyse ultrafine particle number concentration data obtained over a continuous period of one year, using scanning mobility particle sizer in Auckland, New Zealand. The city largely generates its own pollution and has been shown to have relatively high concentrations of Ultrafine Particles (UFPs) compared to other comparable cities. The results show five major pollutant sources, which varied from season to season. During summer, the dominant sources included petrol and diesel emissions from motor vehicles and secondary particles due to new particle formation in the atmosphere. Autumn shared some of these sources and included possible emissions from power plants and cooking activities. Winter had overlapping sources with summer and autumn, with the addition of heating emissions. In the spring, biomass burning was a distinct source.

These findings facilitate better control of pollutants in the environment and provide valuable insights for decision-makers involved in urban planning, transport, and environmental issues.

Biography

Abdullah Aloufi holds a Bachelor's degree in Chemistry from Taibah University and a Master's degree in Analytical Chemistry from King Abdulaziz University (2019), Saudi Arabia. He is also a member of the Royal Australian Chemical Institute (2025).

Abdullah is currently pursuing a PhD in the School of Chemistry and Physics at Queensland University of Technology (QUT), specialising in Analytical and Environmental Chemistry. His research focuses on advanced data analysis techniques for interpreting large-scale environmental datasets, using receptor models such as Positive Matrix Factorisation (PMF) to identify and locate sources of air pollution.

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Wei, Y., & Kumar, P. (2024). Beyond the tailpipe: Review of non-exhaust airborne nanoparticles from road vehicles. Eco-Environment & Health, 4(1), 100130. https://doi.org/10.1016/j.eehl.2024.11.003

[44]

ECO-FRIENDLY SANITISERS BORN FROM LIGHTNING: PLASMA-ACTIVATED WATER AS NOVEL FOOD SANITISATION APPROACH

Bjoern Hendrik Kolbe[1], Adrian Abdo[1], Heema Vyas[1], Bryan Coad[2], Katharina Richter[1,3]

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Abstract

Foodborne pathogens pose a major threat to Australia's public health and economy, causing an estimated 4.7 million illnesses and costing $2.81 billion annually[1,2]. Conventional sanitisers are limited by environmental burden, harmful residues and reduced effectiveness, highlighting the need for safe, effective alternatives.

Plasma-activated water (PAW) is an innovative sanitiser generated by exposing water to energised gases, creating reactive oxygen-nitrogen species with potent antimicrobial activity. PAW may overcome the limitations of current chemical sanitisers.

We hypothesised that PAW exhibits antimicrobial efficacy against key foodborne pathogens, Listeria monocytogenes and Escherichia coli. We aimed to characterise the physicochemical properties, antimicrobial efficacy and stability of different PAW formulations over a 90 day period.

PAW generated for 60 and 90 minutes was assessed for pH, conductivity, oxidative reductive potential (ORP) and concentration of nitrogen species via UVVIS spectrophotometry throughout storage. Antimicrobial efficacy was determined through time-kill experiments on planktonic L. monocytogenes ATCC 13932 and E. coli ATCC 25922 (24h growth at 37°C in heart infusion broth).

Longer PAW generation times correlated with lower pH and increased conductivity and ORP. Additionally, pH and nitrogen species showed stable readings throughout the study's duration. PAW generated for 90 minutes achieved up to 6-log reductions in both species, while 60-minute PAW reduced L. monocytogenes by 5.34 ± 0.67 logs and E. coli by 6.06 ± 0.07 logs.

PAW demonstrated strong, stable antimicrobial activity and maintained key physicochemical properties for 90 days. These findings support its potential use as a safe and effective food sanitiser.

Biography

Bjoern Hendrik Kolbe is a PhD student at the University of Adelaide in the research group of A/Prof. Katharina Richter. His background is in applied material science and dental technologies. Based on his previous experience in plasma technology, he currently researches and optimises plasma-activated water towards a suitable industry application as an efficient food sanitiser.

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[51]

ASSESSMENT OF GROUNDWATER CONTAMINATION USING NOVEL NON-TARGETED ANALYSIS METHODOLOGIES AND TOXICITY TESTING

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Abstract

High-resolution mass spectrometry (HRMS) has found increasing application in environmental chemistry for the purpose of identifying and discovering environmental contaminants. This technique facilitates non-targeted analysis (NTA) by allowing for mass detection of all compounds within a set mass range to a four decimal place accuracy[1]. When hyphenated to chromatography techniques NTA using HRMS allows for wider screening of chemicals beyond targeted chemical analysis[2]. Many studies have applied this methodology. However, when combined with toxicity analysis this allows for contaminants to be further examined in relation to environment effects[3].

This study applies conventional liquid chromatography HRMS (LC-HRMS), supercritical fluid chromatography HRMS (SFC-HRMS), not as commonly used[4], and a test battery of bioassays for assessing a sample extracts effect of the surrounding environment. The combination of these techniques is novel, and this workflow has been applied to groundwater sampled from multiple sites across South-East Queensland. Groundwater was focused on for its potential to retain persistent and mobile organic contaminants, which have high water solubility and polarity that makes them mobile throughout the water cycle[4]. To increase identification capacity beyond current library limitations, in silico fragmentation software was used to match fragmentation patterns to non-spectral structure databases. This allowed for the identification of pesticides, pharmaceuticals, plant toxins and chemical additives within bore water. Toxicity effects reported include bacterial toxicity, agonistic estrogen receptor binding activity, xenobiotic metabolism and photosynthesis inhibition. Structures identified were further assessed using in silico toxicity models to predict whether compounds would induce toxicity, allowing for increased identification confidence.

Biography

My name is Mikaela Radke and I am a PhD candidate from Griffith University. Through studying forensic science as an undergraduate I came to appreciate the utility and power of analytical chemistry. This gave me the opportunity to develop a passion for method development and the application of mass spectrometry in wider science. Combined with my interest in toxicology, this has led me to do a multidisciplinary PhD project looking into the combination of environmental toxicology and analytical chemistry.

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SESSION 2:

MICROPLASTICS
&
NANOPLASTICS

A CITY-WIDE INVESTIGATION OF SMALL MICROPLASTICS IN URBAN ROAD DUST IN MELBOURNE, AUSTRALIA

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Abstract

Road dust is increasingly recognised as both a sink and a secondary source of microplastics (MPs) in urban environments. These particles originate primarily from tyre wear, road marking paints, synthetic textiles, mismanaged plastic waste, and building coatings–sources closed linked to traffic and human activity. Once deposited, MPs can be resuspended into the air by wind or vehicle turbulence or washed into stormwater drains during rainfall, contributing to human exposure via inhalation, ingestion, or dermal contact, as well as broader ecological impacts.

In Melbourne, previous studies on MPs in road dust have largely focused on broad-scale comparisons based on land use or urbanization, often overlooking the influence of direct sources such as vehicle and pedestrian traffic. Many have also excluded tyre wear particles (TWPs) due to analytical limitations. This study addressed these gaps by quantifying MP and TWP abundance and examining potential sources across gradients of vehicle and pedestrian activity, with particular attention to those in the size of 20–500 μm.

Sampling sites were categorised into combinations of low and high traffic and pedestrian intensity. Road dust samples was collected using a standardised sweeping method. Polymer identification and particle sizing will be conducted using Laser Direct Infrared (LDIR) imaging, enabling rapid and accurate MP quantification and characterisation. Findings of this study are expected to advance understanding of MP pollution in cities and inform mitigation strategies.

Biography

Theresa Lam is a PhD candidate at the University of Melbourne, researching the sources, pathways, and potential mitigation of small microplastics (MPs) in urban road environments. Her work focuses on quantifying MP pollution in road dust, air, and stormwater, with particular interest in the role of blue-green infrastructure in reducing pollutant loads. She combines field sampling with advanced polymer identification techniques, such as Laser Direct Infrared (LDIR) imaging, to characterise MP particles and trace their potential sources. Her research aims to improve understanding of urban MP pollution and provide evidence-based insights for environmental management.

[60]

DETECTION OF NANOPLASTIC PARTICLES USING CAPILLARY ISOTACHOPHORESIS

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Abstract

Nanoplastics are an emerging contaminant, yet most analytical methods are poorly suited to their detection[1]. Current approaches, such as pyrolysis-GC/MS, Raman, and FTIR spectroscopy often require high sample concentrations, lack sufficient particle resolution, or demand extensive sample preparation[1,2]. This study attempts to address these limitations by developing a capillary isotachophoresis (ITP) method to detect and preconcentrate 200 nm sulfonated polystyrene nanoparticles (SPNPs), marking the first application of ITP to nanoplastic particles. The method stacks analytes into a sharp zone between a 50 mM Tris-HCl leading electrolyte (LE) and a 50 mM Tris-HEPES terminating electrolyte (TE). A prior capillary zone electrophoresis (CZE) method developed by Ranasinghe et al for the same SPNPs suffered from broad peak shapes, likely due to particle heterogeneity[4]. The ITP approach presented here was designed to overcome these issues and improve the method's limit of detection (LOD).

ITP offers a major advantage over CZE by tolerating larger injection volumes without peak broadening, as analytes are concentrated into a narrow, focused zone between the LE and TE. In this work, hydrodynamic injection was used to introduce the sample, with an optimal injection time of 45 s at 50 mbar (approximately 20% of the capillary length). Longer injection times gave minimal further improvement in peak height. The developed ITP method achieved an LOD of 7.96×10^{-5} % w/v for nanoplastic detection, a 12.6-fold improvement over the previous CZE method. This non-destructive technique requires no chemical derivatisation or particle digestion, making it well-suited for nanoplastic detection or as a complementary preconcentration step prior to other analytical methods.

Biography

I am a current Honours student in Chemistry at the University of Tasmania, where I also completed my Bachelor of Science. My research focuses on developing and improving analytical methods for detecting nanoplastics using capillary electrophoresis.

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[63]

TOWARDS A MULTIMODAL WORKFLOW FOR ASSESSING THE RECYCLABILITY OF MEDICAL PLASTICS

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Abstract

Single-use medical plastics generate a complex waste stream that is poorly addressed in current recycling systems. Despite their significant potential for recycling, these materials are often incinerated or landfilled due to their heterogeneous nature, contamination risks, and lack of standardised protocols. This study developed a multimodal workflow that combines Fourier-transform infrared spectroscopy (FTIR) and hyperspectral imaging (HSI) to assess the recyclability of polypropylene (PP)-based medical plastics. The integration of molecularly specific spectroscopy with high-throughput imaging provides a new approach for characterising heterogeneous medical waste streams. Medical kidney dishes (coloured, n = 27; opaque, n = 4; transparent, n = 23) collected from the Queensland Children's Hospital (QCH) were analysed. FTIR revealed compositional differences both between colour types and within individual dishes when a grid-scanning method was applied. HSI in the short-wave infrared range (1100–1700 nm) produced pixel-level spectra and chemical distribution maps that visualised surface heterogeneity. Principal component analysis (PCA) of both datasets showed distinct clustering related to polymer variability. Together, FTIR and HSI provided complementary insights: FTIR offered high-resolution chemical identification, while HSI captured spatial distribution. Our findings highlight the capability of a multimodal workflow to guide on-site recyclability decisions in healthcare, linking material characterisation with waste management and procurement strategies to support circular economy initiatives.

Biography

Chloe is an Honours student in the School of Environment and Science at Griffith University with a Bachelor of Forensic Science (Chemistry) and Bachelor of Criminology and Criminal Justice. Her research was conducted in collaboration with the Solving Plastic Waste CRC and Children's Health Queensland, which focused on developing analytical workflows for assessing the recyclability of medical plastics. Chloe's work integrates spectroscopy, imaging, and chemometric modelling to address the challenges of complex waste streams. She is passionate about advancing sustainable materials management and contributing to circular economy initiatives within the healthcare sector, with her PhD candidature commencing in January 2026.

[65]

THE USE OF NEAR-INFRARED (NIR) SPECTROSCOPY TO SCREEN MICROPLASTIC CONTAMINATION IN BLACK SOLDIER FLY LARVAE REARED ON FOOD WASTE

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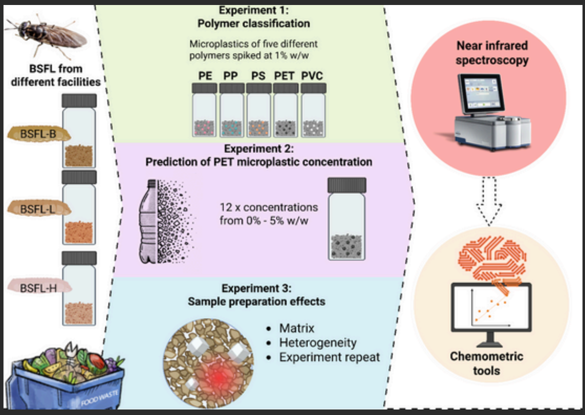
Abstract

Black soldier fly larvae (BSFL) are increasingly promoted as a sustainable protein source for animal feed, particularly when reared on food waste. However, the presence of microplastics in food waste raises concerns about safety and quality assurance in insect-derived feed. This study evaluated the potential of near-infrared (NIR) spectroscopy as a rapid, non-destructive method to detect and quantify polymers in BSFL. Five polymers, polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polystyrene (PS), and polyvinyl chloride (PVC) were each introduced at 1% (w/w), while PET was also tested across 0.1–5% (w/w) to assess concentration prediction. Spectra were collected using Fourier-transform NIR (FT-NIR) spectroscopy, and calibration models were developed using partial least squares (PLS) regression.

NIR spectroscopy successfully identified the presence of polymers in BSFL, although overlapping signals at some wavenumbers complicated classification. PET concentrations were predicted accurately across the tested range. Importantly, two stable spectral regions were observed (around 6050–6090 cm^{-1} and 4250–4050 cm^{-1}), which served as reliable reference points for PET detection within the biological matrix. PLS loadings indicated that predictive power arose from several spectral regions, reflecting the complex interaction between polymer signals and BSFL tissue. Overall, this work highlights the potential of NIR spectroscopy as a screening tool for microplastic contamination in insect-based feeds. By enabling rapid assessment of both polymer type and concentration, this approach supports quality assurance in the feed industry and contributes to the safe development of alternative protein sources.



Graphical Abstract

Biography

Adam Kolobaric is a PhD candidate at the University of Queensland researching how plastics and persistent chemical contaminants transfer from food waste to black soldier fly larvae (BSFL) during valorisation. Their work focuses on developing non-destructive screening techniques to detect contaminants, informed by a background in environmental regulation and a commitment to advancing toxic-free circular systems.

SESSION 3:

WASTEWATER TREATMENT

[5]

MONITORING ORGANIC UV FILTERS IN WASTEWATER/ SLUDGE IN NEW ZEALAND, BY WASTEWATER-BASED EPIDEMIOLOGY

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Abstract

Wastewater-based epidemiology (WBE) is a methodology that is applied to monitor the average consumption/usage of substances by a community. Advantages of WBE include its cost-effectiveness, near-real time analysis and the scale at which WBE can be conducted.1,2 Organic UV filters are essential components of personal care products (PCPs), used to restrict skin damage from the Sun's irradiation. However, there are emerging concerns based on the potential biological effects associated with some UV filters, such as endocrine disrupting effects and allergic reactions. It is therefore of great importance to monitor the usage of UV filters in the population, determining if they are being used to the extent that is needed for protection, but also to understand exposure to the filters themselves.3

To estimate the usage of organic UV filters in the community, a SPE-LC-MS/MS method has been developed for a range of organic UV filters. Target analytes include commonly-employed UV filters octocrylene, homosalate and avobenzone, as well as next generation filters ethylhexyl triazone, bemotrizinol and tris-biphenyl triazine. The method has been validated through accuracy and precision studies and is currently being applied to the analysis of wastewater/sludge samples from the wastewater treatment plants across New Zealand.

We will report development, validation and application of the optimised method for the analysis of UV filters in wastewater/sludge. This method enables accessible methodologies to understand UV filter usage and exposure in populations in New Zealand, which would be of interest to public health organisations.

Biography

Ziyue (Zoey) Li is a PhD student, supervised by Prof. David Barker and Assoc Prof Lisa Pilkington, in the School of Chemical Sciences at the University of Auckland. Zoey's current research focus is the analysis of organic compounds (eg. UV filters) in complex samples such as commercial products and wastewater/sludge using analytical methods, HPLC and LCMS/MS, and the synthesis of novel isotopically labelled standards and their application in analytical method development.

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[13]

ADVANCING HOSPITAL WASTEWATER TREATMENT VIA CONTINUOUS ADSORPTION IN A COILED FLOW INVERTER REACTOR

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Abstract

Hospitals worldwide necessitate substantial water quantities to operate various healthcare facilities and thus generated wastewater represents a complex matrix of organic pollutants, including pharmaceutical and personal care products (PPCPs) that poses a significant threat to aquatic ecosystems and public health. These substances persist in the environment, accumulate in organisms, and exert toxic effects across biological systems. Even at trace levels, prolonged exposure can lead to antibiotic-resistant bacteria, increased cancer risk, developmental abnormalities in children, immune system disruptions, and reproductive issues in both humans and aquatic organisms. Conventional treatments for hospital wastewater (HWW) are time- and space-intensive. This study investigates the use of a compact Coiled Flow Inverter (CFI) reactor with Graphene Oxide (GO) for efficient adsorptive removal of triamterene, a model PPCP. Effects of various parameters including flowrate (10-135 mg/mL), initial pollutant concentration (1-250 ppm), adsorbent dosage (0.2-2 mg/mL) and pH (2-10) were systematically investigated. The results revealed a maximum adsorption capacity of 822 ± 0.07 mg/g, with ~99% removal efficiency across all pH regions. The impact of flowrate on removal efficiency was minimal, and the process demonstrated ultra-fast performance, achieving ~80% removal in 40 seconds which is significantly faster than the conventional batch method requiring ~5 hours for similar efficiency. Furthermore, application to real hospital wastewater showed >90% removal within 1 minute.

Key findings of this study revealed a 450-fold reduction in treatment time, reduced space requirements, and enhanced mixing efficiency compared to conventional batch adsorption, highlighting the potential for a sustainable hospital wastewater treatment in a miniaturized reactor.

Biography

Ammara Waheed is a research student at University of Adelaide, specializing in wastewater treatment. Her work focuses on removing pharmaceuticals and personal care products (PPCPs) using continuous adsorption and ozonation based techniques in Coiled Flow Inverter (CFI) reactors. Previously, she lectured at Chemical Engineering Department of University of Wah in Pakistan. She has expertise in the synthesis of advanced materials for environmental remediation, including inverse vulcanized copolymers, graphene-based photocatalysts, and biosorption techniques for heavy metal and pollutant removal from wastewater. Her research aims to develop cost-effective water purification technologies, shaping the future of environmentally sustainable and innovative wastewater treatment solutions.

[14]

ENGINEERING OF ARSENIC REMOVAL FROM NATURAL WATER USING A COILED FLOW INVERTER

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Abstract

Wastewater treatment is a global challenge and developing cost effective compact and sustainable water treatment system tailored for diverse water quality conditions is crucial to meet global clean water requirements. Coiled Flow Inverter (CFI) has emerged recently as an ideal candidate for multiphase mixing owing to its enhanced mass transfer rates due to equidistant 90o bends, which addressed the poor mixing,excessive space requirement and prolonged pollutant treatment time in the conventional water pollutants adsorption method.

This work leverages the enhanced radial mixing,cost-effectiveness and compact engineering of coiled flow inverter (CFI) reactor to advance the adsorption of arsenic from natural water.

A comprehensive evaluation on the effects of various parameters including flowrates (10, 135 mL/min), initial pollutant concentration (1-200 ppm), adsorbent dosage (0.2-2 mg/mL) and pH (2-10) were performed. Findings showed that a remarkable 98% adsorption was achieved within a short residence time of 38 seconds at a flow rate of 135 mL/min, 10 mg/L initial As(V) concentration As(V) and adsorbent dosage of 1.5 mg/mL. Studies performed on selectivity in the presence of co-ions, adsorbent regeneration and effect of water matrix (Torrens River water) confirmed that CFI reactor has good selectivity for As(V), can operate well in repeated cycles and removes 99%, As(V) from Torrens River water. Benchmarking experiments in Batch and CFI reactor verified that outstanding removal efficiency (98 %) can be attained in 38 seconds in CFI reactor compared to 24 hrs in batch reactor, demonstrating the efficacy of the miniaturized compact device for improved water purification technology.

Biography

Rabia Sabir is a chemical engineer from Pakistan with 8 years of experience in academia as Lecturer, currently pursuing a PhD in Chemical Engineering at the University of Adelaide, Australia. With a strong foundation in chemical engineering, she is focused on developing innovative solutions to address the global challenges of water contamination. Her current research explores advanced methods for efficient water treatment, particularly in the removal of emerging contaminants. Combining engineering expertise with a passion for sustainable environmental solutions, Rabia aims to contribute significantly to the development of more effective and accessible water treatment technologies.

[25]

BIOCATALYTIC OXIDATION OF NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS) FOUND IN WASTEWATER

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Abstract

NSAIDs are commonly used pharmaceutical drugs used to treat pain, inflammation and fever. They work by inhibiting the cyclooxygenase (COX-1 and COX-2) enzyme that convert arachidonic acid into prostaglandins and thromboxanes which are involved in mediating inflammation (1). As a result of their prevalence they are found in the environment in waste water at concentrations that can cause oxidative stress, cytotoxicity, genotoxicity, reproductive impairment and various adverse effects in fish, invertebrates and other aquatic organisms (2).

Biotransformation of the NSAIDs leads to lower toxicity than their parent compound and facilitates their subsequent degradation in downstream processes. It usually starts from activation of inert C-H bond by oxidation which is primarily done by cytochrome P450 monooxygenases (CYP) in-vivo. CYPs are a group of heme-thiolate proteins that can selectively oxidise C-H bond. These are found in almost every living organism including human, bacteria, fungi and other life forms (3). From genome mining, we have found a CYP monooxygenase (CYP105Stv) from Streptomyces thermoviolaceus that can function using only H_2O_2 making it a suitable biocatalyst.

CYP105Stv can bind to and selectively oxidise- diclofenac, ibuprofen, naproxen and some other NSAIDs commonly found in wastewater. Analysis and primary identification of the biotransformation products of these NSAIDs were performed by RP-HPLC and GC-MS. CYP105Stv can selectively oxidise diclofenac into 4-OH-diclofenac, and 4,5-diOH-diclofenac, ibuprofen into 2-OH-ibuprofen and naproxen into 6-O-desmethyl naproxen using only H_2O_2. This enzyme is also functional at upto 47.5 °C. Our findings highlight the biocatalytic potential of CYP105Stv and application of RP-HPLC and GC-MS for analysing NSAID derivatives.

Biography

Tuhin Das is a Higher Degree by Research Candidate at the University of Adelaide, specializing in the engineering of cytochrome P450 monooxygenase enzymes. His research encompasses the biotransformation of terpenoids, steroids, and pharmaceutical compounds, underpinned by a strong foundation in enzymology, biocatalysis, and structural biology.

Associate Professor Stephen Bell is a distinguished academic at the University of Adelaide, specializing in enzyme catalysis and biocatalysis. His research focuses on engineering cytochrome P450 enzymes for sustainable chemical processes, including oxidation of steroids, terpenoids, and aromatic hydrocarbons. His work integrates biochemistry, synthetic biology, and chemistry to develop thermostable enzymes and explore enzyme mechanisms through techniques like X-ray crystallography.

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SEASONAL DYNAMICS, REMOVAL EFFICIENCIES, AND ENVIRONMENTAL RISKS OF CONTAMINANTS OF EMERGING CONCERN IN WASTEWATER TREATMENT PLANTS IN VICTORIA, AUSTRALIA

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Abstract

This study evaluates the occurrence, seasonal dynamics, mass fluxes, and ecological risks of 19 contaminants of emerging concern (CECs) in influent and effluent streams from four wastewater treatment plants (WWTPs) in Victoria, Australia. Triplicate 24-hour composite samples (n = 352) were collected over seven days in autumn (May 2023) and spring (November 2023) and analysed using solid-phase extraction and LC-MS/MS. All CECs were detected in influent samples with >73% frequency, while effluent samples showed lower detection rates, indicating partial removal. Acetaminophen (1,600–26,000 ng/L) and caffeine (716–9,700 ng/L) were most abundant across WWTPs and seasons. Spatiotemporal variation included higher autumn levels of codeine, ofloxacin, sulfamethoxazole, and trimethoprim, and higher spring levels of citalopram, desvenlafaxine, and DEET. Weekly variation was significant ($p < 0.05$) for 10 compounds, with caffeine peaking midweek and fluoxetine, venlafaxine, sulfamethoxazole, atrazine, piperonyl butoxide, BBP, and TCEP peaking on Sundays. Removal efficiencies varied from negative to complete elimination. One WWTP consistently achieved >85% removal for most CECs, surpassing global benchmarks. Risk Quotient (RQ) analysis showed low acute toxicity risks for algae and invertebrates, but chronic exposure posed moderate to high risks for fish at 90th percentile concentrations of venlafaxine, fluoxetine, citalopram, and carbamazepine. Median concentration-based RQs indicated lower risks overall, except for carbamazepine at one WWTP. Invertebrates faced moderate chronic risks from acetaminophen and sulfamethoxazole, though no RQ exceeded 1. Peak exposures were represented by 90th percentile concentrations, while median values approximated long-term exposure, without accounting for dilution in receiving waters.

Biography

Madara Weerasooriyagedara is a PhD researcher in Chemistry at the University of Melbourne, specialising in advanced environmental analytical chemistry. Her work pioneers targeted and non-targeted LC-MS/MS methodologies for contaminants of emerging concern (CECs) in wastewater. She has developed high-performance solid-phase extraction (SPE) protocols, quantified seasonal and spatial occurrence patterns, and conducted ecological risk assessments to inform water quality policy. Madara's research integrates methodological innovation with applied environmental monitoring, contributing to sustainable water management strategies. Her scientific contributions position her as an emerging expert in contaminant surveillance and environmental risk evaluation in Australia and globally.

SESSION 4:

RENEWABLE ENERGY

[11]

MOF-TEMPLATED SYNTHESIS OF HOMOGENEOUSLY DOPED $SrTiO_3$:La/Rh

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Abstract

Hydrogen is positioned as a high value chemical with vast applications in the green energy transition.[1] For this reason, the ability to produce hydrogen renewably is of significant interest.[1, 2] Solar driven photocatalytic water splitting is a promising technology in this regard as it would allow for clean hydrogen production using water, sunlight, and a photocatalytic substrate.[2, 3] Traditional materials only absorb at most ~4% of energy we receive from the Sun, so efficient visible light sensitive materials are key.[2, 3] Heteroatom doping has been shown as a useful strategy in improving the visible light response of the most efficient photocatalysts.[4] Traditional doping strategies result in inhomogeneity introducing defects and limiting activity.[4] Herein is presented a synthetic approach to produce a homogeneously doped material with enhanced visible light absorbance. A metal-organic framework, or MOF, containing titanium and strontium is used as a template to house dopants prior to thermal conversion to yield a crystalline homogeneously doped metal oxide – $SrTiO_3$:La/Rh. Not only is the dopant distribution improved but the increased dopant concentration results in a narrower bandgap, a reduction to 2.45 eV from 2.70 eV. This narrow bandgap further increases the potential for visible light harvest as shown in Figure 1. High-resolution scanning transmission electron microscopy (HR-STEM) micrographs seen in Figure 2 highlight the improved dopant distribution.

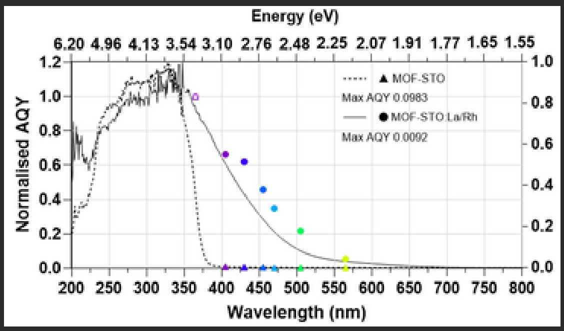

Figure 1. Photocatalytic response across wavelengths for doped and undoped MOF templated $SrTiO_3$.

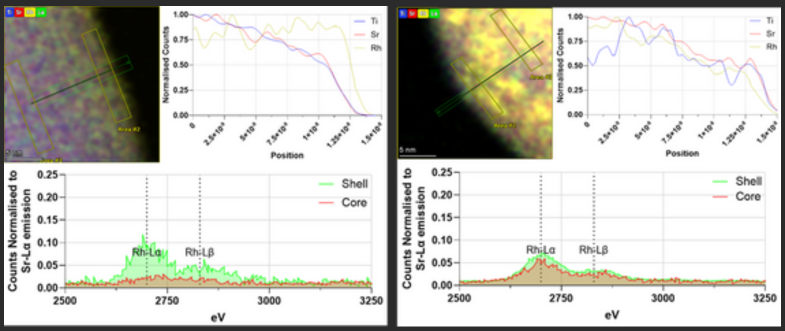

Figure 2. Traditionally synthesized $SrTiO_3$:La/Rh with core/shell dopant distribution (left) and MOF templated $SrTiO_3$:La/Rh with homogeneous dopant distribution (right).

Biography

Tom O'Dea completed his Bachelor of Science with a double major in chemistry in 2023 at the University of Adelaide. He then went on to undertake Honours at the University of Adelaide in 2024 developing a new synthetic approach for visible light active photocatalysts. Tom was awarded the 2024 Rennie Prize for research in chemistry. He is now undertaking a PhD at the University of Adelaide maintaining his focus on developing visible light sensitive water splitting photocatalysts. In this new endeavour Tom is looking towards non-oxide and intrinsically narrow band gap materials as a solution for efficient solar water splitting.

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SINGLET FISSION SENSITIZATION OF NON-FULLERENE ACCEPTORS FOR PHOTOCATALYTIC HYDROGEN EVOLUTION

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Abstract

Non-fullerene acceptors have been responsible for significant efficiency boosts in light harvesting applications for renewable energy, such as photovoltaics. Recently, these materials have been explored for use in photocatalytic hydrogen evolution, with them being able to absorb lower energy photons than most inorganic semiconductors, increasing their efficiency in solar conditions.[1,2] However, the reduced band gap of these materials makes them more prone to efficiency losses from the thermalization of high-energy photons compared to inorganic semiconductors. From the detailed balance limit, the maximum efficiency of a single junction light harvesting device that balances thermalization and maximizes the number of photons absorbed is 33%.[3] One way to reduce thermalization in these semiconductors is to use a material capable of multiple exciton generation. Singlet fission (SF) is one such process, where a high-energy singlet exciton is converted into two triplet excitons of lower energy. Using a SF sensitizer, the maximum potential efficiency can be increased to 46%.[4] In this talk, I will detail how such a material could sensitize a non-fullerene acceptor for photocatalysis, and the physical and morphological constraints required to allow for efficient singlet fission within these systems. We demonstrate that a higher triplet yield can be obtained by using a core-shell morphology, which limits the transfer of the singlet state to an acceptor before SF occurs by taking advantage of the long diffusion lengths of triplet excitons.

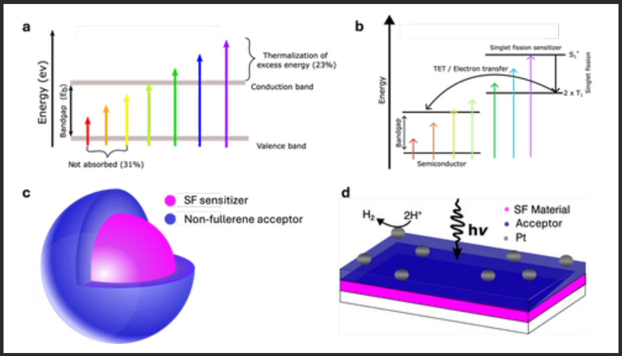

Figure 1: (a) Efficiency losses summarised in the detailed balance limit. (b) Graphical depiction of a singlet fission sensitiser in tandem with a semiconductor. (c) A graphic depicting a core-shell nanoparticle. (d) Schematic depicting singlet fission sensitized film.

Biography

Harrison McAfee is a PhD student at the University of Adelaide under the supervision of Assoc. Prof. Tak Kee and Assoc. Prof. David Huang. His previous education includes a Bachelor of Science (advanced) with a double major in Chemistry and an MPhil thesis titled "Triplet Excitons in Organic Semiconducting Nanoparticles for Renewable Energy Applications." Harrison's research interests focus on the use of triplet excitons in organic semiconducting nanoparticles for hydrogen evolution.

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PHOTO-INDUCED EXCITON DISSOCIATION IN HIGH PERFORMANCE ORGANIC SEMICONDUCTORS

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Abstract

Organic semiconductors have been an important class of photovoltaic materials. Current materials that may be competitive to commercial silicon solar cells come from a series of non-fullerene acceptor. These acceptors which include Y6 and L8-BO, have recently dis- played power conversion efficiencies approaching 20%, with many improvements being due to improvements in solid state packing. L8-BO is a molecular electron acceptor with its backbone structure identical to that of Y6 only altering side chains which influence solid state packing leading it to be the highest performing of the Y series acceptors. In this work, we show spectroscopic evidence of exciton to free charge generation in neat L8-BO films, similar to its analogue Y6, using the technique of pump-push-probe transient absorption spectroscopy. Furthermore, absorption signatures of charge transfer states transitioning to free charge within the neat solid-state material are presented. The comparison of singlet exciton lifetime and population in neat L8-BO, binary bulk heterojunction blends and ternary blend films reveals insight into the mechanism of achieving near 20% efficiency organic photovoltaics (OPVs). Comparing the results of the neat, binary and ternary blend films of L8-BO showed an enhancement of singlet dissociation with the addition of the ternary component. This work clarifies the spectroscopic nature of exciton and charge transfer states in the highest performing Y series acceptor, L8-BO, offering insight into how intrinsic charge generation materials may be optimally used in future OPVs.

CARBON-BASED CO-CATALYST FOR PHOTOCATALYTIC HYDROGEN PRODUCTION BY ORGANIC SEMICONDUCTING NANOPARTICLES

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Abstract

Organic semiconducting nanoparticles (NPs) are promising hydrogen-evolving photocatalysts, but most reports of high-performance organic semiconducting photocatalysts rely on the photo deposition of expensive co-catalysts such as platinum (Pt).[1,2] Reported Pt-free photocatalysts typically exhibit moderate activity,[3] with only a recent report demonstrating high photocatalytic performance through the synthesis of a novel conjugated polymer.[3] However, a more general solution to Pt-free co-catalysts is needed such that the field is not restricted to a specific type of conjugated polymer. Graphene is a promising co-catalyst material as it is composed of an Earth-abundant element and conductive.[4] Graphene has also been successfully utilised as a co-catalyst in inorganic systems,[5,6] but has not been demonstrated in organic systems. This work demonstrates the use of non-fullerene acceptor Y6 and graphene to form a high-performance photocatalytic system. The type of graphene and mass ratio used were varied to optimise photocatalytic performance. This investigation is then extended to various donor-acceptor systems to demonstrate the broad applicability of graphene as a co-catalyst for organic systems.

Biography

Zi Goh is a PhD student at The University of Adelaide, under the supervision of A/Prof. Tak Kee and A/Prof. David Huang. His previous education includes a Bachelor of Science (Advanced) with a double major in Chemistry and a MPhil degree, also at The University of Adelaide. His research interests focus on improving organic photocatalysts for renewable hydrogen evolution.

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SESSION 5:

PFAS: IDENTIFICATION & DETECTION

[2]

EVALUATING PFAS CONTAMINATION IN AUSTRALIAN TAP WATER: BASELINE QUANTIFICATION AND EXPOSURE IMPLICATIONS IN REGIONAL AND URBAN AREAS

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals of increasing global concern due to their persistence, bioaccumulation and potential health risks. Drinking water is a primary exposure route, yet data on PFAS levels in Australia tap water remained outdated, with the last study conducted in 2011 (Thompson et al., 2011). This study aims to fill this critical data gap by evaluating PFAS levels in Australian tap water across urban and regional areas and estimating exposure via daily intake. Tap water samples (50 mL) are being collected from households across all seven Australian states using a community-based approach. Sampling kits were distributed to participants who follow standardized instructions to ensure consistency. Samples are being extracted and analysed using a previously developed and validated solid phase extraction (SPE) method coupled with ultra-trace LC-MS/MS quantification. This method enables the detection of 75 PFAS compounds at sub-ng/L levels sensitivity. Preliminary results from 27 samples in Gippsland (Victoria) revealed 50 PFAS compounds, with concentrations ranging from ranging from 0.27 to 4.02 ng/L. Although some samples exceeded recent USEPA interim health advisory limits for PFOA and PFOS (U.S.EPA, 2022), all values remained well below current Australian regulatory guidelines (NHMRC, 2024). Compared to the 2011 study, this investigation demonstrates improved sensitivity and a broader PFAS detection profile. Hazard ratios for all age groups were below 1, indicating low potential health risks from PFAS exposure through tap water. These findings highlight the value of ultra-trace monitoring and provide essential baseline data to support regulatory efforts and protect public health.

Biography

Wejdan Alghamdi is a PhD candidate in Analytical and Environmental Chemistry at the University of Melbourne. Her research focuses on the occurrence, exposure pathways, and health risks of per- and polyfluoroalkyl substances (PFAS) in the domestic environment. She is currently leading a national study assessing PFAS contamination in Australian tap water using ultra-trace analytical methods. Wejdan is passionate about advancing public awareness and regulatory frameworks for emerging contaminants. She is also an active member of the Australian Laboratory for Emerging Contaminants (ALEC), where she contributes to method development, community engagement, and policy-relevant environmental research.

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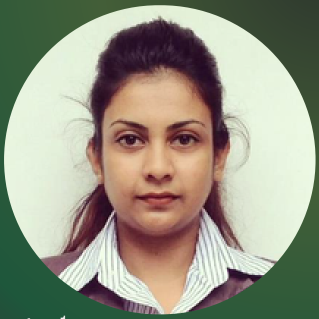
[7]

QUANTITATIVE PROFILING OF PFAS IN WATER AND SEDIMENT ACROSS URBAN CREEKS USING TARGETED ANALYSIS



J. Bimali Koongolla[1], Prasanna Egodawatta[2], Ashantha Goonetilleke[2], Godwin A. Ayoko[1]

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants of concern due to their persistence, bioaccumulation, and potential impact on human health. This study aimed to investigate the spatiotemporal distribution of PFAS in two major urban creeks in Brisbane, Australia. Water and sediment samples were collected from twelve sites representing different land use types, such as industrial, residential, and natural areas, throughout all four seasons. Sample preparation was conducted using solid-phase extraction (SPE), followed by analysis according to EPA Methods 533 and 537.1 for PFAS detection1,2. Fifteen targeted PFAS, including six short-chain and nine long-chain compounds, were analysed and quantified using LC-MS/MS.

PFOS, PFOA, and PFHxA were the PFAS compounds consistently detected and accounted for the highest concentrations among all the analytes. In water samples, short-chain PFAS predominated due to their higher solubility and mobility, while long-chain PFAS were much more prevalent in sediment due to their greater sorption affinity. Compounds per site were most often occurring at higher concentrations of PFAS in water than in sediment. The seasonal observation showed the elevated level of PFAS during summer followed by spring, autumn, and the lowest level in winter, as might be anticipated by the impacts of runoff and regional environmental factors.

These findings provide important baseline data on PFAS prevalence in urban waterways, highlighting the impact of land use and seasonal change on the distribution and transportation of these pollutants. The outcomes of this study contribute to a better understanding of PFAS contamination and support future management strategies in urban water environments.

Biography

Bimali Koongolla is a PhD candidate at the Queensland University of Technology (QUT), within the School of Chemistry and Physics. She holds a Master's degree in Environmental Science from the University of Chinese Academy of Sciences in China, and a Bachelor's degree from the University of Ruhuna in Sri Lanka. She has been involved in research projects in both countries, focusing on environmental monitoring and assessment. Bimali is devoted to applying scientific research to address environmental issues, with a special focus on improving pollution control and promoting sustainable environmental practices.

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[53]

MICROSAMPLING FOR PFAS ANALYSIS: CHEAP HIGH-RESOLUTION BIOMONITORING

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are present in the blood of over 99% of the general population, and exposure to elevated concentrations of PFAS has been associated with multiple negative health outcomes[1]. Despite international concern, PFAS blood testing is generally inaccessible and expensive. Microsampling is an emerging technology that promises high-resolution PFAS biomonitoring data through self-collection of participant samples. This study tests various microsampling technologies for their suitability to at-home sampling for blood PFAS.

Dried blood spots (DBS) (Whatman 903), volumetric absorptive microsampling (VAMS) (Neoteryx Mitra) and capillary action DBS (Neoteryx hemaPEN) were compared for sample stability, reproducibility, and susceptibility to contamination in the home sampling environment and postage. A 35-day time-point experiment was carried out, with sample stability evaluated by monitoring the change in recovery of 49 PFAS over time. After 35 days, the change in individual PFAS was greater than 10% for five PFAS by the hemaPEN, four by DBS and zero by the Mitra. Participants (n = 20) collected blood samples at home. A 'blank' and 'spiked' blood sample was collected with each device by each participant (n = 120) and sent by post to the Australian Laboratory for Emerging Contaminants. No contamination of blank samples was observed. The Mitra and hemaPEN, respectively, retained 45 and 37 of the 49 PFAS when sampled at home, whereas DBS only retained 16 PFAS.

This study presents a robust extraction methodology for the analysis of PFAS in blood microsamples and demonstrates the robustness of VAMS for at-home sampling biomonitoring initiatives.

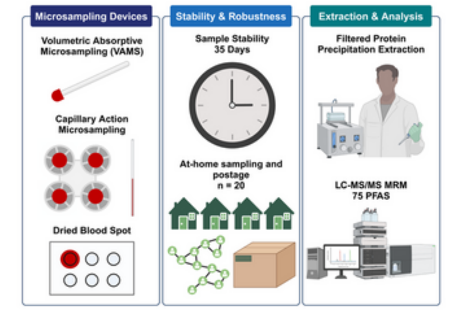

Figure 1 Microsampling blood PFAS workflow

Biography

Jordan Partington is a PhD candidate at the Australian Laboratory for Emerging Contaminants under the supervision of Associate Professor Bradley Clarke. Jordan's research evaluates the exposure of the Australian population to per- and polyfluoroalkyl substances (PFAS). His current research aims to understand the distribution of PFAS throughout the bodies various tissues. He also collaborates with the U.S. EPA's Best Practices for Non-Targeted Analysis working group to make PFAS non-target analysis more standardised and accessible to academia, industry and regulatory bodies. Jordan's research ultimately aims to establish an understanding of the current human body burden of legacy, emerging and novel PFAS.

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[57]

URBAN POSSUMS AS SENTINELS FOR ENVIRONMENTAL CONTAMINATION: FIRST EVIDENCE OF PFAS IN AUSTRALIAN MARSUPIALS

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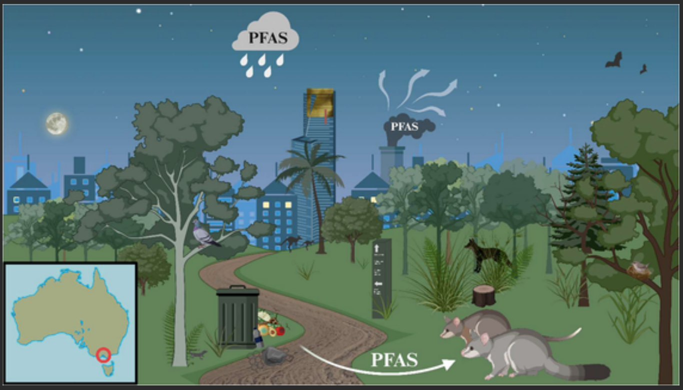
Abstract

Per- and polyfluoroalkyl substances (PFAS) have been widely studied in Arctic and marine animals (Gebbink et al., 2016), but relatively little is known about the state of contamination in terrestrial mammals (Cui et al., 2019), especially synurbic and urban dwelling species. This study is the first to show that Australian native marsupials are contaminated with PFAS. Liquid chromatography and tandem mass spectrometry analysis determined the levels of 75 PFAS in common brushtail possums (Trichosurus vulpecula) and common ringtail possums (Pseudocheirus peregrinus) from the Melbourne region (Victoria, Australia). The possums in this study were contaminated with at least 47 different PFAS. The concentration of perfluorooctanesulfonate (PFOS) in both species was the most prominent result, with a median ΣPFOS (linear and branched isomers) concentration of 74 ng/g (wet weight) in brushtail possum livers and 16 ng/g in ringtail possum livers. Two brushtail possum samples had ΣPFOS concentrations ≥ 200 ng/g. These PFOS concentrations are among the highest levels reported in small terrestrial mammal species globally. The possums in this study are sentinels for a broader problem of PFAS contamination in Melbourne that could be impacting Australian ecosystems and other native species. Further research is required to investigate the extent and severity of PFAS contamination in Australian fauna. This is crucial for native species found in urban environments that may be at a greater risk of exposure to PFAS and other persistent organic pollutants.



Biography

Ellis is an environmental scientist driven by a life-long passion for wildlife and ecology. She is undertaking a PhD in veterinary science and environmental chemistry. Ellis is focusing on ecotoxicological questions related to the extent and impacts of per- and polyfluoroalkyl substances (PFAS) in native wildlife species and broader ecosystems.

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SESSION 6:

BIOLOGICAL APPLICATIONS OF MASS SPECTROMETRY

[10]

MASS SPECTROMETRY-BASED INSIGHTS INTO INVESTIGATING LINKS BETWEEN LIPID METABOLISM AND PROTEIN POST-TRANSLATIONAL MODIFICATIONS IN ALZHEIMER'S DISEASE

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Abstract

Hyperphosphorylated tau (p-tau) is considered as a central factor in the process of Alzheimer's disease (AD), with recent evidence suggesting that lipid metabolism significantly influences tau aggregation and may be altered by tau pathology. This study aims to explore the relationship between p-tau aggregation and specific lipid classes using vesicle as an in vitro model.

Synthetic vesicles composed of phosphatidylserine (PS), phosphatidylglycerol (PG), phosphatidylethanolamine (PE), phosphatidylcholine (PC), and cholesterol, were successfully prepared and characterized by Dynamic light scattering (DLS) with an average diameter ranging from 90 to 130 nm, depending on lipid composition. Thioflavin T (ThT) fluorescence assays revealed that tau aggregation. Transmission electron microscopy (TEM) imaging supported these findings. Native ion mobility mass spectrometry revealed how interact between tau in the presence of anionic lipid vesicles, and neutral lipid vesicles states.

Recombinant wild-type tau protein (Addgene_177653) was successfully expressed in E. coli and purified through cation exchange followed by size-exclusion chromatography, yielding monomeric tau. Protein identity was confirmed using cyclic mass spectrometry, with characteristic charge-state distributions consistent with native-like tau.

The next step involves the development of a cell-based model for comparing WT and P301L tau tagged with a fluorescent protein. Within the cellular context, by treating tau-expressing cells with varying concentrations of the candidate lipids and assessing tau aggregation using native mass spectrometry we will compare data from vesicle and cell models to see how different lipids affect the way tau aggregates. These two in vitro models will lead to new understanding of lipid–protein interactions in AD pathology and identifying potential targets for therapeutic intervention.

Biography

Elaheh began his research career in cancer science by studying the colorectal cancer transcriptomeprofile in Iran. She is passionate about understanding the molecular mechanisms underlying Alzheimer's disease (AD) and focuses specifically on mass spectrometry methods. Her research exploresthe interaction betweenprotein post-translational modifications (PTMs) and lipids using advanced biophysical and biochemical techniques, including native mass spectrometry, transmission electron microscopy, and lipid vesicle and cell line models. Her PhD project is investigating novel functions of candidate lipid metabolism in hyperphosphorylated tau protein as a PTM in AD, a neurodegenerative disease.

[32]

EVALUATION OF CHROMATOGRAPHIC AND MASS SPECTROMETRIC APPROACHES FOR POST-MORTEM METABOLOME AND LIPIDOME ANALYSIS

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Abstract

Determining when a person died, known as the post-mortem interval (PMI), is a major challenge in criminal investigations. The decomposition process is a synergic combination of time-related changes, driven by the cessation of the circulatory system, homeostasis, and metabolic processes. The major constituents of the human body are systematically broken down into simpler molecules, and the degradation patterns of these molecules can be investigated to objectively estimate PMI.

Post-mortem samples are inherently complex and change over time, yet they are typically available in limited quantities. Therefore, maximising the information obtained from a sample is crucial. Liquid chromatography coupled to high resolution mass spectrometry (LC-HRMS) is sensitive, robust, and offers a comprehensive analysis of endogenous small molecules. LC-HRMS can cover a wide range of metabolite polarities, but the heterogeneity and complexity of the metabolome varies, with small polar amino acids and non-polar lipids complicating the ability to capture the entire system in a single analytical method. To overcome this, a LC-HRMS method was optimised to increase the coverage, and identification of metabolites and lipids in post-mortem muscle samples.

Post-mortem muscle samples were collected at the mortuary in the Surgical and Anatomical Sciences Facility at the University of Technology Sydney and underwent a previously optimised multi-omics sample preparation workflow.[1] The pooled extracts were then analysed using an Aquity M-class LC system coupled to a Synapt XS Ion Mobility Time-of-Flight Mass Spectrometer (Waters Corporation) to determine the optimal source parameters, ion mobility parameters, and data acquisition mode for untargeted post-mortem metabolomics and lipidomics.

Biography

Emily is a second year PhD candidate at the University of Technology Sydney, who aims to develop a more objective and accurate approach for estimating the post-mortem interval. She uses GC×GC-TOFMS and LC-HRMS to analyse samples from the Australian Facility for Taphonomic Experimental Research (AFTER), and combines proteomics, metabolomics, lipidomics, and volatilomics, to understand the complex chemical and biological changes that drive decomposition.

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[38]

A MULTI-MODAL TYRAMIDE-RUTHENIUM TAG FOR AMPLIFIED ELEMENTAL-MASS SPECTROMETRY AND IMMUNOFLUORESCENCE IMAGING

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Abstract

Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS), when combined with metal analytes directly conjugated to specific antibodies, is a technique that can visualise and quantify biomolecules in situ.[1] Absolute quantification of the metal analyte is possible when analysed alongside matrix-matched calibration standards. LA-ICP-MS is however limited in resolution and sensitivity compared to standard immunofluorescent (IF) imaging due to the low number of metal analytes reaching the mass spectrometer as the resolution is decreased. Therefore, new approaches are required to detect low abundant biomolecules at high resolution.

Immunohistochemistry also faces challenges in detecting low-abundant biomolecules, with tyramide signal amplification (TSA) used to enhance signal intensity. TSA is a horseradish peroxidase (HRP)-mediated amplification method wherein HRP reacts with hydrogen peroxide and the phenolic group of tyramine to generate a quinone-like radical intermediate. This intermediate covalently binds to the many tyrosine residues surrounding the antibody binding site on the biomolecule of interest, thereby enhancing signal intensity.[2]

Here a ruthenium tris(bipyridine)–tyramide complex was synthesised, allowing for TSA-based signal amplification for LA-ICP-MS imaging. In addition, the fluorescent properties of Ru allowed complementary high resolution multi-modal detection through fluorescent microscopy. This Ru-complex was applied to murine brain and muscle tissues after application of a primary antibody, a biotinylated secondary and HRP complex to catalyse the reaction, detecting both high- and low-abundant biomolecules. The approach demonstrated enhanced sensitivity for fluorescence microscopy and LA-ICP-MS imaging on the same section, and will improve analyses of biomolecules that were previously difficult to detect.

Biography

Rosemary is a 2nd year chemistry PhD student at the University of Technology Sydney in the Faculty of Science (School of Mathematical and Physical Sciences). She is supervised by Associate Professor David Bishop, with her work focusing on advancing elemental mass spectrometry imaging for biomedical and clinical applications. In particular, developing strategies to enhance the detection of low abundant biomolecules and improving spatial resolution in tissue analysis.

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METHOD DEVELOPMENT FOR QUANTIFYING CHLORANTRANILIPROLE IN WATER SAMPLES FOR TOXICITY TESTING

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Abstract

Chlorantraniliprole, a recently registered insecticide increasingly detected in aquatic environments, is under investigation for its potential impacts on freshwater organisms. To assess its toxicity, we conducted acute and chronic toxicity tests on five aquatic species: four invertebrates (Chironomus tepperi, Austrochiltonia subtenuis, Daphnia carinata and Anisops doris) and an aquatic plant (Spirodela polyrhiza). Organisms were exposed to Chlorantraniliprole concentrations ranging from 0.001 to 3.0 mg/L.

Test media were prepared using reverse osmosis water amended with species-specific salt recipes. Water samples were collected at the beginning and end of each exposure to assess actual concentration and potential degradation, considering chlorantraniliprole's sensitivity to light and pH [1]. Samples were spiked with an internal standard and cleaned up using a Solid Phase Extraction column (PREVAIL TM C-18).

Quantification was performed using Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS; Agilent 1290 Infinity HPLC coupled with a 6490 Triple Quadrupole MS). Reverse-phase chromatographic separation was achieved using a C18 column and a gradient elution of 0.1% formic acid in water and methanol. Detection was carried out in a positive mode mass spectrometry, using multiple reaction monitoring (MRM) with transitions of m/z 484→453, 484→286 (analyte), and 487→453 (internal standard). Chlorantraniliprole eluted at approximately 3.3 minutes. This analytical method underpins the correlation of measured exposure concentrations with observed biological responses. The findings will support the development of biomarker assays for sublethal effect detection and inform future environmental monitoring strategies. Ultimately, this research contributes to bridging laboratory-based ecotoxicological data with environmental occurrence to more effectively evaluate ecological risks in freshwater ecosystems.

Biography

Driven by a passion for science, I left my family business to pursue a master's in biotechnology and bioinformatics at La Trobe University in 2014, followed by an internship at the Olivia Newton-John Cancer Research Institute. I am currently undertaking a PhD at AQUEST, RMIT University, researching the ecological effects of an emerging pesticide on aquatic invertebrates. With strong skills in molecular biology, I aim to expand my expertise by developing innovative ecotoxicological bioassays using molecular tools to better understand environmental impacts.

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USING MASS SPECTROMETRY TO GAIN INSIGHTS INTO SNAKE VENOM PROTEINS

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Abstract

Snake bite envenomation is responsible for up to 138000 deaths annually and was recently listed as a neglected tropical disease by the World Health Organisation.1,2 Despite this, many snake venoms, typically consisting of a complex variety of protein toxins are currently poorly understood, limiting the scope of further developments in treatment. The taipans, a genus of snakes consisting of three species – the inland, coastal and the western desert taipan are typically associated with their highly toxic venoms, with the inland taipan known for having the deadliest venom in the world. As a result, understanding the toxins present in these venoms is of great importance, and while many studies have sought to do this, this research often doesn't go beyond the primary protein sequences. In many cases, it has been shown that higher order protein structures as well as modifications to protein sequences such as glycosylation, phosphorylation and disulfide bonding have an important role in toxicity, so characterising these features is vital in understanding how these venoms function.3 In this study, we seek to leverage mass spectrometry as a tool to gain more detailed structural insights into the composition of these venoms. To achieve this, we analyse intact proteins using a combination of mass spectrometry techniques, including native mass spectrometry, ion-mobility and a variety of fragmentation modes to characterise a greater diversity of proteoforms and develop robust analytical workflows, applicable not only for the study of venoms, but to studying proteins in a range of fields, including agriculture and health.

Biography

Shaun is a PhD student at the University of Adelaide under the supervision of Professor Tara Pukala. After completing a Bachelor of Science (Advanced) in Chemistry, Shaun joined the Pukala group to complete a Master of Philosophy, studying the development of mass spectrometric immunoassays for the detection of amyloid protein aggregation. Currently, Shaun's PhD research is interested in the top-down proteomic characterisation of a range of snake venoms, using mass spectrometry tools such as native-MS and ion mobility to gain greater insights into venom protein structure and composition.

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[61]

PREVALENCE AND ANTIMICROBIAL RESISTANCE OF SALMONELLA IN CHICKEN AND BEEF IN PHNOM PENH, CAMBODIA

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Abstract

Salmonella is a significant foodborne pathogen that has emerged as an increasing public health concern in Cambodia. Antimicrobial resistance (AMR) is mostly the result of misuse or overuse of antibiotics in both human healthcare and livestock agriculture. This study aimed to determine the prevalence of salmonella and its antimicrobial resistance profile in chickens and beefs from different markets in Phnom Penh, Cambodia. In total 20 samples (10 beefs 10 chickens) were randomly collected from three major markets in Phnom Penh such as Dermkor, Toul Tumpong and Thom Thmey. The samples were analysed following the ISO 6579-1 for salmonella detect. The samples were subjected to bacterial culture and confirmation of positive salmonella was perfomed by MADI-TOF Biotyper. The salmonella isolated were tested for antimicrobial susceptibility testing (AST) by using disk diffusion method with 22 antibiotics disks in accordance with EUCAST guideline. Out of 20 meat samples, 95% were positive for Salmonella, with 100% prevalence in chicken and 90% in beef. Antimicrobial resistance testing revealed high resistance to β-lactams, notably piperacillin (62.5%), aztreonam (60%), and ticarcillin (52.6%), while carbapenems and extended-spectrum cephalosporins remained fully effective.Moreover, 70% of isolate were identified as mulitidrug resistance, highlighting as a serious health risk in public health. Additionally, Salmonella isolates exhibited antibiotic resistance, which is extremely concerning for environment, consumers and animals. The emergence of many MDR isolates and the high rate of antibiotic resistance are real concerns that call for a strong surveillance network in the One Health concept.

Biography

My name is Huysean Huot. I was born in Kampong Cham, Cambodia and currently I am holding a Master's Degree in Medical Biology at University of Puthisastra. My professional experience includes laboratory management and research in pharmacy field as well as community outreach projects. Furthermore, I had the opportunity to assist front-line workers at the Institut Pasteur du Cambodge during the COVID-19 pandemic by collecting samples and managing patient data. I have actively contributed to international conferences in the Malaysia and Thailand. I also was awarded a research grant by the Royal Society of Tropical Medicine and Hygiene in 2024.

SESSION 7:

APPLICATIONS IN MICROFLUIDICS

ADVANCING GREEN CHEMISTRY: THE ROLE OF MICROFLUIDIC TECHNOLOGIES IN SUSTAINABLE CHEMICAL ENGINEERING

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Abstract

Microfluidics stands at the forefront of sustainable innovation in chemical engineering, offering versatile solutions for materials synthesis, diagnostics, drug delivery, environmental monitoring, and food safety. The unique fluidic behaviour at the microscale, fundamentally distinct from traditional macroscale systems, enables more rapid chemical kinetics and precise process control. These advantages translate directly into enhanced environmental sustainability: microfluidic platforms minimize the use of harsh reaction conditions, reduce byproduct formation, and lower the volumes and diversity of reagents required for chemical processes. This study provides a comprehensive overview of microfluidic fundamentals, emphasizing their application in chemical reaction. Key topics include microscale flow dynamics, advanced flow control and device fabrication strategies, and the latest developments in microfluidic characterization methods for in situ process analysis and optimization. We further discuss how microfluidic systems contribute to greener synthesis routes, process efficiency, and commercial viability, delineating current challenges and proposed solutions. Our study highlights the growing potential of microfluidics as a key for sustainable chemical engineering and environmental responsibility.

Biography

Ayesha Sandaruwani is a PhD student in the school of chemical engineering at the University of Adelaide, Australia. She holds a B.Sc. (Honours) in Chemical and Process Engineering from the University of Moratuwa, Sri Lanka, and earned her M.Phil. (by Research) in Material Science and Engineering in 2022 from the University of Moratuwa, Sri Lanka. Her project was synthesising high surface area material (reduced graphene oxide) using graphite for EDLC applications. She is currently engaged in chemical reaction studies in microfluidic technology under the supervision of Dr. Xiaoyong Xu. Her current research focuses on ammonia synthesis using microfluidic technology.

Xiaoyong Xu received his Ph.D in chemical engineering from the University of Queensland in 2014. In 2021 he joined the University of Adelaide as a senior research fellow. His research activities focus on the development of high-performance perovskites, direct carbon fuel cells, direct ammonia fuel cells and solid oxide cells, with a strong application focus in clean energy and the environment, as well as carbon dioxide emission reduction and hydrogen production. Part of his current research involves the material synthesis in microfluidic approaches, which can lead to the sustainable synthesis of high-performance novel materials various applications.

[21]

TO DESIGN AND ENGINEER AN ARRAY OF SENSING TECHNOLOGIES, INTEGRATED INTO MICROFLUIDIC PLATFORMS, TO MONITOR KEY PARAMETERS OF THE MANUFACTURING OF MRNA VACCINES IN REAL-TIME

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Abstract

The development of robust, real-time monitoring systems is critical for advancing the reliability and scalability of on-chip mRNA vaccine manufacturing. This research focuses on the integration of advanced sensing technologies into microfluidic platforms to enable precise monitoring and control of key process parameters, including pH, conductivity, mRNA concentration, and purity. Electrochemical sensors will be employed for real-time measurements of pH and conductivity, providing immediate feedback on the microenvironment conditions within the microfluidic system. In parallel, UV/Vis and Raman spectroscopy techniques will be implemented to assess mRNA concentration, lipid nanoparticle (LNP) encapsulation efficiency, and the presence of impurities or residual contaminants at various critical stages of the production process.

The integration of these complementary sensing modalities into a single microfluidic platform will facilitate seamless, continuous monitoring of the manufacturing workflow as shown in the figure. 1, enable rapid adjustments, and ensure consistent product quality. This approach offers a significant improvement over traditional batch-based monitoring methods, providing higher throughput, reduced waste, and enhanced process control. By establishing a fully integrated sensing and control framework for on-chip mRNA synthesis and formulation, this research aims to streamline the development and production of mRNA-based therapeutics. The outcomes of this work are expected to contribute meaningfully to the field of mRNA vaccine manufacturing, paving the way for more efficient, scalable, and high-quality production methods in future biomedical applications.

Biography

Vijaykumar Bodarya | Researcher Profiles
2nd year PhD candidate
School of Chemical Engineering,
The University of Adelaide.

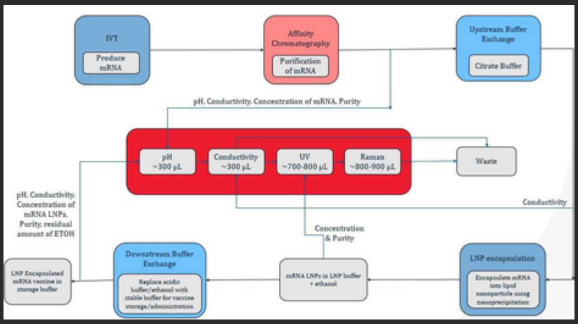

Figure. 1: Schematic diagram of overall workflow

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HIGH-RESOLUTION 3D PRINTING AND APPLICATIONS: DEVELOPMENT OF A MICROFLUIDIC CALIBRATED CONTINUOUS FLOW NITRITE WATER MEASUREMENT SYSTEM

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Abstract

High-resolution stereolithography (SLA) 3D printing eliminates many of the problems previously associated with the fabrication of microfluidic devices both by other 3D printing methods and traditional manufacturing methods. [1]

We will cover a brief review of microfluidic fabrication methods including the Boston Micro Fabrication (BMF) 2 µm series printer, and the development of a 3D printed microfluidic continuous flow colorimetric monitoring device for the detection of nitrite in water.

Nitrite levels are of interest as a marker of water health as higher concentrations are detrimental to both aquatic and human life, and can lead to methemoglobinemia, particularly in infants. [2]

The developed microfluidic chip is a five-layer, modular design with both parallel and serial microfluidic elements for simultaneous sample, reagent and standard injection and has integrated fluidic splitters, mixers, gradient generator and detection zone. The total channel volume is 4.6 µL, average channel dimensions of 75 µm (W) x 150 µm (H) and the overall chip dimensions are ~38 mm x 12 mm x 6 mm.

Nitrite is detected at µM concentration using the Griess reaction. Colorimetric detection is semi-automated and performed by the image processing of a photograph taken by a mobile phone camera and analysed for intensity. The sample is quantified via standard addition. This chip will be integrated into a µTAS unit and deployed for in-field environmental monitoring, for a flexible, low-cost method for point-of-need water quality assessment. Furthermore, this chip setup can be expanded to assay other nutrients by simply changing the reagents used.

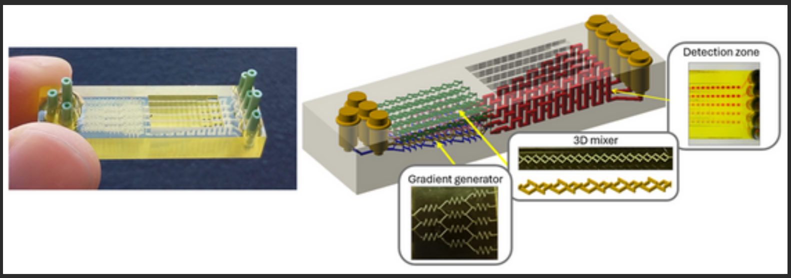

Figure 1 (Left) Microfluidic device, held to show scale. (Right) Microfluidic device structure with sections of interest highlighted.

Biography

Kim Nicolau completed a Bachelor of Science at the University of Tasmania. She commenced a PhD in 2021 at the University of Tasmania in the Australian Centre for Research on Separation Science group. Her research focus are the development and use of high-resolution 3D printing methods for analytical science applications, especially microfluidics.

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[43]

DESIGN AND FABRICATION CHALLENGES OF SPIRAL INERTIAL MICROFLUIDICS FOR LAB-ON-CHIP BACTERIA DETECTION DEVICE

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Abstract

Pathogenic bacteria pose major public health risks, especially through contaminated food and water [1]. While traditional detection methods are effective, they are often slow and costly [2]. Microfluidic technologies offer faster, low-volume, portable and more integrated solutions for bacterial separation and detection over traditional methodologies [3]. The development of a portable microfluidic lab-on-chip system for bacterial detection in water requires effective upstream separation. This study focuses on designing a spiral inertial microfluidic device to isolate bacteria based on size using passive hydrodynamic forces for the enrichment in detection technique. Although several design iterations were tested, achieving functional separation remains a challenge due to fabrication limitations. Initially, chips were directly fabricated using BMF MicroArch S230 3D printer. Despite its high resolution (5–20 µm), printed channels exhibited surface roughness and deformed geometries, especially in the intended trapezoidal cross-sections, critically affecting separation performance. Alternative fabrication strategies involving soft lithography utilizing 3D printed mold were explored to improve optical clarity and material compatibility. While initial attempts presented surface and bonding challenges, iterative refinements have led to improved process stability and device assembly. However, the geometrical distortions from 3D printing persisted in soft lithography replicas, resulting in failed separation in all designs. As a result, we are transitioning to SU-8 lithography and CNC machining for precise mold fabrication. This work highlights fabrication as a critical bottleneck in microfluidic device performance and offers valuable insights for researchers facing similar constraints. Despite limited separation results so far, the iterative troubleshooting process advances the path toward an integrated bacteria detection chip.

Biography

Kawser is a PhD candidate in Australian Centre for Research on Separation Science at the University of Tasmania, specializing in 3D printing and microfluidics. With a background in Civil and Environmental Engineering, his research focuses on developing spiral inertial microfluidic chips as part of a portable lab-on-chip system for real-time water quality monitoring. He is passionate about solving environmental problems through engineering innovations. Outside academia, Kawser is also a dedicated part-time photographer, his interests span across research, design, and personal storytelling through both science and art.

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[46]

BIOACTIVE ISOLATION FROM PLASMA-DELIBERATED BIOMASS VIA BATCH AND CONTINUOUS MICRO-FLOW EXTRACTION

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Abstract

This project aims to demonstrate a comprehensive approach to integrating nonthermal plasma (NTP) and microfluidics in the shape of continuous micro-flow to sustainably extract valuable biomolecules. Biomass requires pretreatment to break down cell wall and overcome its rigidity, enabling efficient extraction of biomolecules [1, 2]. SEM revealed physical changes in Spirulina and Chlorella cells, indicating degradation of the outer layer. The extraction of the bioactive quercetin (an antioxidant and anti-inflammatory flavonoid) has been conducted as a batch process. The total yield after 5 hours was increased by 25% in Spirulina and 22% in Chlorella, demonstrating that NTP is an effective pretreatment method. Process-kinetic analysis was done by Peleg's model and Power law, common in extraction process optimisation. Higher inverse K_2-values, which predicts total extractable yield in the Peleg's model, were determined in treated Spirulina samples (15.47) as compared to untreated (13.28) and treated Chlorella (5.49) as compared to untreated (4.79). Higher B-values, which quantify extraction rate in the Power law, were determined in treated Spirulina samples (11.59) as compared to untreated (12.89); treated Chlorella (4.92) as compared to untreated (4.31). The N-value define the role of diffusion and increased in treated samples: Spirulina: 0.12 to 0.15, Chlorella: 0.09 to 0.1. The batch experiments are currently followed up by continuous microflow using a coiled flow inverter (CFI), which has been extensively investigated by our group for critical metal extraction. A convection-driven segmented flow passes repeatedly coiling, after its reversing curvature direction, which is known leverage Dean forces to enforce the convection.

Biography

I began my research journey as an intern at the Research Institute for Bioscience and Biotechnology (RIBB), Nepal where I gained hands-on experience in applied bioscience research. I completed Master of Biotechnology (Biomedical) (Advanced) at the University of Adelaide in 2024. During the second year of my master's degree, I did a thesis project in "Cold plasma processing of grains project" at the School of Agriculture, Food and Wine. Currently, I am a PhD student at the School of Chemical Engineering, with research interests that span cold plasma technology, compound extraction, and flow chemistry, all with a focus on real-world impact. Apart from my academics and research, I love playing soccer.

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SESSION 8:

HEAVY METALS & ELECTROCHEMICAL SENSING

[16]

CO -OCCURRENCE OF MICROPLASTICS WITH HEAVY METALS IN FRESHWATER SEDIMENTS

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Abstract

Microplastics are synthetic or semi-synthetic materials with irregular shape with a size less than 5 mm. Microplastics are increasingly recognized as emerging global pollutants due to their strong affinity for toxic chemical compounds. Heavy metals, being toxic and persistent environmental contaminants, can interact with microplastics in two ways. Firstly, during the manufacturing process, heavy metals are often incorporated into plastics as additives to improve plastic properties. As plastics undergo chemical and physical degradation, these additives can remain embedded or accumulate on the surface of resulting microplastic particles. Secondly, microplastics can adsorb heavy metals directly from the surrounding environment[1]. Adsorption of metals to microplastics is attributed to their large surface-area-to-volume ratio, small particle size, and hydrophobic characteristics, which collectively enhance their ability to bind with heavy metals. The complex interactions between heavy metals and microplastics pose significant ecological risks, potentially leading to harmful effects on aquatic ecosystems[2].This study investigated the relationship between microplastics and heavy metals in urban creek sediments by employing a dual-density separation method for microplastic extraction and inductively coupled plasma mass spectrometry (ICP-MS) for heavy metal analysis. Polyethylene (PE) and polypropylene (PP) emerged as the most frequently detected polymer types and showed notable associations with multiple heavy metals. These findings suggest that common low-density polymers may play a significant role in the accumulation and transport of heavy metals in freshwater environments.

Biography

I am a PhD candidate in Chemistry at Queensland University of Technology. I apply environmental analytical techniques and chemometrics to analyse persistent pollutants microplastics, PFAS, and heavy metals in freshwater environments. My work combines fieldwork with laboratory analysis to quantify pollutants and fill knowledge gaps in this field. I also enjoy serving as a Young Science Ambassador in the Wonder of Science program, promoting STEM education among Queensland schools. I love research and want to contribute to the future of science by producing new knowledge and turning my findings into practical benefits for society.

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[24]

TEMPERATURE-STIMULATED ELECTRICAL SIGNALLING IN MIMOSA PUDICA: GENERATION AND PROPAGATION OF ACTION POTENTIALS MONITORED BY MULTI-ELECTRODES SYSTEM

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Abstract

Plants generate electrical signals such as action potentials (APs) in response to external stimuli, enabling signal transmission and movement control1. Mimosa pudica exhibits rapid leaf folding and petiole bending following tactile or thermal stimulation, accompanied with propagation of APs2. These signals are induced by ion flux along cell membranes. While temperature-sensitive TRP (Transient Receptor Potential) channels have been reported in animals and recently in plants, their precise roles remain unclear. In this study, we investigated the generation and propagation of APs in M. pudica under the controlled thermal stimulation. Multiple electrodes were inserted in the petiole to measure potential differences relative to the reference electrode in soil, and the electric signal from proximal regions around the stimulation site to distal regions was recorded (see Figure 1). Cold stimuli induced local depolarization near the stimulation site, initiating APs that propagated through the tissue. In contrast, heat stimulation triggered hyperpolarization at the stimulation site, followed by depolarization in adjacent areas, which led to AP initiation. We also observed whole-plant signal propagation and gradual recovery to resting potential. These findings suggest that thermal responses in M. pudica resemble temperature-dependent behavior of cation-exchange membrane systems composing one cation-exchange and two aqueous phases. By comparing experimental data with a cation-exchange membrane model based on the Nernst equation, we can understand temperature-dependent characteristics. The results advance understanding of role of TRP channels in plant electrophysiology and contribute to broad elucidation on plant responses to various external stimuli.

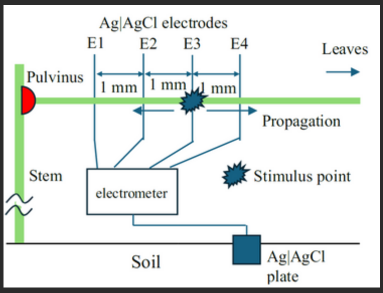

Figure 1. Schematic illustration of potential difference measurements at multiple sites in response to thermal stimulation.

Biography

Yucong Yuan is a second-year doctoral student in the Graduate School of Agriculture at Kyoto University, focusing on elucidation on generation and propagation signals in Mimosa pudica. He earned his M.Sc. in Frontier Biosciences from Osaka University, where he developed scalable methods for using VR devices in fMRI experiments, and his B. Eng. from Shanghai University. He has conducted interdisciplinary research spanning neuroscience, electrochemistry, and analytical chemistry, presented at national conferences, and is preparing publications on generation mechanisms of plant action potentials by external stimuli.

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[28]

ARSENIC DISTRIBUTION AND SPECIATION IN THE NOVEL EXTREMOPHILE NEMATODE *TOKORHABDITIS TUFAE*

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Abstract

Arsenic exposure through groundwater contamination is a global issue which impacts over 200 million people worldwide.[1]Tokorhabditis tufae (T. tufae) is a novel species of extremophile nematode which thrives in the highly saline, alkaline and arsenic-rich environment of Mono Lake, California,[2,3] providing a tractable model for mechanistic studies of adaptation to mineral-extreme environments.[4] Gaining insight from such studies requires an understanding of the in vivo arsenic distribution and speciation which can be acquired by utilising synchrotron-based X-ray techniques.[5] Pilot X-ray fluorescence microscopy data collected at the Australian Synchrotron revealed differences in arsenic uptake and speciation in T. tufae treated with arsenite [As(+III)] and arsenate [As(+V)]. While arsenic concentrations varied between individual nematodes, the total mean arsenic content in T. tufae treated with arsenite was markedly elevated compared to arsenate-treated organisms. This was not observed for Caenorhabditis elegans, which suggests that T. tufae may be capable of detoxifying arsenic via a unique and speciation-dependent mechanism. In T. tufae treated with arsenate, arsenic primarily accumulated in the gastrointestinal tract and was relatively excluded from the gonads, supporting the hypothesis that T. tufae provide maternal protection to developing offspring.[4,6] Further studies are planned to investigate arsenic speciation in T. tufae exposed to arsenite and arsenate at varied doses and exposure times, and to compare the arsenic chemistry of T. tufae with their arsenic-sensitive progeny, using X-ray spectroscopy and imaging techniques. Outcomes of this research contribute novel insights into the biochemistry of this unique organism and may inspire new remediation strategies for arsenic-contaminated areas.

Biography

A former resident of the Adelaide Hills, Ani Baker moved to the CBD during her second year of undergraduate study (Bachelor of Science (Advanced)) at The University of Adelaide. In 2024, Ani completed her MPhil candidature with Professor Hugh Harris and was awarded a Dean's Commendation of Excellence for her thesis. This work, and her current PhD projects, focus on the applications of synchrotron-based X-ray techniques to elucidate the chemical speciation and distribution of metals and metalloids in intact biological samples. During her candidature, Ani has led and conducted experiments on multiple synchrotron beamlines in Australia and overseas.

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[31]

FLUORESCENT SENSOR ARRAYS FOR THE DETECTION OF METALS IN BIOLOGY AND THE ENVIRONMENT: A MULTIVARIATE APPROACH

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Abstract

Metals play vital roles in biological processes and environment, but their imbalance is associated with several problems. For instance, imbalance of Fe^{3}., Co^{2}., and Zn^{2}. (biomarkers for Alzheimer's disease, AD) in the brain can lead to oxidative stress and protein aggregation, making the detection of heavy metals inevitable for early diagnosis and mediating these diseases.[1] Beyond human health, metals also pose significant environmental threats due to industrial discharge, mining activities, and agricultural runoff, contaminating water and soil ecosystems. However, detection of toxic metals in biological and environmental samples remains a challenge, especially in complex environments where multiple metal ions coexist.

Expensive instrumentation, poor sensitivity, and the single-analyte-focused nature of traditional detection methods make them inadequate for real-time monitoring of metals. The development of small molecule-based fluorescent sensors has emerged as a promising alternative for detecting toxic metals.[2] Many toxic and essential metals share very similar properties, making it challenging to design sensors that can selectively target one metal. While selective fluorescent sensors have been the focus of many studies, cross-reactive sensors that respond to multiple analytes, provide distinct advantages, particularly in detecting complex mixtures of metal ions.[3] Cross-reactive sensors generate distinct fluorescence patterns towards various analytes that can be interpreted using multivariate statistical techniques. This approach is highly significant in the context of both environmental pollution and in diseases, where the dysregulation of multiple metals occurs.

Our approach involves the use of small fluorescent sensors within an array-based platform to achieve this goal. By employing multivariate statistical methods such as linear discriminant analysis (LDA), we aim to distinguish between different toxic metals based on the fluorescent responses of our sensor array. We have developed a library of fluorescent sensors capable of distinguishing different toxic metals and our future goals involve refining this system further. We have focussed particularly on ions that are less commonly studied, such as Mn2+, Cr3+ and Cr6+. By expanding the sensor library and its fine-tuning, we aim to create a robust tool for detecting toxic metals in biological and environmental samples.

Biography

Tahir Waseem holds a Bachelor of Science (Honours) in Chemistry from the University of Sargodha, Bhakkar, Pakistan and a Master of Science in Chemistry from COMSATS University Islamabad, Abbottabad. He is currently a Ph.D. candidate at the University of Sydney, working under the supervision of Professor Elizabeth J. New. His research focuses on the use of fluorescent sensors to understand different biological processes.

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SESSION 9:

PFAS: REMOVAL & DESTRUCTION

[4]

ANBO$_3$ (A = LI, NA, K, AG) PHOTOCATALYSTS FOR THE DEGRADATION OF PERSISTENT ORGANIC POLLUTANTS

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Abstract

The scarce forethought for utilising chemicals in industrial and domestic applications has led to widespread environmental contamination. Poly- or perfluoroalkyl substances (PFAS) are persistent organic pollutants (POPs) that exist indefinitely in the environment due to their strong C-F bonds. Photocatalysis lends itself as a method to degrade PFAS as photocatalysts, upon excitation with a photon equal to or greater than their band gap, can undergo oxidation and reduction reactions to degrade pollutants. Herein, niobium-based metal oxides containing a perovskite structure ($ANbO_3$, A = Li, Na, K, Ag) are investigated to degrade PFAS into non-toxic species -carbon dioxide and fluoride. With their wide band gaps, niobates demonstrate large redox potentials, which are used to drive chemical transformation. A range of niobates are synthesised with varying ‘A’ site cations, and particle size is measured using scanning electron microscopy. Crystal structure and crystallite size are measured using powder X-ray diffraction, and the bandgap of the materials is determined using UV-Vis diffuse reflectance spectroscopy. The niobates are also doped with the rare-earth metal, lanthanum, to increase photocatalytic activity by decreasing nanoparticle size. In this presentation, I will discuss how the physical characteristics of $ANbO_3$ (A = Li, Na, K, Ag) alter their photocatalytic performance to degrade highly resistant chemical bonds. In particular, I will focus on the effect of particle size, crystallinity and electron band alignment. The mechanism of degradation is determined using scavenger experiments with nuclear magnetic resonance and a fluoride ion selective electrode used to monitor mineralisation pathways.

Biography

Chantelle Falanga is an honours student in chemistry at the University of Adelaide. In 2024, she completed a Bachelor of Science (Advanced) at the University of Adelaide, and her passion for environmental and analytical chemistry led her to undertake a research project investigating high redox potential photocatalysts for the breakdown of persistent pollutants. Under the supervision of Dr Cameron Shearer, Chantelle is exploring niobium-based metal oxide materials for the remediation of poly- and perfluoroalkyl substances (PFAS) and tyre wear pollutants.

[29]

ADVANCED CATALYTIC REDUCTION PROCESSES FOR THE BREAKDOWN OF FLUORINATED POLLUTANTS

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are a large group of chemical compounds, categorized by their fluorinated carbon chain. Due to their high chemical stability, they have been widely used in industry and consumer products, such as firefighting foams, non-stick coatings, cosmetics, textiles, and electronics. However, PFAS do not break down naturally due to their high chemical stability, which results in the accumulation of PFAS in the environment. This is very concerning, as there is growing evidence of a link between some PFAS and various diseases, such as diabetes and cancer.[1]

There are many techniques that can be used to degrade PFAS, however no method is currently known which can do so effectively, safely and efficiently.[2] Photocatalysis uses light to generate electron-hole pairs from a semiconductor photocatalyst. Provided the redox potential of the photocatalyst is sufficient, these electrons and holes can then degrade the strong carbon-fluorine bonds present in PFAS.[3] Photocatalysis is an attractive degradation technique due to their low environmental impact and energy use. However, most photocatalysts require sacrificial reagents in order to effectively degrade PFAS. If this additional chemical could also be used to create highly reactive species, the PFAS could be degraded by two different mechanisms at once. In this research, we investigate the addition of sacrificial donor molecules to increase degradation rate and also create secondary reactive species to enhance the degradation of PFAS.

Biography

Alex graduated from The University of Adelaide in 2020 from his Bachelor of Science (Advanced) (Honours). Following that he worked at Intertek, testing agricultural produce for pesticides, heavy metals and toxins, along with any other tests required.

Alex returned to The University of Adelaide in 2024 to conduct research into upscaling a PFAS remediation process for Enviropacific Services, aiming to capture and completely destroy PFAS from contaminated sites. He enjoyed this research so much, that in 2025, he decided to start his PhD, looking at advanced catalytic reduction processes for the breakdown of PFAS.

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[45]

RA-INSPIRED SOLUTION FOR VISIBLE-LIGHT DEGRADATION OF PFAS (FOREVER CHEMICALS)

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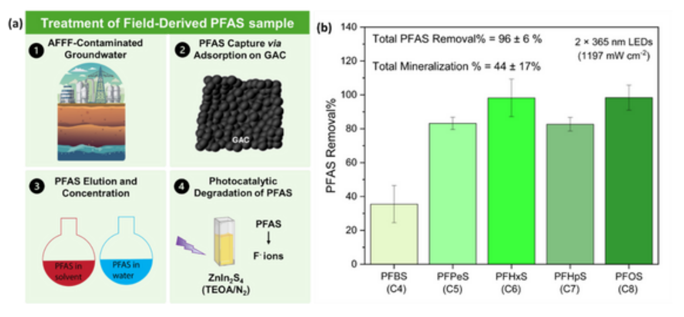
Abstract

Ra was the Ancient Egyptians' god of the sun, and they relied on the sun in different aspects of life. Inspired by this, water treatment using green photocatalysis technology using solar energy is a promising approach. Metal sulfide photocatalysts, including zinc indium sulfide ($ZnIn_2S_4$), have shown promising activity toward the sunlight-driven photodegradation of various water pollutants.[1] However, only a few studies have investigated them for the photodegradation of more persistent chemicals such as per- and poly-fluoroalkyl substances (PFAS).[2,3] Herein, we fabricate $ZnIn_2S_4$ microspheres/nanosheets using solvothermal synthesis and investigate their photocatalytic activity toward the photoreductive degradation of perfluorooctanesulfonic acid (PFOS). Other visible light active photocatalysts such as cadmium indium sulfide ($CdIn_2S_4$), cadmium sulfide (CdS), and graphitic carbon nitride ($g\text{-}C_3N_4$) were prepared and characterized. The PFOS photodegradation under 365 nm irradiation was compared between $ZnIn_2S_4$, $CdIn_2S_4$, CdS, and $g\text{-}C_3N_4$, along with TiO_2. PFOS removal was monitored by a combination of ^{19}F-NMR and liquid-chromatography mass spectrometry (LC-MS). To confirm cleavage of the C–F bond, the evolution of F^- ions was monitored with a fluoride ion selective electrode and confirmed by ^{19}F-NMR. The metal sulfides including $ZnIn_2S_4$ displayed significant production of fluoride (F^-) ions (35 ± 13 ppm) and no PFAS by-products in the post-reaction solutions (from LC-MS), confirming PFOS mineralization (69 ± 26%). Importantly, $ZnIn_2S_4$ could degrade PFOS under visible light irradiation. Finally, $ZnIn_2S_4$ was then used for the photodegradation of a field-derived mixed PFAS sample and achieved high mineralization of the complex sample.



Biography

Mahmoud Adel Hamza obtained his BSc and MSc in chemistry from Ain Shams University (Egypt) in 2013 and 2018, respectively. He was appointed as a teaching assistant at the Chemistry department, Ain Shams University (2014-present), and in parallel, he worked as a research assistant at the Energy Materials Laboratory, the American University in Cairo (2018-2021). He has been pursuing his PhD work at the University of Adelaide, Australia (2021-2025). His current research at the Photo-Cat group is direct to the synthesis of visible-light-active photocatalysts for energy and environmental applications, including H_2 production, biomass valorization, PFAS degradation, and dual-functional photocatalysis

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[59]

OPTIMIZING EXTRACTION AND CLEAN-UP FOR RELIABLE PFAS QUANTIFICATION IN SOILS

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants [1, 2], yet their accurate quantification in soils remains challenging due to strong matrix interferences and inconsistent recoveries [3-5]. This study presents the development and validation of an extraction and clean-up method for quantifying 68 legacy and emerging PFAS in soils using LC–MS/MS. Three extraction solvents—methanol, acetonitrile, and isopropyl alcohol, with and without pH modifiers—and multiple clean-up strategies (dispersive SPE and cartridge-based sorbents) were systematically evaluated. Agilent Carbon S delivered the highest matrix removal efficiency, while basic methanol (10 mM NH_4OH) generally yielded superior recoveries across PFAS classes, except for perfluoroalkane sulfonyl fluorides (PASF), where basic acetonitrile performed better. The optimised sequential protocol—5 mL basic methanol extraction followed by a 3 mL basic acetonitrile wash and Agilent Carbon S clean-up—achieved acceptable recoveries (70–130%) for 50 PFAS. Nonetheless, the method showed reduced performance for volatile PFAS (e.g., FTCA and FTUCA) and for cationic or zwitterionic PFAS common in AFFF formulations. This simple, low sample-handling approach effectively suppresses matrix effects and offers a robust, alternative to more labour-intensive methods. Application to soils from diverse land uses revealed PFOS dominance in 73% of samples, with concentrations below the National Environmental Management Plan guideline. The method provides a practical, high-performance tool for PFAS monitoring, supporting enhanced environmental surveillance and risk assessment.

Biography

I am a PhD candidate in the Australian Laboratory for Emerging Contaminants at the University of Melbourne. My research identifies legacy and emerging PFAS sources in Australian wastewater treatment plants and leads a state-wide soil survey assessing the impact of various land uses on PFAS contamination across Victoria. Utilizing targeted and non-targeted high-resolution mass spectrometry, I uncover chemical signatures associated with PFAS emitters. This work advances early detection and mitigation strategies to address PFAS contamination, supporting environmental protection and public health.

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POSTER SESSION A

UNDERSTANDING THE FATE AND BEHAVIOR OF PFAS IN PORT PHILLIP BAY

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Abstract

Poly- and perfluoroalkyl substances (PFAS) are persistent, toxic, and globally distributed contaminants that pose significant environmental and public health risks. Current monitoring approaches often overlook temporal variability and site-specific contributions, potentially underestimating PFAS loads. This study investigates PFAS inputs and sinks in Port Phillip Bay, Victoria, as part of a broader effort to develop a data-driven mass flux model. Forty-four PFAS compounds were quantified in environmental samples using solid-phase extraction and LC–MS/MS.

High-frequency sampling at three estuarine sites (Kororoit Creek, Mordialloc Creek, and the Maribyrnong River) over 24-hour tidal cycles revealed four- to seven-fold fluctuations in PFAS concentrations, highlighting the limitations of random grab sampling and supporting low-tide sampling for consistency. Broader spatial surveys across six Bay locations and six sediment cores assessed PFAS distribution and long-term accumulation. Sorption experiments indicated that PFAS retention was influenced more by particle size than salinity in the low-TOC sediments studied.

Rainwater sampling identified atmospheric deposition as an additional source, with PFOA dominant. Historical data and literature were reviewed to integrate groundwater inputs, particularly from legacy industrial sites, and to consider biota exposure pathways, including documented PFAS bioaccumulation in Burrunan dolphins.

By combining new empirical observations with historical datasets, this work provides the foundation for modelling PFAS mass fluxes into and within Port Phillip Bay, informing targeted management strategies and future monitoring programs.

[P4]

MASS SPECTROMETRY APPROACHES TO ANALYSIS INTACT PROTEIN ASSEMBLIES IN THE CONTEXT OF PROTEIN-MISFOLDING DISORDERS

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Abstract

Parkinson's disease (PD) is a progressive and incurable neurodegenerative disorder associated with the accumulation of α-synuclein (α-Syn) aggregates in the nervous system. While αS plays a physiological role in membrane trafficking in its monomeric state, its oligomerization and subsequent interactions with lipid bilayers have emerged as key factors driving neurotoxicity. The mechanisms governing these interactions and the factors that modulate them remain poorly understood. Additionally, the efficacy of small molecule inhibitors targeting toxic αS aggregation is not well characterized1-3.

In this study, we utilize lipid nanodiscs as biomimetic membrane models to dissect the role of lipid composition in modulating α-Syn interactions. Coupled with cyclic ion mobility mass spectrometry (cIM-MS), this platform allows for high-resolution structural analysis of α-Syn-lipid complexes and early oligomeric species. Furthermore, we investigate the effects of selected small-molecule inhibitors on modulating α-Syn aggregation pathways in the presence of lipid bilayers. Our findings reveal key molecular insights into how lipid environments contribute to toxic conformational changes in α-Syn, and how inhibitors may differentially affect these processes. This approach provides a powerful framework for identifying membrane-specific therapeutic strategies targeting early-stage α-Syn aggregation in PD.

Biography

I am a PhD candidate at Adelaide University, focusing on the molecular mechanisms of protein aggregation in neurodegenerative diseases. My research combines native mass spectrometry, lipid nanodiscs, and inhibitor screening to study α-synuclein aggregation in Parkinson's disease. I hold a background in Analytical Chemistry and has a strong interest in structural biology and biomolecular interactions.

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[P6]

INVESTIGATION OF ELECTROCHROMIC PROPERTY OF NB_2O_5 PARTICLES FOR SMART WINDOWS

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Abstract

Electrochromic smart windows have emerged as a key technology for energy-efficient buildings, enabling dynamic control of light and heat transmission in response to external stimuli. Toward the development of high-performance electrochromic coatings, nanoscale engineering of materials such as niobium pentoxide (Nb_2O_5) plays a crucial role in enhancing their optical modulation, charge transport dynamics, and switching efficiency [1, 2]. In this study, we report the size-dependent coloration efficiency of Nb_2O_5 nanostructures synthesized via solvothermal methods using ethanol and benzyl alcohol as solvent and Polyvinylpyrrolidone (PVP) as a surfactant, yielding particle sizes ranging from 1µm to 10 nm. The resulting materials were deposited onto fluorine-doped tin oxide (FTO) substrates via spray coating to fabricate ~80% transparent electrochromic electrodes. These electrodes were assembled into electrochromic devices and evaluated for their charge insertion capacity, switching kinetics, and coloration efficiency. Nb_2O_5 nanostructures characterized by TEM, SEM, XRD, Raman spectroscopy, and UV–Vis analysis revealed that decreasing particle size improved crystallinity and enhanced electrochromic performance. The 10 nm Nb_2O_5 films exhibited the highest Li^+ diffusion coefficient of 5.37×10^{-14} cm^2/s and an optical modulation of 19% at 700 nm. Furthermore, they showed switching times with a coloration time of 13 s and bleaching time of 3 s, along with a coloration efficiency (CE) of 5.28 cm^2/C. In contrast, larger Nb_2O_5 particles (150nm) exhibited lower performance. These findings highlight the critical influence of particle size and morphology on the electrochromic properties of Nb_2O_5 and offer valuable insights into the design of next-generation smart window coatings through nanostructure control.

Biography

Mahnaz Dadkhah Jazi is a researcher with expertise in nanomaterials and electrochromic technologies, particularly in the development of materials for smart window applications. She currently is a PhD candidate at the University of Adelaide, School of chemical engineering, focusing on the research of next-generation electrochromic materials and their characterization using techniques such as UV-Vis, SEM, and XRD. Her research also extends to environmental pollutant degradation, contributing significantly to sustainable technology advancements. She has published extensively in high-impact journals, making notable contributions to the fields of nanotechnology, material science, and energy solutions.

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HIGH-SHEAR FLOW ENGINEERING OF METAL–ORGANIC FRAMEWORKS IN WATER TOWARD BIOSENSOR DEVELOPMENT

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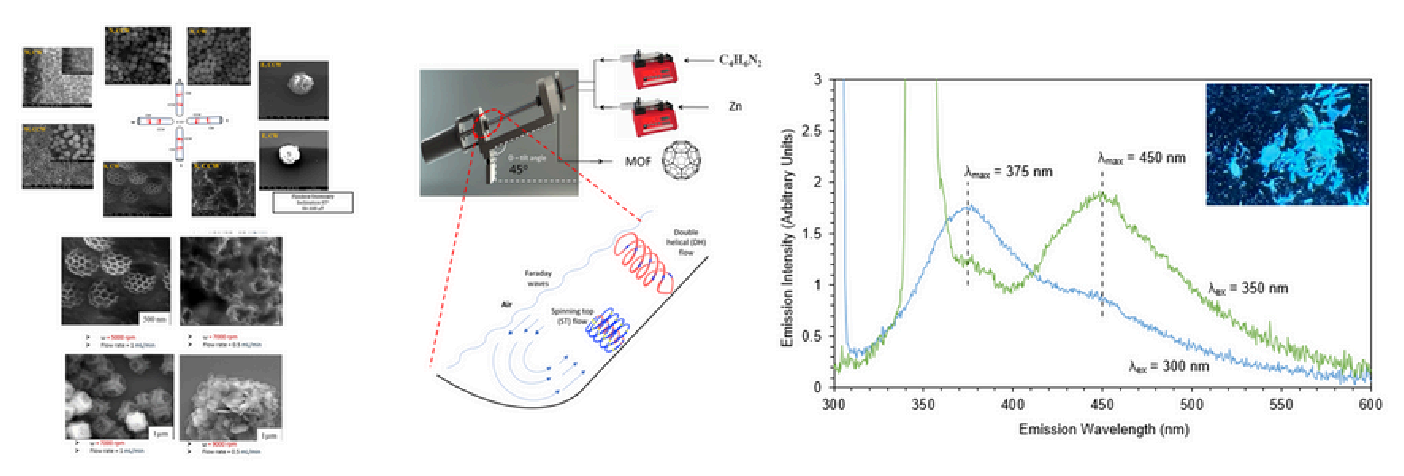
Abstract

This study introduces a novel synthetic process for preparing metal-organic frameworks (MOFs) under continuous flow conditions in a vortex fluidic device (VFD) [1]. The processing is conducted in water, in the absence of any added auxiliary substances or organic solvents, adhering to the principles of green chemistry. This approach enables the control of both the selectivity of MOF formation and the size and shape of the material. As such, the fabrication of the material is scalable, and the VFD itself is an energy-efficient microfluidic platform.The VFD induces mechanical energy in thin films of liquid associated with intense micromixing, which can be harnessed for material processing, as demonstrated herein. The MOF nano form upon adding aqueous imidazole and zinc acetate solutions, using water as the solvent (green chemistry). The imparted mechanical energy in the thin film is in the form of high-shear topological fluid flows of submicron dimensions, namely double helical and spinning top flows, Fig. 1. These topological fluid flows control the size and shape of the particles formed, which are impacted by the rotational speed of the tube, its tilt angle, and the concentration of reagents, and orientation of the rapidly rotating tube relative to the Earth's magnetic field. The principles of green chemistry are embedded in the research, including the use of less hazardous reagents and minimising waste generation [2,3]. The shapes of the MOF material depend on the operational parameters of the VFD, allowing access to various shapes, including prisms, doughnuts, 2D sheets, nanoparticles, and more. Different methods have been used to characterise the materials, including Raman spectroscopy, X-ray powder diffraction (XRD), and atomic force microscopy (AFM).



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[P10]

AUTOMATION OF LAYER-BY-LAYER CHEMICAL VAPOUR DEPOSITION OF FUSED SILICA CAPILLARY

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Abstract

The objective of this work was to develop an automated, reproducible layer by layer coating for fused-silica capillaries suitable for long-term, high-throughput coatings providing a low-electroosmotic flow (EOF) in capillary electrophoresis (CE)[1-4]. A previously developed vapor delivery system was redesigned by replacing the vacuum pump with a syringe pump and using ethanol and a 4:1 acetonitrile:H2O mixture to volatilise and optimise reagent delivery and silane hydrolysis[5]. Durability testing over ~4 080 separations (92 days) confirmed that the two-layer PDTA–GPTMS coating maintained acceptable repeatability (migration time %relative standard deviation (%RSD) = 4.8–10.6 for common anions) with 800 runs required for equilibration of the coating. Migration times were highly consistent across runs 801 – 4 080, with %RSD of 2–3 %. The fully automated CVD system (ACVD) achieved the lowest measured EOF values in this work: 13.2×10^{-9} m^2/V·s for GPTMS and 7.1×10^{-9} m^2/V·s for GPTMS-(PD-TA)1, the latter representing a 78 % reduction relative to uncoated capillaries. These findings demonstrate that solvent-vapor delivery, optimised solvent composition, and automated reagent handling yield robust, low- EOF coatings, laying the groundwork for scalable, unattended CE applications.

Biography

Mohamad Mayer is a 23-year-old analytical chemist starting his PhD in Chemistry at the University of Tasmania, Hobart. Under Professor Michael Breadmore, he developed an automated CVD system for uniform fused-silica capillary coatings. Mohamad has worked in industrial labs, also serves as a laboratory demonstrator and advocates for greater recognition of analytical chemists’ contributions to public health and safety. He is aiming to publish soon and advance portable CE tools for environmental sustainability. Outside the lab, he enjoys group activities, learning new languages, and mentoring aspiring scientists.

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[P12]

SCALABLE DEPOSITION OF CUBI OXIDE CATALYSTS VIA SOLUTION PRECURSOR PLASMA SPRAYING FOR ELECTROCHEMICAL CO_2 REDUCTION

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Abstract

The electrochemical reduction of CO_2 (CO_2RR) offers a promising route to storing intermittent renewable energy as value-added chemicals and fuels. However, the deployment of CO_2RR systems is limited by the lack of scalable and sustainable methods for catalyst fabrication. In this study, we investigate the application of solution precursor plasma spraying (SPPS)—a thermal spray technique not previously utilised in CO_2RR catalyst synthesis—to deposit Cu, Bi, and mixed CuBi oxide coatings onto carbon fibre substrates. Cu and Bi were chosen for their complementary CO_2RR product selectivities, with Cu favouring C–C coupling and formation of multi-carbon (C_{2+}) products, and Bi known for selective formate production while also helping suppress the competing HER. This work aims to investigate how product distribution varies with the Cu:Bi ratio. The resulting plasma-sprayed films form a compositional series of Cu_xBi oxides ($x = 3, 2, 1$), as confirmed by EDS and XPS, and exhibit coating thicknesses around 1 μm. Characterisation by XRD, SEM, and XAS reveals mixed-phase oxide structures across the series. Electrochemical evaluation to date includes linear sweep and cyclic voltammetry and chronoamperometry with product detection. Preliminary results show low CO_2RR activity for CuOx films, while BiOx coatings demonstrate high Faradaic efficiencies for formate at more negative potentials. Ongoing work will assess structure–activity relationships, with product analysis by NMR and GC, and electrochemical metrics including Faradaic efficiency, partial current density, ECSA, charge-transfer resistance, and long-term stability. This study provides the first insights into SPPS-deposited oxide catalysts for scalable CO_2RR applications.

Biography

Aaron Bourke is a PhD candidate at Swinburne University of Technology, where he is researching scalable fabrication methods for catalysts used in electrochemical CO_2 reduction. His current work focuses on the development of bimetallic coatings using solution precursor plasma spraying (SPPS) and magnetron sputtering. With a background in chemistry and materials science, Aaron is particularly interested in the intersection of energy storage, catalysis, and sustainable manufacturing. Beyond academia, he follows developments in the mining and energy sectors, with a growing interest in the economic and industrial impact of emerging clean technologies.

[P14]

PEROVSKITE OXIDES TO GENERATE RENEWABLE HYDROGEN FROM WATER AND SUNLIGHT

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Abstract

To prevent global temperatures rising by 1.5 °C by 2050, it is critical to develop cost-competitive alternatives to fossil fuels. Green hydrogen is a key renewable fuel – able to decarbonize the 25% of world CO_2 emissions which can't be electrified.[1] However, renewable H_2 is currently cost-prohibitive.
Photocatalysts are nanoparticulate semiconductors which absorb sunlight, splitting water into H_2 and O_2. Photocatalysts are simpler and cheaper than other methods for renewable H_2.[2] However, state-of-the-art photocatalysts fall short of the 5 – 10% conversion of sunlight to hydrogen (STH) needed for commercial viability. Fabricating photocatalysts which are active to the visible, and most abundant, region of sunlight is the most significant way to reach these STH targets.[3]
This work adopts the technique of doping Rh into the crystal structure of an ABO_3 perovskite, $SrTiO_3$, developed by Kudo et al.[4] Combined with a codoping strategy developed by Domen et al.[3] Briefly, the first strategy works by introducing Rh^{3+} states which modify the electronic structure of $SrTiO_3$ narrowing its bandgap and enabling visible light activity.[4] However, this technique also introduces Rh^{4+} defect states which facilitate charge-recombination, mitigating the improvements attained from doping. By codoping La with Rh, La^{3+} states are introduced which suppress the formation of Rh^{4+} states.[3]

Biography

Thomas Small, has recently submitted his PhD Thesis in the Department of Chemistry at the University of Adelaide. His research focused on designing and synthesising photocatalytic materials which could absorb the visible portion of sunlight. This aims to improve the commercial viability of photocatalytic water-splitting for hydrogen production.

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[P16]

DEVELOPMENT OF GREEN NANOSENSORS FOR REAL TIME DETECTION EMPLOYING BIOPHYSICAL TOOLS

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Abstract

Biomass waste precursor-based zero-dimensional nanomaterials have recently emerged as new frontiers in environmental science because of their green, cost-effective and simple methods of synthesis, coupled with their recyclability and practical uses. Herein, we have synthesized intrinsic nitrogen-functionalized carbon quantum dots (N-CQDs) using biomass waste through microwave-assisted pyrolysis technique. The synthesis protocol involved a renewable, easily-accessible carbon precursor (amla juice) conforming with green-and-sustainable synthesis. The presence of intrinsic nitrogen in amla juice led to the formation of surface-functionalized N-CQDs, as confirmed by XPS and FT-IR techniques that also indicated the presence of amino, hydroxyl, and carboxyl groups on the N-CQD surface. Morphological characterization of N-CQDs using high-resolution TEM imaging revealed spherical quantum dots with an average diameter of ~8.1 nm. The optical properties of N-CQDs were investigated using UV-Vis as well as steady-state and time-resolved fluorescence spectroscopy. The N-CQDs show green emission with remarkable quantum yield of ~48%. Moreover, the N-CQDs exhibit excellent colloidal, photo-stability, and environmental stability as a function of variable pH and ionic strengths. We also investigated the sensing potential of N-CQDs towards a diverse array of bioactive molecules. Our nanoprobe demonstrated a unique selectivity and sensitivity towards riboflavin (Vitamin B2) with a detection limit of 35 nM and we rationalized that fluorescence resonance energy transfer (FRET) primarily mediates N-CQDs-riboflavin interactions. Further, our nanosensor could also detect vitamin B2 in a commercially-available tablet with high efficiency. Overall, we believe that our novel green fluorescent nano-bio-sensor, synthesized via low-cost-and-green route, may have potential applications in biological and food industries.

Biography

Mandeep Kaur, PhD student at Thapar Institute of Engineering and Technology. Her research works focuses on exploring the interactions and binding mechanisms and photophysical properties of carbon dots and protein conformations induced by bioactive molecules.

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FROM CATCH TO CONCERN: THE PRESENCE OF PFAS (PER AND POLYFLUOROALKYL SUBSTANCES) IN AOTEAROA’S FRESHWATER FISH

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Abstract

When innovation is embraced before it is understood, the consequences for people and the environment can be disastrous. Once heralded for their water- and fire-resistant properties per and polyfluoroalkyl substances (PFAS) are now widespread in many ecosystems across the globe. Sometimes referred to as ‘forever chemicals’ their wide range of uses and remarkable resistance to degradation has allowed them to proliferate in food webs. There appears to be limited information on the presence of PFAS in New Zealand however, we know that they are present in some ground and surface water. This research begins to unravel some important questions about the fate and occurrence of these chemicals in New Zealand’s freshwater fish.

This study focused on three locations across the lower North Island where, based on global trends, PFAS contamination is likely: a military base, wastewater treatment plant, and fire station. Fish liver samples and individual health metrics were collected from fish caught upstream and downstream of these sites. Additionally, fish liver samples were provided by local fishing clubs in the lower North Island from areas popular for sport -fishing, with no known sources of contamination. The fish livers were tested for over 75 different PFAS at the Australian Laboratory for Emerging Contaminants in Melbourne. This data will begin to build a picture of PFAS concentrations, composition, and potential bioaccumulation in ecosystems of Aotearoa New Zealand. This talk will discuss the results and findings of this study as well as their significance for Aotearoa’s fish and those that consume them.

Biography

Carys holds a Bachelor of Science in Biological Sciences from the University of Canterbury and is currently studying towards her Master of Science in Ecology at Massey University. She is particularly interested in ecotoxicology and her master’s thesis focuses on PFAS contamination in freshwater fish. Prior to beginning her postgraduate research, Carys worked for the Canterbury Regional Council in land and resource management, and she is currently employed by Traverse Environmental as an environmental monitoring officer and data analyst. Carys is passionate about working at the intersection of science and policy, aiming to translate her research into meaningful environmental outcomes.

[P20]

DEEP LOW-FREQUENCY RAMAN SPECTROSCOPY FOR THE CHARACTERISATION OF BURIED APATITES

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Abstract

The current method for classifying breast microcalcifications involves a routine mammogram with a subsequent invasive needle biopsy. However, only around 20% of needle biopsies of microcalcifications result in a cancer diagnosis meaning a majority of microcalcifications are benign.[1] Microcalcifications are broadly classified into 2 classes being Type I (Calcium Oxalate) which are benign and Type II (Calcium Hydroxyapatite) which can either be benign or malignant.[2] Further to this there is established literature that correlates substitution of other ions (Metals and Carbonate) into the hydroxyapatite lattice as potential diagnostic tools.[3-5]

Therefore, there is a clear need for the development of non-invasive, diagnostic tools that can classify these microcalcifications in situ with great precision. Key metrics that have been used in the literature to discriminate between subclasses of type 2 calcifications surround crystallinity and carbonate content.[3, 4, 6] As such, commonplace techniques such as X-ray diffraction (XRD) and vibrational spectroscopy which can probe these factors have been applied rather easily, to already extracted specimens. Where the literature lacks however is both a single catch all technique to assess both carbonate content and crystallinity as well as its ability to detect these factors both in situ and non-invasively.

Two such relatively recently developed techniques that can be combined are low frequency Raman which probes phonon modes related to the long-range order of molecules as well as spatially offset Raman which has the ability to collect a Raman spectrum below an external layer. Preliminary results surround the comprehensive characterisation of substituted apatites and the construction of a free space low-frequency Raman system.

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POSTER SESSION B

ASSESSMENT OF SOME ORGANOCHLORINE PESTICIDES IN THE ROAD DUST FROM A METROPOLITAN CITY IN NIGERIA: AKURE AS A CASE STUDY

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Abstract

Environmental pollutants are on the rise as a result of various developments in major cities in terms of infrastructure development, industrialization, and population shift from rural to urban areas. Organochlorine (OC) pesticides are popularly used in the agriculture and the health sectors. Due to its numerous environmental, ecological, and health risks, they have been banned. There is paucity of data on OCPs in the City under investigation, hence the need to assess their concentrations in road dust. Samples were taken from seven different locations and analysed using standard methods. The following OC pesticides congeners - α-HCH, β-HCH, γ-HCH (Lindane), and δ-HCH, popularly called the hexachlorocyclohexane were analysed. Their concentrations are in the following range: BDL – 2.272 µg/kg for α-HCH, BDL – 10.080 µg/kg for β-HCH, 4.872 – 31.834 µg/kg for γ-Lindane, and BDL for δ-HCH. The highest is from the sampling location 7 (SL 7) while the least is from the sampling location 5 (SL 5). The highest Σ HCHs is from the sampling location 7 (SL 7) (41.914 µg/kg) while the least is from the sampling location 3 (SL 3) (7.146 µg/kg). The order of increase of the HCHs with the locations is SL 7 > SL 3 > SL 2 > SL 4 > SL 6 > SL 5 > SL 1. The presence of lindane is predominance in the road dust samples which is capable of causing several environmental and human health problems.

[P3]

BREWER'S WASTE ISN'T SPENT: CAPTURING THE STRUCTURAL COMPLEXITY OF HORDATINES IN BREWERY WASTE PRODUCTS

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Abstract

Global beer production generates over 38 million tonnes of waste annually, primarily as brewer's spent grain and barley malt rootlets, which are typically used as low-value animal feed or discarded to landfill. These waste products contain hordatines, a unique class of phenolamides expressed in barley that are thought to contribute to the astringent flavour of beer and exert antifungal activity. Formed via the dimerization of hydroxycinnamoyl agmatines, hordatines are categorised into four main structural types (A, B, C, D) that can be further modified via hydroxylation, methylation and glycosylation. However, the full extent of hordatine structural variation has not been explored. In this work, liquid chromatography coupled to drift tube ion mobility mass spectrometry is used to study hordatines isolated from brewery waste products for the first time. 169 unique hordatine structures could be identified in a single sample by accurate mass, with extensive isomerism captured by the added dimension of ion mobility. Clear structural trends among these compounds were apparent, with these tentatively assigned to previously characterised stereoisomers resulting from the hydroxycinnamoyl agmatine dimerization process, with in silico collisional cross section calculations supporting this. This work demonstrates the immense structural heterogeneity of hordatines in brewery waste products and gives insight into the underlying chemistry that controls their biosynthesis. Understanding the chemical composition of brewery waste products will enable their transformation into value-adding commodities in the food and health industries, reducing global waste and leading us closer to a circular economy.

Biography

With a background in plant metabolomics and lipidomics, River's research employs various mass spectrometry-based techniques, including HPLC-DAD-MS, IM-MS, MALDI-MS and GC-MS to profile and structurally interrogate complex biological matrices in the context of agriculture, food science and the environment. River currently works across multiple projects that include profiling foliar cuticular waxes in grain crops, characterising novel metabolites in barley and deconstructing cell wall components from brewery waste products. River was awarded his PhD in 2024 from the University of Adelaide under the supervision of Prof. Tara Pukala and Prof. Vincent Bulone.

[P5]

ESTIMATION AND HEALTH RISK ASSESSMENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN LOCALLY-ROASTED MEATS MARKETED IN ZARIA METROPOLIS, NIGERIA

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Abstract

Locally-roasted meat sellers use woods, plastics and charcoals in processing, packaging, drying, smoking, roasting, grilling and frying. Such fuels contain Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are carcinogenic and teratogenic. The study investigates the concentrations of PAHs in roasted meats. Six markets; AM, ZM, DM, TM, SM and SBM were sampled. GC-MS and FT-IR were used for the analysis. Anthracene was the highest in AM (15.86 µg/kg), exceeding the standard ($P<0.05$) suggesting pyrogenic combustion-related PAHs. Benzo[a]anthracene was highest in AM and SM, indicating exposure to combustion by-products. PAHs, benzo[a]pyrene was highest in AM (0.048 µg/kg), below the USEPA (0.2 µg/kg). Fluoranthene and Pyridine in TM and SM. Naphthalene in SM (62.04 µg/kg) is associated with petroleum residues and indoor combustion. Significant differences ($P<0.05$) for antrhracene, benzo[b]fluoranthene and fluorene are due to vehicular emissions, open burning and roasting methods High levels of PAHs in AM and SM, pose health risks. The FT-IR spectra are similar but differ in transmittance. The FT-IR functional groups of aliphatic C-H stretching at 2922 and 2855cm^{-1}, showed the presence of aliphatic chains, typical in lipids. Bendings in methylene C-C vibrations at 1461cm^{-1}, in methyl at 1379cm^{-1}, C-O and C-N stretching at 1237, 1159 and 1095cm^{-1}, Out-of-Plane C-H bending at 827 and 723cm^{-1}, meaning that DM and SM have PAHs similar. Benzo(a)pyrene and the aromatic compounds with high-temperature cooking underscore the need for monitoring and implementation of safety standards. The FTIR supports the evidence of PAHs and lipid oxidation products in roasted meats, highlighting the impact of cooking methods on food safety

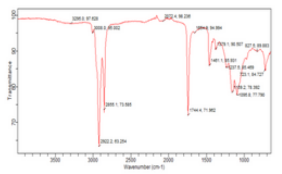

Fig.1: FT-IR spectra pf the sample obtained at Amaru market point-1

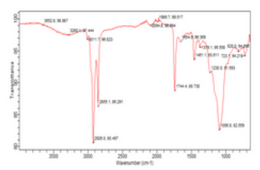

Fig.2: FT-IR spectra of the sample obtained at Amaru market point-2

Biography

I was born on the 15th day of July, 1968 in Kiyawa, Kano state. I have been a Professor since 1st January, 2023 and Head of Chemistry Department, Northwest University, Kano – Nigeria. I held several administrative positions in all places I work, including Nigeria and Uganda. My areas of research are in Analytical and Bioanalytical chemistry and have published several local and internal journals of reputable standards. I speak languages including, Hausa, Fulfulde, English, French, Arabic and Hindi / Urdu. One of my best hobbies is travelling.

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A STABILITY STUDY OF URINARY ALBUMIN CONTENT IN FRESH CLINICAL SAMPLES ON PROLONGED STORAGE AT – 20 °C AND – 80 °C USING UV/VISIBLE SPECTROSCOPY

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Abstract

Albuminuria–the pathological elevation of albumin in urine–represents a critical early biomarker for renal dysfunction in diabetic kidney disease (DKD) and various forms of chronic kidney disease (CKD). As the most clinically validated surrogate endpoint for DKD progression, precise quantification of urinary albumin concentration is fundamental for early detection, risk stratification, and therapeutic monitoring of kidney impairment.

Here, we systematically evaluated the temporal stability of urinary albumin under common storage conditions using high-precision UV-Visible spectroscopy. Twenty-two fresh clinical specimens spanning both normoalbuminuria (<30 mg/L) and microalbuminuria (30-300 mg/L) ranges were analyzed with a NanoDrop One spectrometer immediately after collection and following 8 and 16-week storage intervals at -20°C and -80°C without prior processing. We observed progressive, time-dependent reductions in detectable albumin concentrations across all storage conditions, with significant degradation occurring by 16 weeks. Our findings establish that optimal preservation of urinary albumin integrity requires storage at -80°C with analysis within 8 weeks of collection.

These results highlight the previously underappreciated impact of pre-analytical variables on albuminuria assessment and have immediate implications for clinical practice, biobanking protocols, and longitudinal research studies. Implementation of standardized handling procedures based on these findings could substantially enhance the reliability of this essential biomarker, ultimately improving risk assessment and clinical decision-making in kidney disease management.

NEW OPTICAL SENSOR FOR THE RAPID DETECTION OF CR (VI) POLLUTION IN THE ENVIRONMENT

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Abstract

Detecting hexavalent chromium (Cr (VI)) pollution in water is important for environmental and public health. In this work, we present a new chromium sensitive isoindigo dye and low-cost paper sensor that can sensitively and selectively detect Cr (VI) in water. The disposable paper sensor successfully detected Cr^{+6} ions in water down to a low limit of 0.1 μM, which is lower than the limit set by the World Health Organization of 0.960 μM[1]. The new sensor is, therefore, a valuable new tool for monitoring water quality at the field especially when combined with handheld Fluorescence spectrometer technology.

Biography

*Fatimah Alzubaidi is a PhD researcher at QUT, researching novel nanomaterials and sensors for detecting heavy metals and disease biomarkers.
*Qian Liu, an ARC DECRA Fellow/Lecturer at QUT, specializes in organic synthesis, solar energy, semiconductors, and flexible organic bioelectronics.
*Sergei Manzhos, Associate Professor at Tokyo Institute of Technology, focuses on computational modeling of materials.
*Prashant Sonar, an ARC Future Fellow and Professor at QUT, is an expert in organic synthesis.
*Emad L. Izake, Associate Professor at QUT, his research focuses on novel materials and sensors for environmental, biomedical and hazard control applications.
*Godwin A. Ayoko, Professor of Chemistry at QUT, specializes in environmental analytical chemistry.

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HYDROGENATION OF ALKENES AT LOW H_2 CONCENTRATIONS USING PHOTOCATALYTIC SOURCES

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Abstract

Hydrogenations typically occur at high-pressures to increase the low solubility of hydrogen gas (H_2) in the organic solvent allowing H_2 to interact directly, in suitable quantities, with the metal catalyst surface in solution. This interaction occurs via the Horiuti-Polanyi mechanism[1] where the H_2 dissociates on to the surface, the alkene substrate binds to the metal, and the hydrogen atoms transfer to the substrate resulting in the alkane product. Given that the rate determining step in this mechanism is the final step, then from an experimental point of view, all you need to do is supply enough H_2 to replace any hydrogen atoms that have been used in the hydrogenation catalysis. This opens up the possibility of using low-concentration H_2 sources in hydrogenation catalysis. Photocatalytic water splitting using metal oxide semiconductors results in the generation of hydrogen and oxygen gases via water reduction and oxidation reactions.[2] If you use a suitable sacrifical agent such as methanol in such a system, then this stops the oxidation reaction and you end up with a low-concentration photocatalytic H_2 source which could be utilised further. Here, we introduce a novel dual-catalysis reactor design that integrates a photocatalytic hydrogen source with a hydrogenation reactor. This setup enables complete conversion of both activated and unactivated alkenes to their corresponding alkanes using exceptionally low hydrogen concentrations at atmospheric pressure.

Biography

I am currently working on a PETRONAS-funded project at the University of Adelaide, where I design and build reactor systems to investigate bespoke photocatalytic materials for H2 production and hydrogenation. This follows my previous role as a senior lecturer in inorganic chemistry at the University of Brighton from 2014 to 2023, and my postdoctoral research fellowship at Monash University from 2008 to 2013. I completed my PhD in inorganic chemistry at the University of Edinburgh from 2005 to 2008.

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ECO-FRIENDLY SANITISERS BORN FROM LIGHTNING: PLASMA-ACTIVATED WATER AS NOVEL FOOD SANITISATION APPROACH

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Abstract

Foodborne pathogens pose a major threat to Australia's public health and economy, causing an estimated 4.7 million illnesses and costing $2.81 billion annually[1,2]. Conventional sanitisers are limited by environmental burden, harmful residues and reduced effectiveness, highlighting the need for safe, effective alternatives.

Plasma-activated water (PAW) is an innovative sanitiser generated by exposing water to energised gases, creating reactive oxygen-nitrogen species with potent antimicrobial activity. PAW may overcome the limitations of current chemical sanitisers.

We hypothesised that PAW exhibits antimicrobial efficacy against key foodborne pathogens, Listeria monocytogenes and Escherichia coli. We aimed to characterise the physicochemical properties, antimicrobial efficacy and stability of different PAW formulations over a 90 day period.

PAW generated for 60 and 90 minutes was assessed for pH, conductivity, oxidative reductive potential (ORP) and concentration of nitrogen species via UVVIS spectrophotometry throughout storage. Antimicrobial efficacy was determined through time-kill experiments on planktonic L. monocytogenes ATCC 13932 and E. coli ATCC 25922 (24h growth at 37°C in heart infusion broth).

Longer PAW generation times correlated with lower pH and increased conductivity and ORP. Additionally, pH and nitrogen species showed stable readings throughout the study's duration. PAW generated for 90 minutes achieved up to 6-log reductions in both species, while 60-minute PAW reduced L. monocytogenes by 5.34 ± 0.67 logs and E. coli by 6.06 ± 0.07 logs.

PAW demonstrated strong, stable antimicrobial activity and maintained key physicochemical properties for 90 days. These findings support its potential use as a safe and effective food sanitiser.

Biography

Bjoern Hendrik Kolbe is a PhD student at the University of Adelaide in the research group of A/Prof. Katharina Richter. His background is in applied material science and dental technologies. Based on his previous experience in plasma technology, he currently researches and optimises plasma-activated water towards a suitable industry application as an efficient food sanitiser.

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METHACRYLATE-BASED POLYMER INKS FOR 3D PRINTING OF POROUS MONOLITHS

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Abstract

Porous polymer monoliths are single pieces of porous material with an inherent network of interconnected pores, making them ideal for applications that require tunable properties and a high surface area, ranging from chromatographic separation columns to biosensing applications.[1] As such, optimising their properties and developing efficient, precise methods for their fabrication, in particular additive manufacturing (3D printing), has become an area of significant interest.[2]
Methacrylate-based systems are well-reported in this context, but this project investigates the suitability of a novel photocurable system, based on the monomers glycidyl methacrylate (GMA) and ethylene glycol dimethacrylate (EDMA) with solvents dioxane and dodecanol. To identify formulations of inks leading to optimal monoliths, the proportions of ink components, including overall porogen content, are varied, with monolith transparency used as an indicator of indicator of a polymerisation-induced phase separation mechanism, whilst modulation of the ratio of the two porogenic (pore-forming) solvents is used to control pore size in the cured material. The performance of the inks in 3D printing is evaluated through parameters such as cure time, printing resolution and ink viscosity. Measurements of mechanical strength, surface area, and post-printing chemical modifiability investigate the physical properties and quality of the printed monoliths. The results of the study aim to assess the effectiveness of this chemical system for 3D printing high-quality porous monoliths.

Biography

Third-year undergraduate Integrated Masters student in Chemistry at the University of Bath, United Kingdom and former chair of the University of Bath Chemistry Society. Currently visiting Australia to undertake a year-long industrial placement as a student researcher at Future Industries Institute, University of South Australia. Research has focused on the additive manufacturing, testing and characterisation of porous polymer monoliths under the supervision of Dario Arrua and Jing Zhang. Previously presented work at the SA Materials, Polymer and Physical Chemistry Symposium 2025.

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DEVELOPMENT AND VALIDATION OF A MULTI-CLASS SPE–LC-MS/MS METHOD FOR QUANTIFICATION OF CONTAMINANTS OF EMERGING CONCERN IN DIVERSE WATER MATRICES

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Abstract

A robust and highly sensitive analytical method was developed and validated for the simultaneous quantification of 39 multi-class contaminants of emerging concern (CECs) across six environmentally relevant water matrices, enabling trace-level analysis of diverse compound classes, including industrial chemicals, pharmaceuticals, personal care products, and pesticides. The experimental workflow integrates solid-phase extraction with liquid chromatography tandem mass spectrometry (LC-MS/MS), following rigorous optimization of extraction conditions, evaporation parameters, and mobile phase composition under both positive and negative electrospray ionization. Comprehensive validation confirmed excellent linearity ($R^2 > 0.99$), low method detection limits (MDL) (0.01–1.23 ng/L), and quantification limits (MQL) suitable for trace monitoring. Instrumental detection limits reached sub-femtogram levels for selected analytes, highlighting the method's exceptional sensitivity. Recoveries ranged from 70-130% with relative standard deviations <15% across all matrices, demonstrating method accuracy and precision under both intra- and inter-day conditions. This validated method offers a reliable platform for multi-residue quantification of CECs in complex environmental matrices. It is ideally suited for monitoring studies, source tracking, regulatory compliance, and risk assessment applications requiring ultra-trace sensitivity, high selectivity, and broad chemical coverage.

Biography

Madara Weerasooriyagedara is a PhD researcher in Chemistry at the University of Melbourne, specialising in advanced environmental analytical chemistry. Her work pioneers targeted and non-targeted LC-MS/MS methodologies for contaminants of emerging concern (CECs) in wastewater. She has developed high-performance solid-phase extraction (SPE) protocols, quantified seasonal and spatial occurrence patterns, and conducted ecological risk assessments to inform water quality policy. Madara's research integrates methodological innovation with applied environmental monitoring, contributing to sustainable water management strategies. Her scientific contributions position her as an emerging expert in contaminant surveillance and environmental risk evaluation in Australia and globally.

[P19]

COAL GANGUE ASH-BASED GEOPOLYMER: SYNTHESIS AND APPLICATION FOR THE REMOVAL OF WATER-SOLUBLE DYE POLLUTANTS

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Abstract

Coal gangue is one of the most important mineral wastes produced during coal mining and washing, accounting for about 10–15% of total coal production. Due to its extensive deposition, it poses significant environmental challenges such as land occupation, soil degradation, and leaching of harmful substances. Various strategies have been proposed to mitigate such impacts, including recycling in construction materials, extraction of valuable minerals, and use in alkali-activated binders. Utilization of such wastes in geopolymer synthesis not only reduces waste volume and related pollution but also contributes to material cycling and sustainable development. Geopolymers have also emerged as strong candidates for pollutant adsorption due to their sustainability, environmental friendliness, and low cost. These materials are synthetic alkali aluminosilicates formed by reacting silica- and alumina-rich solids with alkaline solutions. In this study, coal gangue from Mazandaran province, Iran, was used as the aluminosilicate source. Different synthesis conditions were tested, and the optimal parameters were identified as: heat treatment at 800 °C for 4 h, alkaline activators of sodium hydroxide and sodium silicate at 1:1 ratio, and a solid-to-liquid ratio of 0.4. The adsorption performance of the prepared geopolymer was evaluated using methylene blue as a model dye at initial concentrations of 100 and 200 $mg.L^{-1}$, yielding removal efficiencies of 84.5% and 92.6%, respectively. Overall, the results confirm that coal-gangue-based geopolymer is an efficient and sustainable option for water treatment, with additional potential in construction materials.

Biography

Amirreza Azadmehr has Ph.D. in Inorganic Chemistry, Although the subjects of his MSc and Ph.D projects were about the synthesis of organometallic compounds based on alkoxides (organotin) in order to prepare precursors for the synthesis of anticancer drugs, but as a faculty member at Amirkabir University of Technology (Since2009), his research interests revolve around developing innovative solutions to address pressing environmental challenges especially in the field of waste and effluents from mines and mineral processing factories. By harnessing the unique properties of minerals (mineral in slag, dust, sludge and tailing). He aims to develop efficient and sustainable methods for pollution control and remediation, based on creating a cycle of materials from the removal of mine waste and tailing to the production of inorganic compounds. So that he uses adsorption and photocatalytic degradation methods to achieve this goal.

In the field of water and wastewater treatment, Amirreza is interested in synthetic Geopolymers based on minerals. His work in this area has led to the development of novel materials that offer improved adsorption and filtration capabilities, revolutionizing the way water and wastewater are treated.

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