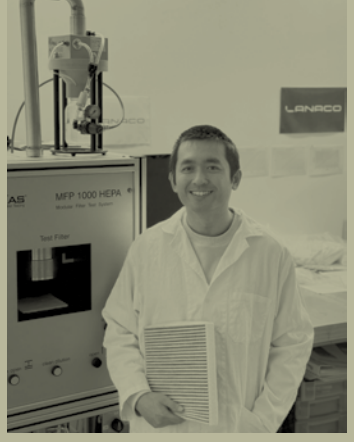
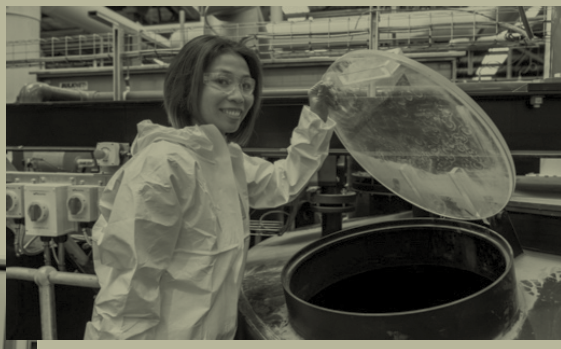


Our *Inspired* 100

MacDiarmid Institute Annual Report 2024



MacDiarmid Institute
2024 Annual Report

Contents

Nicola Gaston and Justin Hodgkiss

CO-DIRECTORS

In 2024 we reached the mid-point of our current funding cycle. Early in the year we examined research outcomes from projects we started in 2021, firstly with a self-review, and then via an expert external review by our International Science Advisory Board (ISAB). In their report, our ISAB congratulated the Institute on “a high level of delivery”, and said it was clear that the Institute had “not only built upon and grown all of its goals and milestones, but is a bastion of progressive thinking and stability”.

The timescale on which research comes to fruition can be challenging. But over the course of 2024 we have seen challenging milestones being met, and real advancements in knowledge and capability being produced. This evidence then led to the collective determination of new projects — 2025 to 2028 — bringing into the Institute a new cohort of PhD researchers.

The ISAB also told us how impressed they were with the skillset, enthusiasm, and achievements of our graduates — reminding of us of Alan MacDiarmid’s frequently quoted statement that “science is people”.

Recalling the words of our founding Director, Sir Paul Callaghan — who said “a hundred inspired New Zealand entrepreneurs could turn this country around” — we created a list to celebrate our alumni who are indeed contributing to the deep tech sector here in Aotearoa New Zealand, (QR code adjacent). You’ll note it now has well over a hundred alumni listed!

We congratulate all our alumni for the impact they are making and thank them for their generosity in allowing us to showcase their contribution to so many different parts of what is now an effective, efficient and growing deep tech ecosystem.

As then Minister of Research Science and Technology, Hon Judith Collins, said at the launch of the Cleantech Report at our Techweek event at Parliament: “there are many cases of NZ science PhD graduates populating the deep tech sector in this country, running start-ups, and working within wider industry”. The Minister also noted “the crucial role NZ science can play in transforming our economy through cleantech and deep tech commercial solutions”. Minister for Climate Change, Hon Simon Watts was blunt about the opportunity: “we can lead in this space. We should use the amazing capability in our country and in this room”.

Finally – it has been a privilege and an adventure for us to be the Co-Directors of the MacDiarmid Institute over the last six years. We are really proud of everything that the Institute whānau have achieved in that time, and confident that we can embrace change positively in the knowledge that there are many exciting ways to contribute to the deep tech ecosystem in New Zealand.

Follow this link to read about 'Our Inspired One Hundred'.

Hēmi Rolleston

BOARD CHAIR

Tēnā koutou katoa

I am delighted to bring you my third Chair’s report. Once again, I am amazed firstly by the calibre of inspiring passionate people involved with the Institute, and secondly by the research being undertaken towards our common goal.

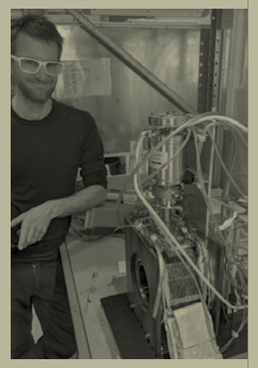
Like every year, one thing that is constant is change, and we have farewelled some very key people. First and foremost, my fellow board members Joe Manning (GNS representative 2018-Jan 2025) and Ian Wright (University of Canterbury representative 2021-2024). Alongside that we farewelled Professor Justin Hodgkiss who has made a huge contribution to the Institute over a significant period of time, firstly as Deputy Director Commercialisation and Industry Engagement from 2015-2017, and then as Co-Director from 2018-2024, all the while running a large research group, and building his own start-up company Advemto along the way. We wish him all the best with Advemto and look forward to hearing of his success in the commercialisation arena. While saying a fond haere rā, we also said a big haere mai to Blanche Morrogh and Marny Reakes who joined the Board as independent directors bringing great new expertise and energy. We were also very pleased to welcome Nicola Gaston into the role as the sole Director.

I invite you to read and celebrate the Institute’s achievements. It gives me great pleasure to see the ongoing success of the Discovery Scholarship programme (which has now run for five years, 2020-2024) and to watch these rangatahi go on to further study in the sciences. We couldn’t do this alone, and I extend a warm welcome to our newest co-sponsor Spirax Sarco who, along with our longtime co-sponsor GNS Science, enable us to do this important mahi.

It’s impressive to see the impact of the tranche one research coming through in the science stories within this report, and to read about the continued success for our researchers in the commercial sphere, to see the impact of our outreach grow for example in the deepening relationships in Northland, and to watch our graduates ‘fly’ as they take off into the world, especially - referencing the words of Sir Paul Callaghan – celebrating the achievements of ‘Our Inspired One Hundred’, our alumni who go into the world of deep tech here in Aotearoa New Zealand.

1.

Te Moana Nui a Kiwa



This year in Te Moana Nui a Kiwa we reflect on our people, our relationships and the remarkable achievements we've made together.

Key highlights include welcoming Spirax Sarco as a new co-sponsor for our Discovery Scholarship programme, alongside continued support from Geological and Nuclear Sciences (GNS) Green Hydrogen Platform. These partnerships are integral to the growth and success of our scholarship programme.

Celebrating continued success for our Discovery Scholarship community

We are grateful for our co-sponsors' support with the Discovery Scholarship programme, for Māori and Pacific Island students in science. This is an extension of our long running DiscoveryCamp programme that supports students studying in the fields of physical sciences, chemical and materials engineering, Māori sciences and sciences related to sustainable innovation.

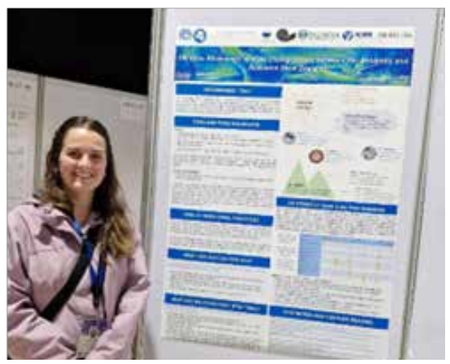
This year, we proudly celebrate the achievements of our Discovery Scholarship alumni. Their accomplishments reflect their passion and commitment to contributing across their fields of research and study.

Nicky Hambrook (Kāi Tahu) has completed her Master of Science in biochemistry at Te Whare Wānanga o Waitaha University of Canterbury under the supervision of Associate Investigator Professor Renwick Dobson. Nicky earned an A-grade for her research on the targeting of novel fungal effector proteins during *Austropuccinia psidii* (myrtle rust) infections. Her work not only enriches scientific understanding but holds significant potential for real-world applications in plant health and biosecurity.

Alyssa Thomas (Patuharakeke) attended the XI SCAR Open Science Conference in Pucón, Chile. This prestigious conference, focused on Antarctic research, featured a wide array of presentations and posters across numerous scientific disciplines. Alyssa presented her poster, titled 'He Tohu Āhuarangi: climate change signs between Antarctica and Aotearoa (New Zealand)', which was a collaborative effort with Professor Ocean Mercier (Te Herenga Waka Victoria University of Wellington) and Dr Sarah Seabrook (NIWA). This experience highlighted Alyssa's valuable contributions to the global scientific community and showcased her research on an international platform.

Additionally, Alyssa celebrated the recent publication of her first academic paper, 'Helping the "Helping hands": supporting Māori postgraduates to advance community aspirations for environmental research.' This collaborative case study, developed with her supervisor and research colleagues, emphasises the importance of incorporating cultural perspectives into scientific research.

Georgia-Rae Jones (Te Arawa, Ngaati Whakaue, Waikato-Tainui, Ngāpuhi, Ngāti Mutunga) has celebrated her graduation from Te Wānanga Aronui o Tāmaki Makaurau Auckland University of Technology with a Bachelor of Science majoring in environmental science. Reflecting on her experience, Georgia-Rae shares: "Graduation was a very surreal experience, and the day went by incredibly fast. It all happened so quickly. I was busy having my photos taken that morning, rushing around and before I knew it, I found myself standing on stage, holding my certificate with a mix of excitement and disbelief. I was so grateful to be surrounded by my whānau and friends on the day."



Alyssa Thomas in Chile.

Georgia-Rae will continue with postgraduate studies and begin studying for a Master of Science with a specialisation in in geospatial science. She is currently doing a summer internship with Principal Investigator and Deputy Director Māori Associate Professor Pauline Harris (Rongomaiwahine, Ngāti Rakaipaaka, Ngāti Kahungunu).

These accomplishments are just a snapshot of the extraordinary drive and talent among our Discovery alumni. Their successes—ranging from pioneering research and global presentations to published work—highlight their capabilities. We are immensely proud of how they continue to forge new paths, build partnerships and inspire future generations.

Georgia-Rae Jones at graduation.

A huge acknowledgement and thanks to our co-sponsors, the GNS Science Aotearoa: Green Hydrogen Platform and Spirax Sacro. These partnerships are integral to the growth and success of our scholarship programme.

In 2024 we offered 18 scholarships across the following categories: Te Huarahi Ki Mua Award for previous Discovery Scholarship recipients; Te Mātauranga Pūtaiao Award (Māori Science Award); Te Taumata Award (High Achiever Award); Piki Ake Award (Step It Up Award); Te Kainga Rua Award (Second Chance Learner Award).

- 3 Piki Ake Award - Step It Up Award recipients
- 1 Te Kainga Rua Award - Second Chance Learner Award recipient
- 4 Te Mātauranga Pūtaiao Award - Māori Science Award recipients
- 4 Te Taumata Award - High Achiever Award recipients
- 6 Te Huarahi Ki Mua Award recipients

Spirax Sarco representatives attended the 2023 MacDiarmid Institute Symposium. From left: Associate Professor and Deputy Director Māori Pauline Harris, Spirax Sarco representative Chris Probert, Strategic Manager Māori Kirsty Doyle, and Spirax Sarco Representative Sharon Shah.

Global Young Scientists Summit 2024:

A transformative experience for emerging researchers

The Global Young Scientists Summit (GYSS) in Singapore is an annual event that draws together outstanding young researchers and world-renowned scientific leaders to explore the latest in science, technology and solutions to pressing global challenges. This year, MacDiarmid Institute Discovery alumna Juliet Nelson (Ngāti Tūwharetoa, Ngāti Raukawa) attended the summit.

Juliet, who is currently completing her Master of Science under the mentorship of Co-Director and Waipapa Taumata Rau University of Auckland-based Principal Investigator Professor Nicola Gaston, describes the GYSS as an unparalleled opportunity for learning and connection. “The summit is intended to be a platform for younger scientists and researchers,” she notes, emphasising the multidisciplinary nature of the event and the breadth of expertise represented.

The five-day summit featured a packed schedule of talks, panel discussions, site visits and small group discussions. Participants had the unique chance to engage directly with distinguished scientists, including Nobel Prize laureates, Fields Medallists, Millennium Technology Prize recipients and Turing Award winners. Juliet highlights the welcoming atmosphere created by the speakers, stating, “My highlight speaker was Klaus von Klitzing, the 1985 Physics Nobel Prize winner. He was extremely warm and welcoming, as well as being full of optimism with regards to future career advice.”

Networking and knowledge exchange were key components of the summit. Attendees benefited not only from formal presentations but also from social events designed to foster informal conversations and collaborations. “The organisers certainly kept us busy, and there was a lot to take in!” Juliet says. The summit’s multifaceted approach provided a comprehensive view of current and future scientific challenges, as well as potential avenues for impactful research.

Juliet expresses her gratitude to the MacDiarmid Institute for supporting her participation in the GYSS. “Thank you again to the MacDiarmid Institute for the encouragement and funding to attend this conference!” she says, encouraging other early career scientists to seize the opportunity to attend in future years.

GYSS 2024 not only offered Juliet and other attendees a chance to gain knowledge and inspiration from some of the brightest minds in science but also reinforced the importance of collaboration and innovation in addressing global challenges.

Connecting Earth and sky

Deputy Director Māori Associate Professor Pauline Harris has been awarded the prestigious Murray Geddes Memorial Prize by the Royal Astronomical Society of New Zealand (RASNZ). This annual award recognises individuals who have made outstanding contributions to the field of astronomy within Aotearoa New Zealand, and Pauline’s extensive achievements in astrophysics, cosmology and education earned her this distinguished honour. Pauline’s notable body of work spans multiple facets of astronomy. One of her most impactful contributions has been to the field of Māori astronomy, which has fostered deeper cultural connections and enhanced the recognition of indigenous knowledge systems. A key part of this work involved championing the establishment of the Matariki public holiday in New Zealand.

Matariki, known as the Māori New Year, is celebrated when the Pleiades star cluster rises in the mid-winter sky. This event holds profound cultural significance, serving as a time for reflection, remembrance and renewal. Beyond its astronomical importance, Matariki embodies themes of environmental sustainability and interconnectedness. Traditionally, it marks a time when Māori would assess resources, acknowledge the past year’s harvests and plan for sustainable practices to ensure future prosperity.

In contemporary celebrations, Matariki reinforces the importance of living in harmony with the natural world. It invites communities to consider their relationship with the environment and to embrace sustainable practices that preserve resources for future generations. Pauline’s work has highlighted this intrinsic link.

Her efforts in revitalising Māori astronomy, maramataka, and in promoting Matariki as a public holiday not only brought Māori knowledge to the forefront but also underscored how traditional astronomical practices can inform and inspire modern approaches to sustainability. By connecting the celestial to the terrestrial, Pauline has made significant strides in showing that the wisdom embedded in cultural traditions holds valuable insights for contemporary challenges.

In addition to her research and advocacy, Pauline has dedicated herself to astronomy education and outreach. She has inspired countless students and community members through workshops, public talks and educational initiatives that bridge complex astronomical concepts with accessible learning.

Pauline’s receipt of the Murray Geddes Memorial Prize — a prize awarded by the Royal Astronomical Society of New Zealand in recognition of the recipient’s significant contributions to astronomy in Aotearoa — is a testament to her exceptional contributions to New Zealand's astronomical landscape. Through her work, she continues to illuminate not just the night sky but also the connections that bind us to our environment and cultural heritage.

Pauline Harris receives the Murray Geddes Memorial Prize. (From left) President of the RASNZ Nalayini Brito-Davies, Deputy Director Māori Pauline Harris, and nominator and Regional Coordinator (Oceania), DarkSky International Gareth Davies.

Merging tradition and innovation: Derek Kawiti's impact through *The Drawing Board*

Professor Derek Kawiti (Ngāti Hine, Ngāpuhi, Tūhoe, Ngāti Porou), an esteemed Te Herenga Waka Victoria University of Wellington-based Principal Investigator, has made significant strides in the realm of indigenous innovation and community empowerment. He is the driving force behind the programme *The Drawing Board*, which airs on Whakaata Māori, showcasing initiatives that blend traditional knowledge with modern problem-solving.

The Drawing Board serves as a platform where emerging Māori thinkers and leaders present their innovative solutions to various challenges, ranging from environmental sustainability to cultural preservation and economic development. The programme not only highlights practical and creative ideas but also fosters discussions that bridge the gap between ancestral wisdom and contemporary needs. Through *The Drawing Board*, Derek aims to create a space that celebrates Māori ingenuity, encourages collaboration and inspires future generations to explore solutions that are grounded in their heritage while addressing modern realities.

As host of *The Drawing Board*, he continues to illuminate pathways that merge innovation with tradition, empowering Māori communities to shape their future with confidence and creativity.

"Māori have always understood that no matter the natural environment, the spaces we consciously create, or unconsciously leave behind, powerfully influence the success of our living environment."

Professor Derek Kawiti, Principal Investigator

The Karioi Report: A landmark achievement in geoscience and cultural collaboration

The Karioi Report marks a significant milestone in geological research and intercultural collaboration, led by Dr Oliver McLeod and GNS Principal Investigator Diane Bradshaw (Ngāti Te Wehi, Ngāti Mahuta hapū of Waikato Tainui, Te Uri o Hau ki Te Rarawa). This groundbreaking study presents the first comprehensive geologic map of Karioi maunga, an extinct stratovolcano near Raglan in the Waikato region of Aotearoa New Zealand. The research draws upon over 30 years of meticulous field surveys, incorporating interviews with kaumātua, advanced petrology, aeromagnetic data and radiometric dating.

One of the report's key highlights is its 1:25,000 scale map, showcased on a high-resolution, hill-shaded LiDAR base, which documents traditional place names and pā sites contributed by Tainui kaumātua. This integration of mātauranga-a-hapū and geoscience reflects an interdisciplinary approach, demonstrating how cultural heritage and modern science can collaboratively deepen understanding. The companion monograph, featuring a foreword in Te Reo Māori, provides comprehensive notes on stratigraphy, volcanic activity, tectonics and visual aids such as photographs and geological sketches.

The launch of the Karioi monograph and map book on 7th September 2024 in Raglan celebrated the dedication of Diane and Oliver, and the involvement of Waikato Tainui mana whenua. Attended by local communities, this event highlighted the report's importance as an educational and resource management tool. Its findings not only enhance regional geological understanding but also support broader studies, including the future activity of the Auckland Volcanic Field and the Kawhia–Aotea ecosystem research.

The Karioi Report stands as a testament to the fusion of geoscientific inquiry and indigenous knowledge, ensuring that both perspectives contribute to the comprehensive story of the maunga and whakapapa of Karioi.

Oliver McLeod (left) and Diane Bradshaw (right) at the launch of the Karioi monograph and map book on 7th September.

Collaborating with our communities: Mātauranga Māori panel at our 2024 annual symposium

A panel discussion on engaging with Māori communities brought together voices from diverse fields to explore strategies for meaningful collaboration. Facilitated by Deputy Director Māori Associate Professor Pauline Harris, the session featured Strategic Manager Māori Kirsty Doyle (Ngāti Kahungunu, Rongomaiwahine, Ngāti Rakaipaaka), Associate Investigator Dr Taniela Lolohea (Tongan) from Te Wānanga Aronui o Tāmaki Makau Rau Auckland University of Technology and filmmaker and community collaborator Hiona Henare (Ngāi Tara, Muaūpoko, Ngāti Huia).

The panel explored how engagement with Māori communities requires genuine relationship-building, respect for cultural values and a shared vision for achieving community goals. The stories shared by each speaker provided examples of how these principles are applied in practice.

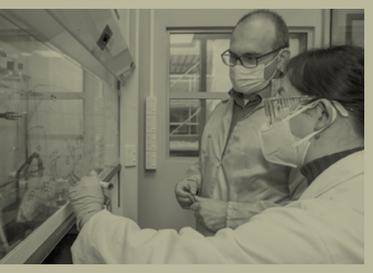
Hiona brought a landowner's perspective, highlighting the importance of collaboration that is grounded in understanding the land and its stories. She spoke about being open to working with scientists and encouraged them to walk the land, fostering deeper connections with the whenua (land) and the people who hold its guardianship.

Taniela shared his experiences working closely with a school in Tonga on a water monitoring project, which provides practical solutions for the community. This collaboration demonstrates how scientific initiatives can address immediate needs while fostering relationships and building rangatahi capability.

Kirsty emphasised a community-centric approach that places the aspirations of Māori communities at the forefront of engagement efforts. She reflected on the importance of taking the time to build genuine relationships, fostering trust and ensuring that voices are truly heard. Kirsty highlighted that meaningful collaboration begins with deeply listening to the goals and values of the community and aligning efforts to support those aspirations authentically.

Through these stories, the panel highlighted common themes of trust, respect, and a commitment to aligning scientific and collaborative initiatives with the values and priorities of Māori and Pacific communities. Together, the speakers illustrated the transformative potential of culturally responsive engagement to create meaningful and enduring outcomes.

Above from left: Kirsty Doyle, Hiona Henare and Taniela Lolohea at the annual symposium 2024. Below: Pauline Harris facilitating the panel at the annual symposium.



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Out of the lab

The PhD projects that we started to fund in 2021 produced real dividends in 2024. We here highlight stories of international connection and collaboration, in hydrogen and in aerospace; of self-healing silicone for waste reduction; of the practical applications of ‘weird stuff’, in quantum technologies; and of the simultaneous production of fundamental knowledge and of ethylene. Individually and collectively, our researchers ask the most important question in science: **why?**; and at the same time demonstrate **how** to deliver.

“But why did it work?”

Professor Aaron Marshall

Science *is* people

2024 saw connections with our German colleagues continue to deepen in relation to green hydrogen research.

Our scientists have long enjoyed close research collaborations with Germany researchers, and these have focused in recent years towards the green hydrogen research space. Current collaborations were given a boost in 2021 with the announcement of the establishment of a German-New Zealand Green Hydrogen Centre (He Honoka Hauwai) (2021-2026) and then again in 2022 with the award of three German-New Zealand research grants (2022-2025), with all four jointly funded by Germany (BMBF) and New Zealand (MBIE Catalyst).

MacDiarmid Institute Investigators are leading, and extensively involved, in three of the four projects, including in the German-New Zealand Green Hydrogen Centre He Honoka Hauwai in partnership with Ngāi Tahu, who generously gifted the centre its name, logo and phrase.

Ta Tipene O'Regan ONZ, Upoko o Awarua Runaka, Patron of Murihiku Regeneration comments, "If we are not going to transit into green hydrogen, then please tell me what we *are* going to do! This country has no enduring or useful alternative for its future!"

Ōtākou Whakaihu Waka University of Otago (UoO) based Principal Investigator Professor Sally Brooker co-leads He Honoka Hauwai with Dr Paul Jerabek (Helmholtz-Zentrum Hereon), and Te Whare Wānanga o Waitaha University of Canterbury (UoC) based Principal Investigator Professor Aaron Marshall is the New Zealand deputy lead. The team is establishing the physical centre at UoO, growing our German-New Zealand research and industry connections, and engaging in schools and public outreach.

> "This is an example where strategically targeted government funding contributes greatly to deepening research connections between New Zealand and a key science research partner Germany."
> Professor Sally Brooker

"Germany is putting considerable resources into the green hydrogen space and keen to work with NZ researchers. These four co-funded projects enable us to partner with this key international strategic partner, building impactful research and industry links as well as working to deliver climate impact research that NZ and the rest of the world needs."

Paul Jerabek says, "Our ongoing collaboration represents much more than just scientific research – it's a bridge between two nations committed to solving global challenges. By combining New Zealand's unique plethora of renewable resources and Germany's technological expertise, we're not just developing innovative hydrogen technologies, we're actually creating a blueprint for other international scientific cooperations that could help transform our global energy future. NZ has an extraordinary advantage with its abundant almost untapped renewable energy potential, particularly from hydro, wind, and geothermal sources, which makes it an ideal environment for green hydrogen production and utilization. The passion and innovative spirit of NZ researchers, combined with their deep commitment to sustainable technologies as well as social and generational responsibility, makes this collaborative research not just productive, but truly inspiring."

Sally Brooker speaking at H2Wheels, Te Papa.

Anna Garden, Richard Barker (PVC Sciences), Dave Warren, Thomas Klassen (Director, Institute for Hydrogen Technology, Helmholtz Zentrum Hereon), Helen Nicholson (Acting VC), Richard Blaikie (DVC R&E), Sally Brooker and Nigel Lucas.

AFFORDABLE GREEN HYDROGEN PRODUCTION

Aaron Marshall (UoC) leads one of the three research projects funded in 2022. This grant aims to develop more efficient anodes for anion exchange membrane electrolysers to produce affordable green hydrogen. The collaboration is on "developing low-cost AEM water electrolysers" and involves from the German side, Fraunhofer IFAM Dresden researcher Dr Christian Immanuel Bernäcker and University of Bayreuth's Professor Christina Roth, and from the New Zealand side, MacDiarmid Institute Principal Investigator Professor Geoff Waterhouse (Waipapa Taumata Rau University of Auckland (UoA)), Associate Investigator Dr Kim McKelvey (Te Herenga Waka Victoria University of Wellington (VUW)), Professor Daniel Holland and Aaron (both UoC).

The team has developed new catalysts and porous electrode structures and has recently been awarded Australian Synchrotron beamtime to investigate these in order to understand how gas bubbles are evolved in these structures. The team is commissioning a demonstration water electrolyser when our German collaborators visit New Zealand for AMN11 and the third New Zealand Hydrogen Symposium (NZHS), both in February 2025. The grant also enabled Christina Roth (also a Keynote at AMN11) to teach at UoC for a semester in 2024.

AFFORDABLE GREEN HYDROGEN STORAGE

Another of the three research projects funded in 2022 relates to cost effective hydrogen storage materials using NZ resources and is co-led by Paul (Hereon) and Sally (UoO), and includes on the New Zealand side MacDiarmid Institute Investigators Professor Chris Bumby (VUW), Professor Nigel Lucas (UoO), Associate Professor Anna Garden (UoO), Professor Alex Yip (UoC) and Professor Peng Cao (UoA), along with Associate Professor Michael Jack, Associate Professor Jonathan Lever, MacDiarmid Institute Affiliate Dr Dave Warren, Dr Linda Wright and Terry Nicholas. The German team are drawn from the internationally renowned Institute of Hydrogen Technology at Helmholtz-Zentrum Hereon (Hereon) and includes Dr Claudio Pistidda, Professor Thomas Klassen, Dr Klaus Taube and Professor Julian Jepsen.

This team aims to develop a more cost effective, so more commercially viable, hydrogen storage technology using NZ resources. Specifically, the team will develop safe, large-scale, long-term hydrogen storage materials using TiFe (titanium iron) metal alloys, researching how to make these materials from New Zealand resources – including from the ilmenite sands on the West Coast near Barrytown.

Anna Garden says this is a different approach to producing FeTi (ferro titanium). "FeTi (the material we are interested in) is usually produced from pure Fe and pure Ti, whereas here we are

trying to make it directly from the ilmenite sands. Nigel, Claudio and Chris are working on different methods to do this and to test the subsequent hydrogen uptake, and Paul and I are working on modelling the material, including the possible effects of impurities. If impurities are not going to be a problem, or indeed if they help, then we can avoid the economic and environmental costly purification processes."

Anna says there are extensive in-person collaborations underway for the storage project, many at the PhD student level, with their German partners at Hereon, which is based just outside Hamburg.

Above: Sally Brooker at the H2 Expo in Hamburg.

Below: Alan MacDiarmid.

"PhD student Alex Haack (who is supervised by Nigel Lucas) spent his first year in Germany and is now in New Zealand at UoO. My PhD student Lekshmi Dinachandran started with me here at UoO and has spent two months in Hereon with Paul this year, with another trip in the planning. Chris Bumby's PhD student Zarar Rasheed also spent a couple of months at Hereon this year."

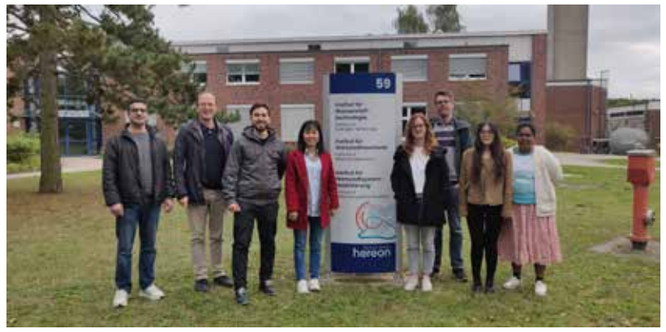
She says those are just the directly MacDiarmid Institute-related ones. "Beyond that, as part of the project, Michael Jack's PhD student (Al-Hasan Abdulwahid) visited Hereon recently and is looking to return in 2025."

Anna says her UoO team have also had several visits from the German postdocs, as well as from Paul, Klaus and Thomas (head of the hydrogen institute at Hereon), along with a visit from representatives from the German Parliament (all parties except one), in a 'Pacific Friendship Meeting', which was also attended by their local Member of Parliament, Hon Rachel Brooking. Klaus presented a keynote at NZHS-1, Thomas at NZHS-2, and Claudio (head of the materials design department at Hereon) will at NZHS-3. Paul has also participated in all NZHSs and several AMN conferences, and will talk at AMN11 in February 2025.

"Our namesake Alan MacDiarmid said 'Science is People' and this is very much the case with these projects: relationships are being built between people, over time and research together"

Sally says the success of the project centres on the strong relationships being developed between researchers. "Our namesake Alan MacDiarmid said 'Science is People' and this is the very much the case with these projects: relationships are being built between people, over time and research together, which is bigger than just what they do, as it's also getting to know who they are working with, which in turn leads to long term collaborations. So a cornerstone of the success of these projects is the movement of people between the two countries.

"Alan MacDiarmid would be proud."



Some of the He Honoka Hauwai | German-NZ Green Hydrogen Centre team visiting materials design collaborators at the Institute for Hydrogen Technology at Helmholtz-Zentrum Hereon — Mohammad Zarar Rasheed (Victoria University of Wellington), Thomas Klassen, Ebert Alvares, Thi-Thu LE (all three Helmholtz-Zentrum Hereon), Anna Garden (University of Otago), Alex Haack (University of Otago & Helmholtz-Zentrum Hereon), Yuanyuan Shang and Lathapriya Vellingiri (both Helmholtz-Zentrum Hereon).

Women and Gender Minorities Network

This year we have made progress to strengthen and build community in the MacDiarmid Institute Women and Gender Minorities Network. Our inaugural chair of the network, Jaye Barclay (they/he, takatāpui, Ngāti Apa, Ngāti Hauiti, Te Āti-Haunui-a-Pāpārangi), was appointed in April. They bring with them to the position an enthusiasm for building and maintaining a sense of community and support for those of marginalised gender identities in STEM.
The network had an initial hui in October to formalise wording of the name change and discuss hopes and expectations for the network going forward, culminating in the first (hopefully of many) in-person breakfast meet-up at Te Herenga Waka Victoria University of Wellington's Kelburn campus during the Institute's annual symposium in November. We look forward to hosting similar in-person and online gatherings to promote whakawhanaungatanga across the Institute, and we hope to grow network capacity and involvement of staff and students alike. Watch this space!

The Institute's Women and Gender Minorities breakfast on 18 November 2024.

2024 Annual Symposium

On 18th November 165 students, early career researchers and Investigators from around Aotearoa New Zealand gathered in Pōneke Wellington for the MacDiarmid Institute's annual symposium. This year Co-Directors Professors Nicola Gaston and Justin Hodgkiss took the opportunity to frame where the Institute is in its current contract, and outline thoughts for the second four-year period. Deputy Director Māori Associate Professor Pauline Harris chaired a mātauranga Māori panel on the topic of collaborating with communities, while Deputy Director Commercialisation and Industry Engagement Associate Professor Natalie Plank chaired a commercialisation discussion. The panel gave the Institute the chance to hear from and ask questions of Principal Investigators Dr Laura Domigan and Professor Eric Le Ru, and Associate Investigator Dr Ben Mallett, about their journeys into the start-up world. Deputy Director Outreach and Education Associate Professor Anna Garden spoke about the importance of building relationships.

The programme also featured updates and highlights from the four research programmes, ending with a very well-attended poster session at which approximately 70 students presented their work. The Deputy Directors also took the opportunity to celebrate the achievements of the Co-Directors and thank them for all of their contributions to the MacDiarmid Institute throughout their time in the roles.

Investigators met the following day to discuss MacDiarmid Institute research and hear from external speakers. Early career researchers had the opportunity to attend a number of Career and Relevant-to-Industry Skills Programme (CRISP) workshops (detailed elsewhere in this report).

Left and right: Associate Professor Anna Garden speaking at the annual symposium.

Below: (From left) Kirsty Doyle, Hiona Henare and Dr Taniela Lolohea on the mātauranga Māori panel.

Group photo taken during the MacDiarmid Institute annual symposium on 18 November 2024.

PhD students Shae Patel (left, McKelvey / Liu lab) and Campbell Tiffin (right, Marshall lab) conducting electrocatalytic CO_2 reduction experiments.

Where great ideas bubble up

Over the last 150 years, humanity has harnessed chemistry to make products underpinning the modern economy, from fertilisers and fuels to synthetic fibres and pharmaceuticals.

But we still don't fully understand many of the chemical processes underpinning these products, says Te Whare Wānanga o Waitaha University of Canterbury-based MacDiarmid Institute Principal Investigator Professor Aaron Marshall.

"With things like ammonia and methanol production, nobody fundamentally knew how they worked, but the industry figured out how to make them and carried on producing them," says Aaron.

The key to breakthroughs in chemical processes that can help to decarbonise the economy is revisiting chemical processes to gain new insights that radically improve them.

That's the approach Aaron is taking with his work with the Catalytic Architectures research programme at the MacDiarmid Institute, which centres on the electrochemical conversion of carbon dioxide into fuels. It's an area that researchers have been working on for over two decades. During that time, big gains have been made in developing electrode materials with high catalytic performance, the key to driving the adoption of carbon capture, storage and conversion technologies.

THE RIGHT TOUCH

However, making catalysts efficient enough to offer cost-effective alternatives to simply burning fossil fuels is still a major challenge.

"It's pretty easy to make a catalyst that converts CO_2 into something useful like ethylene, or ethanol," Aaron explains.

"Our catalyst is 25% efficient at doing so, which is very good. It's satisfying to switch the thing on and it works. But why did it work? The focus for us over the last few years has been on how reactants interact with the catalytic surface."

Aaron's experiments at the MacDiarmid Institute have progressed from dipping lumps of copper into baking soda solutions and running electricity through it to produce small amounts of methane, to designing gas diffusion cells.

"We discovered that putting copper nanoparticles onto an inert porous support and delivering the CO_2 to these nanoparticles through the back of this porous support produces a completely different behaviour," he says.

> "It goes from producing 20% ethylene to producing 80% ethylene."

A breakthrough in the process came courtesy of one of Aaron's PhD students.

"The best way I can describe it is that he simply had the right touch," Aaron says.

SYNCHROTRON INSIGHTS

The team is exploring how gas bubbles are pumped through these porous systems and the geometry of the porous structures themselves. Progress to date suggests this area of research may be as or more important than coming up with new catalytic materials.

Aaron says the strength of the MacDiarmid Institute is the ability to explore new avenues of potential as experiments yield promising results.

"A contestable government grant usually involves you pursuing a specific goal for a short period. At the MacDiarmid Institute, we have fairly broad overarching research aims which enable us to dig a bit deeper and occasionally go off on tangents," he says.

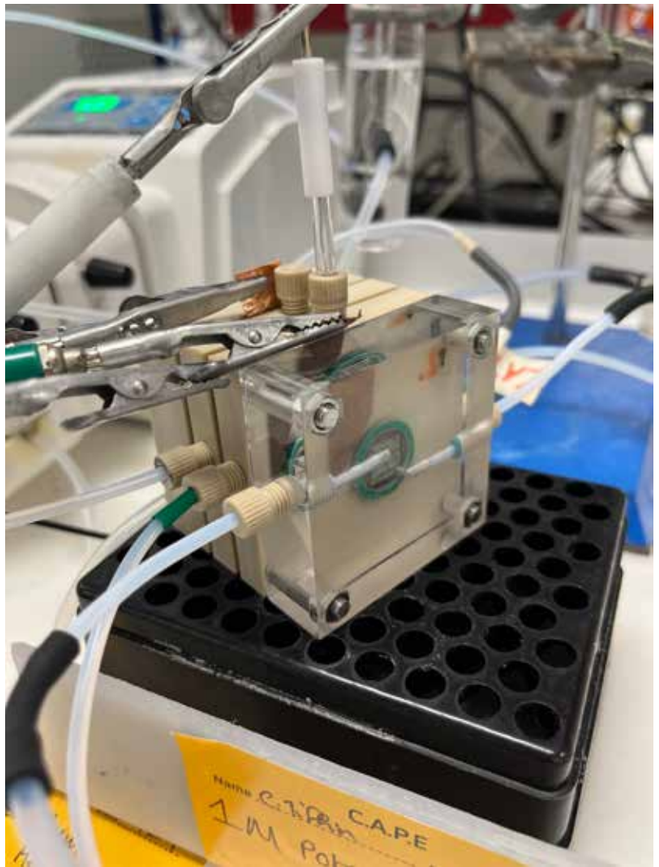
The collaboration between the MacDiarmid Institute's Principal Investigators and Associate Investigators is another strength, he says, with researchers like Dr Kim McKelvey, a Te Herenga Waka Victoria University of Wellington-based MacDiarmid Institute Associate Investigator tackling the same set of problems from different angles.

Aaron's next set of experiments will involve using the Australian Synchrotron to look in detail at the composition of gas bubbles. Infrared spectroscopy will be used to examine bubbles under a microscope.

"When we dissolve CO_2 in a thin layer of liquid, it generates a gas bubble," explains Aaron.

"We are going to measure the composition of that gas bubble right from the start and see how it changes with time. That's where it all starts, so it seems like a process we should understand."

"A contestable government grant usually involves you pursuing a specific goal for a short period. At the MacDiarmid Institute, we have fairly broad overarching research aims which enable us to dig a bit deeper and occasionally go off on tangents."



Electrochemical gas-diffusion cell purchased using MacDiarmid Catalytic Architecture strategic funding to support collaborative research.

FROM SCIENCE TO START-UPS

A demonstration project for carbon capture and conversion is also on the cards, which Aaron says will showcase the potential of the technology. He's excited to see cleantech spin-off companies emerging from the MacDiarmid Institute and other New Zealand research institutions.

Aaron serves as the Chief Technology Officer of start-up Zincovery, which is making zinc recycling more efficient and sustainable. He's also co-founder of start-up Ternary Kinetics, which is developing zero-emission liquid fuels suitable for existing infrastructure and transport systems, such as power-hungry heavy transport.

His co-founders are Dr Sean Simpson and Sean Molloy, two of the key people behind LanzaTech, New Zealand's most successful cleantech start-up, which listed on the Nasdaq in 2023. Rocket Lab founder Sir Peter Beck is also a director and investor of Ternary Kinetics.

"If you look back over 15 years to the early days of LanzaTech, they were bubbling some gas through a beaker on a bench. It didn't necessarily look like it would go somewhere. Now look at the scale they are operating at," says Aaron.

"Everybody knows that just minimising CO_2 isn't enough. We've got to be capturing it, storing it and converting it. I think we've got the right capability to make a difference."

"Everybody knows that just minimising CO_2 isn't enough. We've got to be capturing it, storing it and converting it."

Magnetic sandwiches for advanced computing

Quantum computing offers us the possibility of solving problems that can't be solved with classical computing, and superconducting computing promises extreme energy efficiency and higher speeds. But for these benefits to be delivered beyond experimental trials, breakthroughs are required.

Sure enough, behind the walls of two Pōneke Wellington laboratories, breakthroughs are being made. Physicists working as part of the Future Computing research programme at the MacDiarmid Institute are combining atoms in novel ways to create new materials for the next generation of computers.

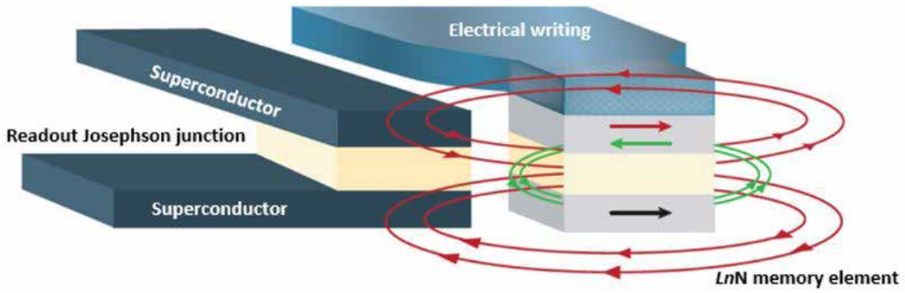
Fresh from a PhD with the Spintronics Group at Te Herenga Waka Victoria University of Wellington (VUW), Dr Catherine Pot describes what she's been up to. "I've been making magnetic sandwiches. It's a bit like taking two flat, rectangular fridge magnets and putting a layer between them to stop them interacting with each other. When we point our fridge magnets in the same direction, they behave like a strong magnet. When we point them in the opposite direction to each other, then the two magnets cancel each other out. It's these two different states that can be used to signal 'zeros' and 'ones' in a memory device for computing. With our materials, we're doing this at the scale of microns and at the temperature of liquid helium."

Associate Investigator Dr William Holmes-Hewett of VUW's Paihau-Robinson Research Institute was one of Catherine's supervisors.

He emphasises the scale of these 'sandwiches'. "They're unimaginably small. Looking down on them, they're a few microns in diameter – almost a hundred times smaller than the width of a human hair. Looking at them side on, you're getting down to a countable number of atoms high in each layer. We're building layers on the order of 5-50 nanometres thick." The reason for the tiny size is simple. Progress from storing a hundred megabytes of memory on the family computer back in the 1980s to one terabyte now – a ten-thousand-fold increase – comes from memory devices getting smaller. The more memory we want to store, the smaller the storage devices need to get to keep computers at a practical size.

As for the mind-blowingly cold temperatures these scientists are working with (liquid helium is minus 269 degrees Celsius), Will describes how this enables a well-controlled environment for quantum computations to operate in. "If you think about what heat is, it's just things shaking, atoms shaking, molecules shaking. When it is cold, atoms are not moving much at all, those are the conditions we need for manipulating quantum computing components."

Opposite: Catherine and Will enjoy the laboratory work associated with investigating quantum materials. Here they are making adjustments on the ultra-high vaccuum chamber in which they make their magnetic sandwiches.



Schematic diagram showing how a rare earth nitride magnetic sandwich (right-hand block of grey and cream layers) might be integrated with other superconducting componenents to becomea memory element with read and white capabilities. Image by Gwen Hendry.

Catherine's magnetic sandwiches can act like a memory element in a computer because the orientation of the magnetic layers within the sandwiches can be switched between two different states. This memory device will work in conventional computing at regular temperatures, but because it also works at cryogenic temperatures, it has potential applications in superconducting and quantum computing as well.

So, what are these amazing sandwiches made of? The researchers have focused on a class of materials called the rare earth nitrides. Not only are they ferromagnetic, but they're also semiconductors. This combination of these two characteristics in one material is unusual as Catherine explains: "Most ferromagnetic materials are metals, so you've got limited control over the electrical properties. In our materials, we can choose the magnetic properties from the rare earth selection, and independently change the electrical properties according to the desired application."

In an ultra-high vacuum chamber that looks like a submarine, the scientists have been evaporating various combinations of rare earth elements like samarium and gadolinium in the presence of nitrogen to find the specific magnetic and electrical properties useful for future computing applications.

Memory has been one of the main roadblocks to upscaling and bringing quantum and superconducting computers out of the laboratory into the real world. Catherine and Will, with MacDiarmid Institute colleagues, demonstrated their prototype memory element in a 2023 paper[1] in a world first. Will summarises, "This was the first memory element based on rare earth nitrides built for superconducting applications."

Both Catherine and Will are proud of the heritage they are building on. Understanding rare earth nitrides has taken over two decades of work by the Spintronics Group at VUW (also known as the Rare Earth Nitrides Group and a long-standing part of the MacDiarmid Institute). Will says, "While other groups worldwide have experience in making superconducting devices, we're the leading group in terms of experience with these rare earth nitride materials. Our work is trying to apply novel materials to solve problems faced by traditional materials – quantum computers require cryogenic electronics that don't exist at the moment. We're trying to build those electronics here in New Zealand."

Will's fascination lies with investigating the fundamental electronic behaviour of the rare earth nitrides and putting that to good use. He's a rare breed of doing both computational and experimental work – his research benefits from the direct feedback and iterations between the computer and the laboratory.

1. C. Pot, W. F. Holmes-Hewett, E.-M. Anton, J. D. Miller, B. J. Ruck, H. J. Trodahl; A nonvolatile memory element for integration with superconducting electronics. Appl. Phys. Lett. 13 November 2023; 123 (20): 202401. https://doi.org/10.1063/5.0175432

Catherine is living up to the award she won as a secondary school student – the Prime Minister's Future Scientist Prize in 2016. With an honours degree and now a PhD under her belt, she's keen to keep working in this field. There is still a lot of work required to move from laboratory-based demonstrations of these tri-layer sandwiches into a situation where they can be transported between labs and made to interface with other computing components.

Some of this will be explored in a 2024 MBIE Endeavour Fund programme, "Scalable cryogenic memory technology for superconducting and quantum computing," led by MacDiarmid Institute Principal Investigators Professor Ben Ruck, Head of the School of Chemical and Physical Sciences at VUW, and Dr Simon Granville, Principal Scientist at Paihau-Robinson Research Institute.

...the team are actively working with national initiatives such as Quantum Technologies Aotearoa and with researchers in Japan, Italy, Australia and the US.

Collaboration is key to making breakthroughs in any field and the team are actively working with national initiatives such as Quantum Technologies Aotearoa and with researchers in Japan, Italy, Australia and the US. Will reflects, "What's really cool is that over the last 20 years the team at VUW has developed the fundamental knowledge to be able to use these rare earth materials in an exciting, applied setting and, because of that knowledge, we've made connections with groups who have complimentary expertise. Together we've been able to achieve something that none of us could do at the beginning."

Ben, Catherine and Will with the Riber deposition system in the Spintronics laboratory at VUW. Protective clothing helps keep the environment clean which is crucial when making such small structures. Will says getting a piece of dust in the system would make their procedure like "trying to bake a cake with a watermelon in the cake tin".

New horizons for Māori in aerospace

Pauline Harris and Kirsty Doyle in NASA Houston.

Māori are no strangers to voyages into the unknown. With an ancient mastery of astronomy, Māori ancestors charted the vast Pacific. Reading the stars and their movement across the skies, they found their way to distant, unknown lands with remarkable precision and skill. This journey embodied generations of wisdom passed down about celestial practices, rituals, time systems and navigation. This deep knowledge has been revitalised and will play an important role in reaching new destinations.

"Today, mātauranga Māori offers us a foundational philosophy for space exploration, one that balances technological progress with the health of our ecosystems and the well-being of future generations," says Te Kunenga ki Pūrehuroa Massey University-based Associate Professor Pauline Harris, from Rongomaiwahine, Ngāti Rakaipaaka and Ngāti Kahungunu ki Wairoa.

Pauline is the Deputy Director Māori of the MacDiarmid Institute and part of the Institute's Mātauranga Māori research programme. Her research project, "Ko tātai arorangi he kaiarataki i te rā: Integrating space-based observations into traditional Māori calendar systems, the maramataka", applies data analytics and machine learning on satellite data to determine Māori environmental monitoring priorities.

"It's important that we keep observing the skies and land to understand how our world is changing and how this will affect our enduring knowledge systems. These earth observations are key to tackling some of the big environmental issues that Māori face," says Pauline.

"To develop this work further, we need to encourage and create opportunities for the next generation of Māori scientists and engineers."

> "Today, mātauranga Māori offers us a foundational philosophy for space exploration, one that balances technological progress with the health of our ecosystems and the well-being of future generations."

Pauline has been instrumental in building Māori research capability and capacity at the MacDiarmid Institute.

Joining her in this mission is Strategic Manager Māori Kirsty Doyle from Ngāti Kahungunu, Rongomaiwahine and Ngāti Rakaipaaka.

Pauline Harris at NASA AMES, Silicon Valley, California.

Together, they have led the Discovery Scholarship programme which aims to encourage more Māori and Pacific peoples in the science sector.

"By empowering more Māori and Pacific students to enter scientific and engineering fields, we are laying the foundations to build a science sector that values and promotes diversity, both in people and in perspectives," says Kirsty.

> to establish a sustainable, healthy, open-minded space industry

Pauline and Kirsty recently led a team of researchers to collaborate with NASA's Indigenous Peoples Initiative (IPI) which aims to support Indigenous-led initiatives and projects that utilise NASA data, products and tools.

"With this collaboration, NASA acknowledges and promotes the importance of diversity in worldview within the aerospace sector. These are considerations that aerospace sectors globally should take note of, including right here in Aotearoa New Zealand," says Pauline.

In recent decades, there has been a rapid acceleration in space technologies, sparking a new space race. Amidst these exciting advancements, concerns about sustainability, long-term well-being and the impact on future generations risk becoming mere afterthoughts.

"Rather than this space race being a machine of reckless resource consumption and careless waste production, we can carve out a new path that prioritises the best aspects of humanity," says Pauline.

"We need to seize the opportunity to make Aotearoa New Zealand's place in the space race unique. Set an example to establish a sustainable, healthy, open-minded space industry that is not marred by inequities in opportunity."

Pauline and Kirsty both emphasise that as Aotearoa New Zealand embarks on this voyage into the vast unknown, Māori need to be at the forefront of leadership, decision-making and research based on Māori values and principles.

"We need to embed these principles and values early in this process so that we have a clear vision to aspire to. This starts with creating opportunities for more Māori researchers to explore and develop new knowledge," says Kirsty.

"Here at the MacDiarmid Institute, we are already setting this vision in motion by nurturing Māori scientists to look towards the stars once more to venture into new horizons."

Pauline Harris and Kirsty Doyle at the Jet Propulsion Laboratory, California Institute of Technology in the USA.

The healing partnership of silicone and sulphur

The versatility of the group of materials known as silicones is something to marvel at. Silicones are used for everything from kitchen implements, to industrial adhesives, to life-saving medical equipment. Based on chains of alternating silicon and oxygen, silicones can range in consistency from thick oils to flexible rubber, and they are resistant to changes in temperature and chemistry.

But the exact qualities that make silicones so useful, also make them very hard to recycle. The global silicone market was valued at 18.5 billion US dollars in 2022 and is growing – silicones are used extensively in the construction industry. Currently, most used or expired silicone goes to landfill, rendering a potentially useful material into a waste product.

The MacDiarmid Institute's Reconfigurable Systems research programme is working to reduce waste by developing new materials that are recyclable or reconfigurable. This includes designing materials that can repair themselves at a molecular level.

Associate Investigator Dr Erin Leitao of Waipapa Taumata Rau University of Auckland first became intrigued by chemistry through cooking as a young child. The inventive activities and excellent teachers she encountered in high school physics and first year chemistry captured her interest. Combined with a love of logic and problem solving, chemistry has since taken her from a PhD in Canada to an academic position in Aotearoa New Zealand.

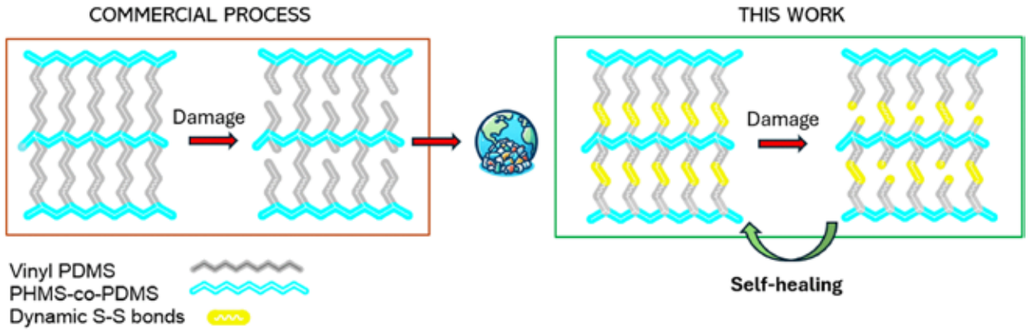
Erin's research focuses on making new materials from earth-abundant elements such as silicon, nitrogen, phosphorus, sulphur and oxygen to reduce reliance on carbon, eliminate the creation of toxic byproducts and enable recycling. She first started working on silicones and sulphur with MacDiarmid Institute-affiliated PhD student Kun Woo Park in 2019 and the research continues as part of her student Mahsaalsadat (Mahsa) Rokni's PhD. Erin explains, "We basically just wanted to find an easy way to repair existing silicone."

> Currently, most used or expired silicone goes to landfill

The challenge in changing any material to make it more reuseable is finding a way of doing so that doesn't change the properties that make it so useful in the first place. "The reason we started working with sulphur is because it has similar properties to silicone plus an ability to 're-heal', that is to be able to repair itself. We thought about bringing them together to enhance those properties rather than adding anything that would detract from the original silicone material." And, in line with the environmentally friendly goals of the overall research, sulphur is an obvious choice because it's widely available as a waste byproduct.

Mahsa carried out the process to introduce elemental sulphur into the long chain polymers of a commercial silicone sample.

Erin Leitao and Mahsaalsadat Rokni are experimenting with adding sulphur to silicone materials to give them re-healing properties.



Typically, when silicone gets damaged, it is sent to the landfill (above left panel). MacDiarmid Institute researchers are experimenting with adding sulphur bonds into the predominantly silicon – oxygen structure to enable the material to self-heal (above right panel). Reproduced from Rokni et al., 2024.

In their 2024 paper, the research team describe cutting discs of unmodified silicone as well as their sulphur-infused silicone with a knife, then heating them to 120 degrees Celsius and applying pressure with a heat press for a day. The unmodified silicone discs remained damaged. The sulphur-infused samples healed – not just visibly but also at a molecular level. To Erin and Mahsa's delight, the synthesis had worked – they had created a repairable silicone.

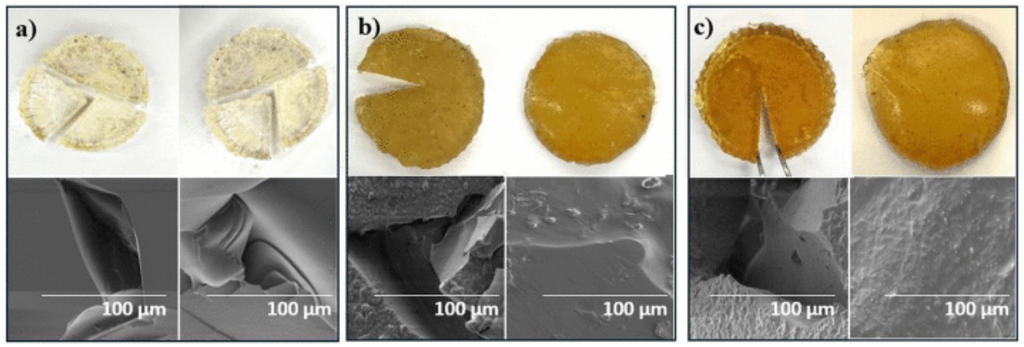
Already, there are others excited about these findings. Within the MacDiarmid Institute itself, the researchers are testing the silicone used by Principal Investigator Professor Volker Nock of Te Whare Wānanga o Waitaha University of Canterbury. He uses silicone replicas of body parts to trial medical applications, and he would be thrilled if he could remould the silicone instead of throwing it away when it's worn out.

Erin explains that existing research on reusing silicone is based on analogues, not on commercially available materials. "No one has taken the commercial product itself and played with it the way we have." She hopes to run trials with New Zealand companies who use silicone.

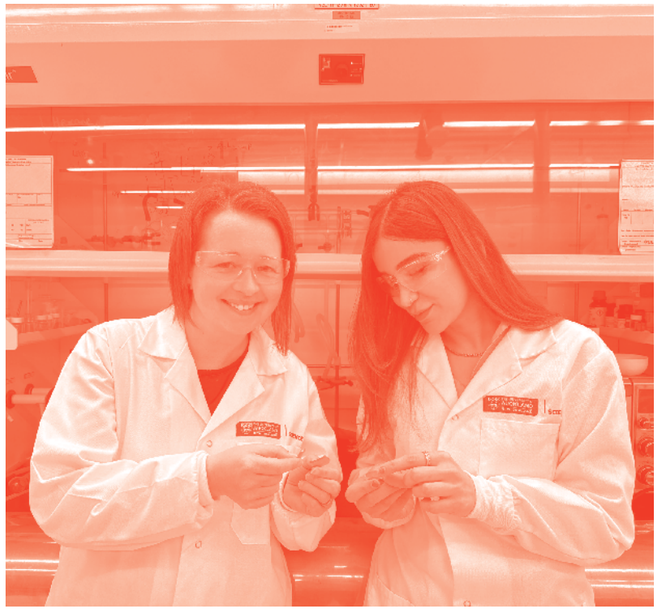
The researchers found that their re-healing technique worked for a few different types of silicones but it's not a 'one size fits all'. There are many formulations, with slightly different properties, so there's further work underway to enable healing properties for a variety of formulations. "In our initial proof of concept, we tried marrying the two components and we were pleasantly surprised that it worked with the first formulation we attempted. Now we need to expand the portfolio."

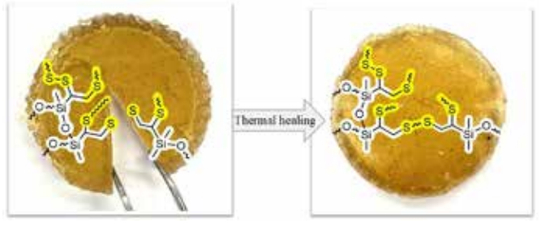
> "I want full circularity of silicone. That's the ultimate goal for this research."

The team are awaiting materials to scale-up the processing of repairable silicone and carry out extensive testing. Further testing will help to determine the materials' suitability for different applications. For example, there is confidence that this material will have properties that are well suited for some areas in healthcare.Ultimately though, Erin is focused on the waste reduction possibilities: "I want full circularity of silicone. That's the ultimate goal for this research."



Silicone discs synthesized by the researchers (top row) with corresponding scanning electron microscope images (bottom row). Panels show damaged discs on the left and "healed" discs on the right for a) silicone without sulphur (no healing observed); b) silicone with some sulphur; c) silicone with high amounts of sulphur. Reproduced from Rokni et al., 2024.





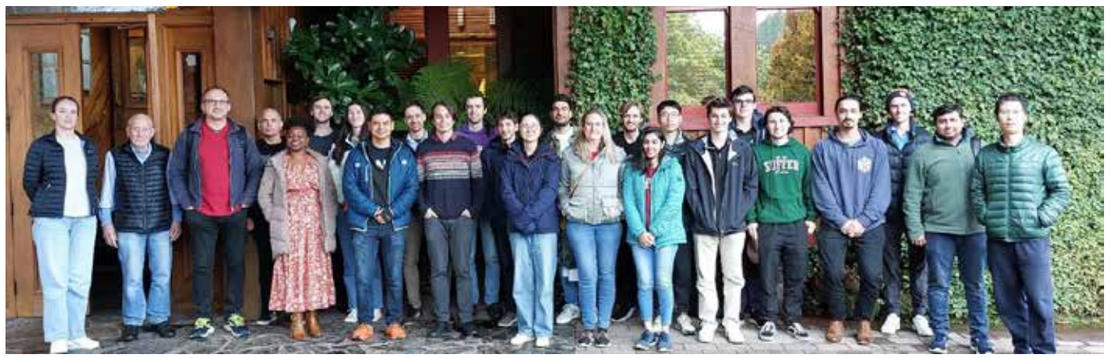
2024 Cluster hui

THIN FILMS HUI, 24-26 JUNE 2024

30 researchers, from undergraduate students right through to the most veteran of researchers, attended the Thin Films Hui in the atmospheric setting of the Powderhorn Chateau in Ohakune, at the base of Mt Ruapehu. The two-and-a-half-day mix of tutorial-style presentations on thin film growth, basic and advanced characterisation methods, 15-minute student and 30-minute postdoc research talks included a workshop dinner and a wind-down quiz put on by Associate Investigator Dr Daniel Sando. The days were described as “long but worthwhile” and there were even a few chances to step out at lunchtime and enjoy the scenery without the dreary weather dampening enthusiasm too much.

Topics covered thin film growth, lab x-ray techniques and magnetic and electronic properties of materials, and included Professor Joe Trodahl’s tutorial on Raman spectroscopy, Deputy Director Māori Associate Professor Pauline Harris’ talk on mātauranga Māori (just in time for Matariki) and three special international guests: Dr Grace Causer, Dr Pablo Mota Santiago and Peggy Zhang from Australia, who gave excellent tutorials on neutron, synchrotron and probe microscopy techniques.

Big thanks to the Thin Film Hui 2024 organisers: Principal Investigators Associate Professor Franck Natali and Dr Simon Granville and Associate Investigators Dr Will Holmes-Hewett and Dr Daniel Sando.



Top: One of the talks at the Thin Films Hui.

Above: Group photo of the Thin Films Hui attendees.

STIMULI RESPONSIVE MATERIALS HUI, 24-25 OCTOBER 2024

The Stimuli Responsive Materials Hui was a two-day workshop on topics related to Reconfigurable Systems research, held at Te Whare Wānanga o Waitaha University of Canterbury University’s Cass Field Station in the Craigieburns. The event was attended by nine people, including Investigators and PhD students, and they all gave presentations relevant to the theme. Each talk was followed by discussion, and the students received feedback on their work and suggested avenues for future investigation. The group also discussed internal MacDiarmid Institute business and the possibility of future follow-up events.

Hui attendees had the opportunity to stretch their legs during a visit to Arthur’s Pass and the Devil’s Punchbowl waterfall on the second day, and they really appreciated the fact that the remote location offered them a break from their busy schedules to focus on research discussion. Congratulations to Associate Investigator Professor Catherine Bishop and Principal Investigator Professor Volker Nock on organising such a successful event.

Above and left: Photos of attendees during the Stimuli Responsive Materials Hui in October 2024.

2024 Awards

David Barker – University of Auckland
Maurice Wilkins Centre Prize for Chemical Science (New Zealand Institute of Chemistry)

Chris Bumby - Victoria University of Wellington
Shorland Medal 2024 (New Zealand Association of Scientists)

Jack Chen – Auckland University of Technology
Next 95 Annual List of Innovators (for Spherelose) (Sustainability Business Network)

Nicola Gaston – University of Auckland
Elected Fellow of the Royal Society of New Zealand

Justin Hodgkiss – Victoria University of Wellington
Elected Fellow of the Royal Society of New Zealand

Shane Telfer – Massey University
Vice-Chancellor's Teaching Excellence Award (Massey University)
Douglas Pharmaceuticals Prize for Industrial and Applied Chemistry (New Zealand Institute of Chemistry)

Jadranka Travas-Sejdic – University of Auckland
Life Membership of Clare Hall, University of Cambridge, UK

2024 Funding successes

2024 MARSDEN STANDARD GRANTS

Renwick Dobson* - University of Canterbury
"How does Streptococcus pneumoniae, the main cause of community acquired pneumonia and meningitis in children and the elderly, acquire a critical antioxidant from its host to survive at infection sites?"

Justin Hodgkiss* and **Paul Kruger*** - Victoria University of Wellington and University of Canterbury
"Building on the discovery of a new category of glass to create structurally resilient glasses formed from hybrid perovskites that have promising application in photovoltaics and LEDs"

Luke Liu and **Shane Telfer** - Victoria University of Wellington and Massey University
"Producing next-generation materials that can capture methane"

Volker Nock* – University of Canterbury
"Unravelling the mechanisms that enhance the spread of pathogenic biological bulldozers"

* Contributing as an AI

2024 MARSDEN FAST START GRANTS

Renwick Dobson* – University of Canterbury
"Understanding how lytic enzymes could allow drugs to breach membranes in bacteria causing illnesses such as salmonella, and pneumonia"

* Contributing as an AI

2024 FELLOWSHIPS

William Holmes-Hewett – Victoria University of Wellington
Mana Tūāpapa Future Leader Fellowship, Royal Society Te Apārangi

Patricia Hunt - Victoria University of Wellington
Mana Tūārangi Distinguished Researcher Fellowship, Royal Society Te Apārangi

Bicheng (Amy) Zhu – University of Auckland
Mana Tūāpapa Future Leader Fellowship, Royal Society Te Apārangi

2024 MBIE ENDEAVOUR FUNDING

Margaret Brimble* - University of Auckland
"Effective eradication: strategies, tactics, and technologies for successful marine invasion management"
Endeavour Research Programme

Simon Granville, **Ben Ruck**, **William Holmes-Hewett*** and **Martin Allen*** - Victoria University of Wellington and University of Canterbury
"Scalable cryogenic memory technology for superconducting and quantum computing"
Endeavour Research Programme

Prasanth Gupta, **Kim McKelvey*** and **Geoff Waterhouse*** - GNS Science, Victoria University of Wellington and University of Auckland
"Semiconductor Electrocatalysts for Renewable-powered Ammonia Farms: Towards Green Fertilisers and Energy Storage"
Smart Ideas Grant

Justin Hodgkiss* - Victoria University of Wellington
"Ultrasensitive paper-based fluorescent sensors for detecting liquid illicit drugs"
Smart Ideas Grant

Jenny Malmström* – University of Auckland
"Smart, functional, high-performing keratin structures for new biologically-derived export products"
Endeavour Research Programme

Volker Nock* - University of Canterbury
"Superior protein biocomposites through tailored gradients of nature-inspired microstructure"
Smart Ideas Grant

Cameron Weber* - University of Auckland
"Heavy drugs for improved glioblastoma prognosis"
Smart Ideas Grant

Ben Yin* and **Matthew Cowan*** - Victoria University of Wellington and University of Canterbury
"A foundation for zero emissions: Low-energy, carbon-absorbing cement"
Endeavour Research Programme

* Contributing as a Key Researcher

2024 MBIE CATALYST FUNDING

Renwick Dobson – University of Canterbury
"Defining how pathogenic bacteria import antioxidants across their cell membrane"
Catalyst: Seeding General

Simon Granville and **Jenny Malmström*** – Victoria University of Wellington and University of Auckland
"Light-driven science and technology enabled by magnetic materials at multi-scale"
Catalyst: Seeding General

Justin Hodgkiss - Victoria University of Wellington
"Interface Materials Informatics platform for virtual screening of next generation organic solar cell devices"
Catalyst: e-ASIA Joint Research Programme

Charlie Ruffman – University of Auckland
Japan Society for the Promotion of Science 16th HOPE Meeting: Atomic-scale motion in liquid metals is critical for catalysis
Catalyst: Leaders (16th HOPE Meeting)

Ben Yin - Victoria University of Wellington
"Direct lithium extraction from New Zealand geothermal water"
Catalyst: Leaders (International Leader Fellowship)

2024 DOMESTIC FUNDING – OTHER

Catherine Bishop – University of Canterbury
"Industrial Development of a Spinodal Copper Nickel Alloy"
Masters sponsorship

Margaret Brimble – University of Auckland
"Methane Inhibitors" AgriZeroNZ
"Sustainable Supply of Oligonucleotide Building Blocks", Strategic Science Investment Fund Ribonucleic Acid (RNA) Development platform

Jack Chen – Auckland University of Technology
"Commercialisation Development of Spherelose (extension to 2021-SfTI-IAP03-AUTV)"
SfTI Impact Acceleration Funding

Nathaniel Davis - Victoria University of Wellington
"Singlet fission perovskite solar cells", KiwiNet Emerging Innovator Programme
"Singlet fission perovskite solar cells", SfTi Commercial Development

Renwick Dobson – University of Canterbury
"Preliminary data for endolysin function"
Biomolecular Interaction Centre Seed Grant

Muhammad Hanif – University of Auckland
"Development of targeted therapy for the treatment of Glioblastoma"
Neurological Foundation - PhD Fellowship

Luke Liu - Victoria University of Wellington
Ministry of Primary Industries Scholarship

Aaron Marshall – University of Canterbury
"Science & Engineering review of low-carbon zinc recycling"
Consulting

Joseph Nelson – Lincoln Agritech
"Biosecurity Spearhead 11: Biosecurity Technology: Detecting the Last Predator", Subcontract

Volker Nock – University of Canterbury
"Towards better tools to understand how pathogens survive environmental stress", Biomolecular Interaction Centre Seed Grant
"Osmotic stress on a Chip", 2x Biomolecular Interaction Centre Summer Scholarships
"Observing root growth and signalling responses to stress gradients and pathogens using the bi-directional-dual flow-RootChip", Faculty of Engineering Publishing Scholarship

Jami Shepherd – University of Auckland
"Ultrasonic Laundry Washing Research"
Fisher and Paykel Appliances - RA funding

Jadranka Travas-Sejdic – University of Auckland
"In vitro testing of enzymatic-based organic electrochemical transistor (OECT) sucrose sensors"
Subcontract

Geoff Willmott – University of Auckland
"Inertial microfluidics", Contract with ESR
"Ultrasonics research", Contract and Fisher and Paykel Appliances

2024 INTERNATIONAL FUNDING

Margaret Brimble – University of Auckland
"Synthesis and Characterization of EQ302 and Analogs"
Equillium, Inc., USA

Matthew Cowan – University of Canterbury
"Tracking the conversion of ZnO to mixed-ligand zeolitic imidazolate frameworks (ZIFs) and ZIF melts for gas separation membranes"
Australian Synchrotron Beamtime Application

Erin Leitao – University of Auckland
"Indigenous knowledge-inspiring science"
Strategic Initiative

Luke Liu – Victoria University of Wellington
"A new route to highly selective methane capture materials"
EQT Foundation

Aaron Marshall – University of Canterbury
"Tracking the reductive phase transformation of zinc ferrites to leachable zinc oxide in industrial electric arc furnace dusts", Synchrotron Funding
"Imaging hydrogen and oxygen bubbles within porous transport layers to optimise the structure of low-cost AEM water electrolysers", Synchrotron Funding

Volker Nock – University of Canterbury
"Bioengineering a better plant root - do phi thickenings make plant roots stronger?"
Hermon Slade Foundation

2024 UNIVERSITY INTERNAL FUNDING

Matthew Cowan – University of Canterbury
“Landfill gas capture”
Faculty Strategic Fund

Nathaniel Davis - Victoria University of Wellington
“EQE Machine for solar cells”
Capex

Petrik Galvosas - Victoria University of Wellington
“NMR and MRI characterisation of cancer in mouse models and cell lines”
Faculty Strategic Research Grant

Michele Governale - Victoria University of Wellington
Research and Study Leave

William Holmes-Hewett - Victoria University of Wellington
“Materials for superconducting memory systems”
Faculty Research Establishment Grant

Jon Kitchen – Auckland University of Technology
“On surface electrocatalysis: exploring covalent attachment of lanthanide coatings for electrochemical CO2 reduction”
Faculty Research Development Fund

Luke Liu - Victoria University of Wellington
“Selective Methane Capture from Agricultural Emissions”, Faculty Strategic Research Grant
“Methane capture technology using metal-organic frameworks”, Faculty Strategic Research Grant

Volker Nock – University of Canterbury
“Critical Point Dryer”
Capex

Jami Shepherd – University of Auckland
Faculty of Science Commercialisation Seed Funding
Faculty of Science Post Parental Leave Grant

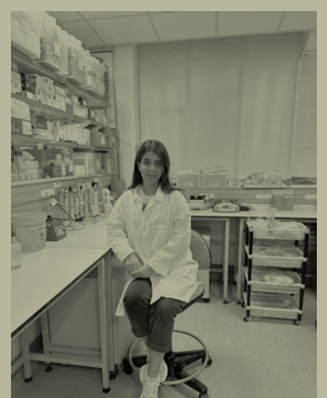
Tilo Söhnel – University of Auckland
“Investigating the physical properties of novel Ru clusters stabilized by oxidate framework”
Faculty Research Development Fund

Jadranka Travas-Sejdic – University of Auckland
“Centre for Innovative Materials for Health”
Faculty of Science, University of Auckland

Ben Yin - Victoria University of Wellington
“Exploring Geothermal as a Resource for Hydrogen Production and Lithium Extraction”
Mātauranga Māori Research Fund

3.

Into the marketplace



The MacDiarmid Institute's focus on commercialisation and industry engagement continued in 2024. Alongside our NZ Cleantech Mission partners, we proudly launched the Cleantech Report 2024 in Parliament. We have witnessed researchers successfully launch new start-up ventures while existing companies thrive and evolve. Our ongoing support through seed funding, workshops and seminars fosters a collaborative environment for our community to work, learn and grow together. This year also saw some Investigators transition from academia to the start-up world, reflecting the dynamic development of our ecosystem.

Cleantech Report 2024: Materials for a sustainable economy

The advanced materials research occurring at our labs across the country is well positioned to contribute to new products, processes and services that underpin a transition to a sustainable economy. That motivated us to work with the NZ Cleantech Mission, to co-author the New Zealand Cleantech Report 2024: Profiling the New Zealand Cleantech Sector.

The report analyses this rapidly emerging sector, showcasing some of the globally competitive emerging companies, and exploring the challenges and opportunities that local cleantech entrepreneurs face when taking their companies global.

"My hope is that this document serves as both a reflection on Mint Innovation's journey so far and a roadmap for the future, encouraging a continued commitment to innovation and sustainability, and positioning New Zealand not just as a creator but also as a global leader in the clean technology arena."

Mint Innovation co-founder and CEO Dr Will Barker

The sector is comprised of over 130 companies across the country, and data from 65 of these companies that employ 1190 people identified:

- over $535 million aggregate historic private investment, (to 31 March 2024), leveraged off $55 million in historic grant funding;
- intention to raise $440 million capital in 2024;
- $291 million revenue (for two years to 31 March 2024), despite the majority of companies still being pre-revenue;
- $121 million R&D expenditure (for two years to 31 March 2024);
- $87 million spent on capital items (for two years to 31 March 2024).

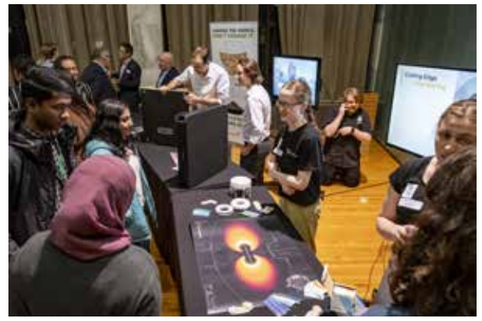
Ten of the companies surveyed are MacDiarmid Institute affiliated start-ups and we continue to advocate for policy, funding and investment settings that support these to compete in global markets. In line with this, we were pleased to see the consultation for the second set of Nationally Determined Contributions under the Paris Agreement include a pillar for innovation to contribute towards New Zealand's emissions reduction for the first time.

The report has helped identify and showcase this emerging sector of the New Zealand economy and provides an opportunity for investors, policy makers and entrepreneurs to focus their efforts on enhancing New Zealand's ability to participate in the largest disruptive economic trend in our lifetimes.

Above: John Worth (Geo40) speaking at the Techweek event.

Right: Techweek event exhibitors.

Below left: Strategic Manager Māori Kirsty Doyle, Peter Gilberd (Tertiary Education Commission) and Deputy Director Māori Pauline Harris.



Above: NZ Cleantech Report authors (from left) Kevin Sheehy, Aljo Anand and Phil Anderson (far right), with Hon Simon Watts (second from right).

Left and far left: Natalie Plank at the Techweek event.

SHOWCASING THE NEW ZEALAND CLEANTECH SECTOR AS PART OF TECHWEEK

We launched the New Zealand Cleantech Report in Parliament at our regular Techweek event, titled *New Zealand Science Forging Global Cleantech Solutions*. We once again led the hosting of this event, and were hosted in Parliament by Minister for Climate Change, Hon Simon Watts, and Minister of Science, Hon Judith Collins for this launch.

The event included a mini expo of cleantech companies and was able to showcase these companies and the excellent speakers to our 200 guests from commercial, investment, research and policy backgrounds. Exhibitors included:

- Liquium
- CarbonScape
- Bspkl
- Enpot
- Tūhura Otago Museum
- Hot Lime Labs
- XFrame

The groups we worked with as co-hosts for the event were:

- MacDiarmid Emerging Scientists Association (MESA)
- KiwiNet
- Momentum Committees (Return on Science)
- NZ Product Accelerator
- Dodd-Walls Centre
- Biomolecular Interaction Centre
- Paihau–Robinson Research Institute
- House of Science
- CHIASMA

Techweek speakers Veronica H-Stevenson (Humble Bee Bio, above), Michelle Dickinson (Nanogirl Labs, right) and Marny Reakes (Pacific Channel and MacDiarmid Institute Governance Board, left).

Below: Techweek event contributor and co-host logos.

New decarbonisation focused research collaboration with Fisher & Paykel Appliances

The Fisher & Paykel Carbon Zero SmartHome R&D Institute has a mandate to pursue research and innovation with the potential to fast-track home energy decarbonisation.

Decarbonising the appliances that consumers rely on in the modern home is going to need new approaches to the age-old tasks of cleaning, heating and cooling homes and keeping food fresh. We are now working with Fisher & Paykel Appliances on a research project to develop an innovation in washing machines to enhance their operational sustainability.

Through a set of mutual site visits to the Fisher & Paykel Design Centre and R&D facilities and some of the labs of our scientists, we developed an understanding of each other's capabilities and aspirations. Bringing together the deep understanding of the appliance market, including what customers are wanting, with the multidisciplinary research skillset, we have now been able to commence work on our first collaborative project. We aim to grow our engagement with Fisher & Paykel as well as other companies tackling the sustainability challenges across numerous industries to re-invent the processes, products and services that society needs to live within planetary boundaries.

FISHER & PAYKEL

"With a critical focus on carbon emissions, we are seeking to address the urgency of the climate crisis with speed and scale in multiple areas of our business."

Fisher & Paykel Appliances

Seed funding projects to give a rapid boost to commercial feasibility

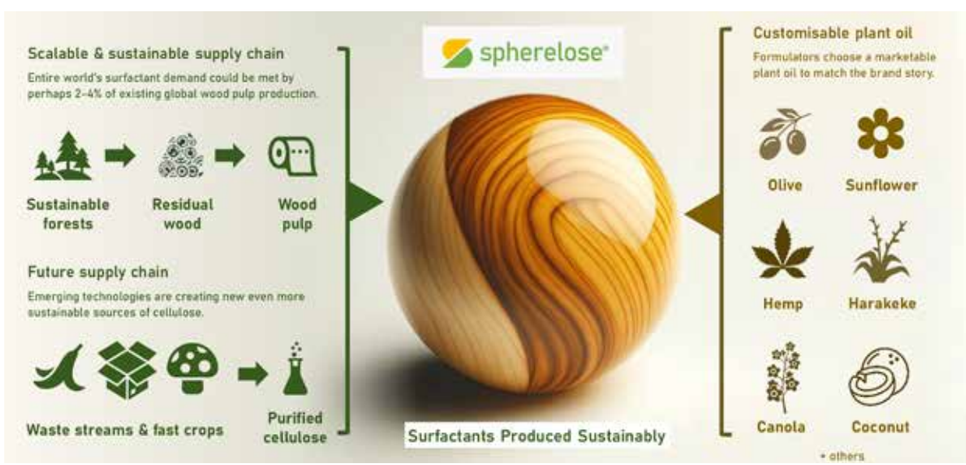
Providing early commercial funding to pursue commercial milestones can help researchers convert academic work into commercial value. The seed funding we provide aims to build commercial capability and confidence for researchers to validate the potential applications of their research and work with their Technology Transfer Offices (TTOs) to begin packaging intellectual property into an investable proposition. We regularly see the small amounts of seed funding (less than $25k) lead to ambitious commercial projects as we have seen both Spherelose and Ternary Kinetics launched this year after receiving seed funding.

Ternary Kinetics is developing technology to "move electricity as a liquid, to power electric trucks, trains, planes and industry, with zero emissions renewable power." With the most rapid turnaround from scientific proof of feasibility to investment we've yet seen, Principal Investigator **Professor Aaron Marshall** was able to start his second company in partnership with Sean Molloy and Sean Simpson and raise over $3M capital from local and international investors, in an 18-month period. The rapid acceleration from the lab to a commercial venture is highly exceptional in deep tech, and demonstrates that the cleantech innovation network locally is beginning to operate highly efficiently to bring innovation to market. Aaron's research at Te Whare Wānanga o Waitaha University of Canterbury continues to focus on numerous electrochemical solutions to the world's energy transition.

Spherelose is scaling up the production and formulation of a bio-sourced, biodegradable surfactant from cellulose into a range of products that rely on emulsifiers and surfactants for their active properties. Developed by Associate Investigator **Dr Jack Chen**, the proprietary process and material provide a platform technology that is well-placed to displace petrochemical emulsifiers and enhance the sustainability of cosmetics, detergents and related product categories. Jack was a finalist in the Sprout Agritech Breakthrough Innovator category of the 2024 KiwiNet Awards. He continues to develop the technology as CSO of Spherelose, while researching further green chemistry solutions to many of the world's sustainability challenges at Te Wānanga Aronui o Tāmaki Makau Rau Auckland University of Technology.

We look forward to seeing the commercial ambitions of our 2024 seed funding recipients achieved in the coming years. These recipients were:

- Associate Investigator Dr Michél Nieuwoudt – Raman laser diagnostics
- Associate Investigator Professor Peng Cao – battery anode materials
- Associate Investigator Dr Matthew Cowan - fluidized bed gas separation process
- Associate Investigator Professor Renwick Dobson – antimicrobial peptides



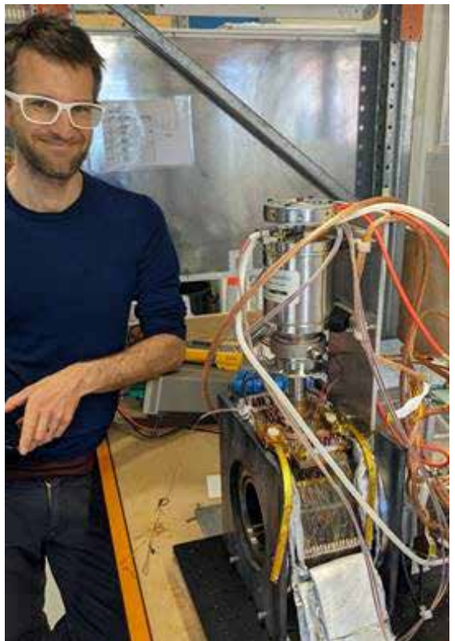
Launching into deep space commerce

Associate Investigator Dr Ben Mallett and his co-founder **Dr Jamal Olatunji** took the plunge and founded their start-up to commercialise thruster technology that enables routine deep space travel for large spacecraft. The company is spinning-out from Paihau-Robinson Research Institute after its demonstration of several world-firsts related to the thrust technology, and the upcoming launch of the Heki mission to the International Space Station.

"The market validation process was the single most important factor in our deciding to take the plunge and spin-out JxB."

Dr Ben Mallett

The MacDiarmid Institute has supported the team with critical advice and supported the team's market validation work through an early seed funding round. The skills, knowledge and networks the team gained by undertaking the market validation has enabled them to effectively engage with potential international partners and investors. The company – JxB Space Systems – has an option agreement for the exclusive license to commercialise the technology, and will be raising capital in early 2025 with its aim of taking the prototype into commercial partner testing.



Left: Dr Jamal Olatunji.

Top right: A plasma shines bright.

Right: Dr Ben Mallett.

Making the leap – from scientist to full-time start-up C-suite

The Institute has always thrived through renewal of our Investigator cohort and this year we are pleased to see that three of our researchers are moving into full-time commercial roles at their respective deep tech start-ups.

Professor Justin Hodgkiss (Co-Director and Principal Investigator) is embarking on the journey of CEO in Advemto, and announced first close of their seed capital raise in late November. Advemto spun out in 2022 to commercialise technology developed at Te Herenga Waka Victoria University of Wellington (VUW) for time-resolved fluorescence instrumentation. More recently, they have refined their focus on the high throughput biomarker discovery market for biotech and pharmaceutical industry clients. The ultrafast laser spectroscopy technology that Advemto has developed is able to provide a step change in resolution, and throughput for the fast-moving market of human therapeutics and diagnostics. Advemto's transformational biomarker mapping allows labs to identify hundreds of biomarkers simultaneously, surpassing the limitations of traditional fluorescent methods.

Dr Laura Domigan (Principal Investigator) is taking on the Chief Scientist role full-time at Opo Bio, a B2B company creating high-quality cell lines for precision fermentation, that can be used in a range of applications, from collagen for cosmetics to animal-free food and biotech ingredients.

Having a longstanding interest in taking science to the market, Laura has worked through a few commercial options related to her research over the seven years she was with the MacDiarmid Institute. The market timing, highly capable team she's pulled together and maturing Opo Bio technology stack have supported her confidence in making the move from academia to the commercial world this year. Raising capital in a highly constrained environment has not been easy, but Laura, her co-founder Vaughan Feisst and their Opo Bio CEO, Olivia Ogilvie (MacDiarmid alumna), have stood out from the crowds and succeeded in setting the company up to scale and grow in 2025.

Professor Eric Le Ru (Principal Investigator) is committing most of his time as Chief Science Officer at Marama Labs, a company that Eric co-founded in 2019 with two other MacDiarmid Institute alumni, Dr Brendan Darby (his PhD student at the time) and Dr Matthias Meyer. The Marama Labs team have recently developed further capability in analysing pharmaceutical formulations. Their proprietary analytical equipment, CloudSpecTM, quantifies the therapeutic content of nano-formulations such as RNA in Liquid Nanoparticles in seconds, with a unique accurate and precise fluorescence-free technology. The company continues to pursue ambitious R&D projects that enhance their ability to service the biotech, pharmaceutical and fermentation markets. Eric's extensive scientific expertise developed over the ten years he's spent with the Institute at VUW is pivotal to progressing the company's entry into new applications and markets.

Above: Laura Domigan (right) with Olivia Ogilvie.

Below from left: Dr Brendan Darby, Dr Matthias Meyer and Prof Eric Le Ru.

Spin-outs formed in 2024

MACDIARMID INSTITUTE AFFILIATED START-UP COMPANY DATA

The start-up companies affiliated with us report[1] that during the 2024 year, they:

- Raised NZ $41.2 mil private capital (includes one company that is now registered offshore)
- Raised NZ $24.4 mil private capital from offshore investors (includes one company that is now registered offshore)
- Spent NZ $8.8 mil on R&D, with $3.3 mil of that spent in New Zealand
- Employed 56.9 FTE staff in New Zealand – includes a growth of 9 FTE (new employees) over the course of 2024
- Employed 24.4 FTE of PhD team members in New Zealand
- Employed 16 MacDiarmid Institute alumni in New Zealand (including founders)

Two new companies spun out of their universities and were registered:

- JxB Space Systems from Victoria University of Wellington, Robinson Research Institute and Univentures
- Spherelose – Auckland University of Technology and AUT Ventures

Looking forward to 2025, our affiliated start-up companies report that:

- At least four new companies plan to go to market for capital raises

Patenting

Patenting activity in 2024 grew to include 29 researchers, students and alumni who reported 33 Formal IP milestones including Invention disclosures, patent applications, and granted patents.

The following patent activity was undertaken by our researchers in partnership with their respective Technology Transfer Offices (only MacDiarmid Institute researchers named on the patents are included here).

PATENT APPLICATIONS

Nathaniel Davis, Jake Hardy
- Perovskite material and uses thereof - WO2024258297A1

Margaret Brimble
- Methanogen Inhibitors (Publication) - AU2023326615A1
- Methanogen inhibitors (Publication) - WO2024039250A1
- Lipidated Polymyxin Analogues (Publication) - EP4384533A1

Shane Telfer, Elnaz Jangodaz
- Multivariate metal-organic frameworks - AU2024900804A0

Natalie Plank, Jadranka Travas-Sejdic, Roshan Khadka, Han Yue Zheng, Thanihaichelvan Murugathas
- Sensor device and methods - US20240241077A1

James Storey
- Homopolar electric machine - (AU2024901882A0)

Ren Dobson, Daniel Mak, Claude Meffan, Volker Nock
- Microfluidic devices, systems and methods - AU2024900227A0

Matt Cowan
- Solid-state copper(i) sorbents for olefin separations - US20240367089A1

Aaron Marshall, Leatham Landon Lane
- Method for processing materials containing iron and zinc - AU2024903553A0

Ben Ruck, William Holmes-Hewett, Jackson Miller, Catherine Pot, Eva Anton
- Switchable magnetic device or dot for data storage (publication) US20240147869A1

Peng Cao, Yuguang PU
- High-entropy oxides (publication) - EP4476172A1

Geoff Waterhouse
- A preparation method of cobalt phosphide nanomaterial by visible light reduction of cobalt salt in aqueous solution – China Patent application number: 202410405231.4
- A visible light driven preparation method of reduced graphene oxide in aqueous solution – China Patent application number: 202410799941X
- A preparation method of heterojuncture catalysts and its application – China Patent application number: 2024118159548
- A preparation method of biomass derived carbon supported FeP and its application – China Patent application number: 2024116665441
- A preparation method of carbon enveloped CoP & carbon enveloped CoP on C3N4 and their applications – China Patent application number: 2024116665070

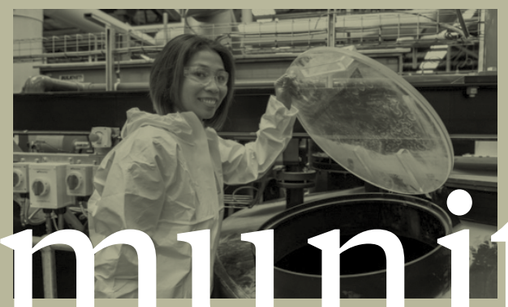
PATENTS GRANTED

Simon Brown, Shawn Fostner, Saurabh Bose
- Neuromorphic computing - EP3317224B1

[1] Data provided by seven responding startup companies

4.

Into the community



Outreach and education within the MacDiarmid Institute continued to grow in 2024. A key initiative was connecting with secondary school educators and participating in national and international chemical education conferences. We contributed to regional outreach across the motu, from an expo in Te Urewera, to ongoing collaborative engagements in Northland, Otago and Southland. Underpinning all of our activities are our Investigators and students; driven by their passion for research and education, they inspire our communities and our Institute alike.

DiscoveryCamp and NanoCamp 2024

Our Waipapa Taumata Rau University of Auckland and Te Wānanga Aronui o Tāmaki Makau Rau Auckland University of Technology researchers hosted ten Year 12 and 13 students at our annual NanoCamp, 21-25 January. The programme included labs where the students learnt about nanoparticles and solar cells, a visit to the Photon Factory and a day trip to Tiritiri Matangi Island, as well as a panel of our current PhD students talking about their own journeys in science and academia.

DiscoveryCamp took place in Pōneke Wellington and was run by our Te Herenga Waka Victoria University of Wellington-based researchers, 22-26 January. Ten Year 12 and 13 students spent the week building their own solar cells, investigating MRI and the scanning electron microscope, learning about space science, lab visits and visiting GNS Science and Paihau-Robinson Research Institute.

"I personally find failure something scary and uncomfortable. But (the PhD students we spoke with) were in agreement that failure is good and its always going to part of the journey. I learnt we should always be open to failure and always learn from failure."

"DiscoveryCamp has definitely made me feel more confident as a Māori female wanting to gain science based degrees."

"DiscoveryCamp helped me to realise that there are other people like me who want to do the same things or similar things and...(that) science is so much more than I could ever imagine."

"Was NanoCamp 2024 anything like I expected? No. But it was even better than I could have imagined. And I will be forever grateful for this experience."

NanoCamp 2024 attendees, organisers and volunteers in Albert Park, Tāmaki Makaurau Auckland.

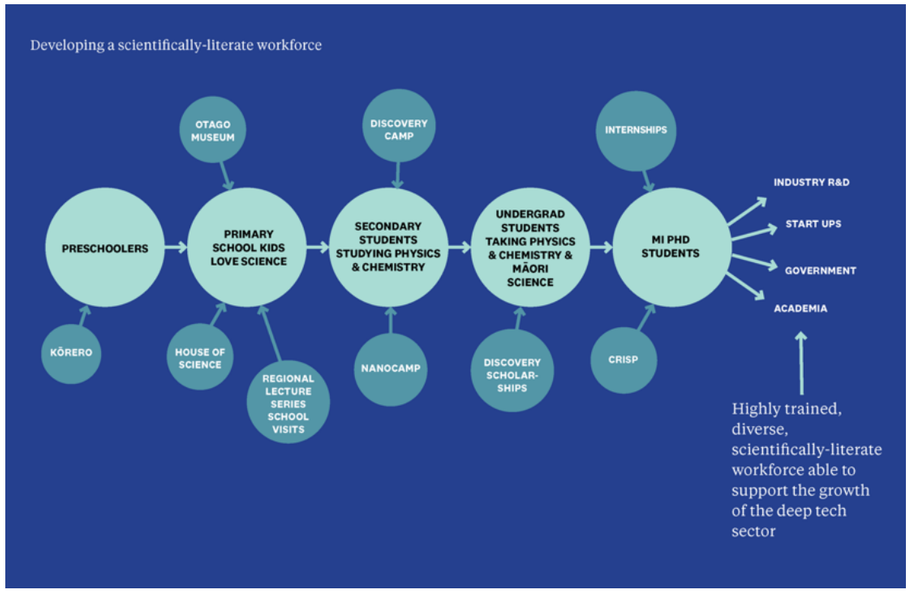
DiscoveryCamp 2024 attendees during visit to Zealandia.

MacDiarmid Institute presence at IUPAC International Conference on Chemistry Education

In July our Deputy Director Outreach and Education, Ōtākou Whakaihu Waka University of Otago (UoO) based Principal Investigator Associate Professor Anna Garden, and UoO-based Institute Affiliate Dr Dave Warren travelled to Pattaya, Thailand, as invited speakers at the International Union of Pure and Applied Chemistry (IUPAC) International Conference on Chemistry Education 2024 (ICCE 2024). Anna presented a talk 'From kindergarten to KiwiNet – Outreach and Education in a Centre of Research Excellence'.

The IUPAC audience was enthusiastic about the Institute's Discovery Scholarships, especially the different categories of awards catering for different types of learners. At the New Zealand ChemEd BioLive conference for secondary teachers this year, Anna presented to chemistry teachers a gold nanoparticle experiments she was introduced to in Thailand (next article).

In addition to highlighting the Institute to an international audience, Anna and Dave's trip was a useful chance to connect with colleagues in chemical education, and to begin discussions around ways to evaluate informal and non-formal modes of education. Anna and Dave made the first attempt at evaluation following a MacDiarmid Emerging Scientists Association (MESA) workshop (reported on elsewhere) and will continue work in this space with a view towards quantifying the impact of her portfolio's activities.



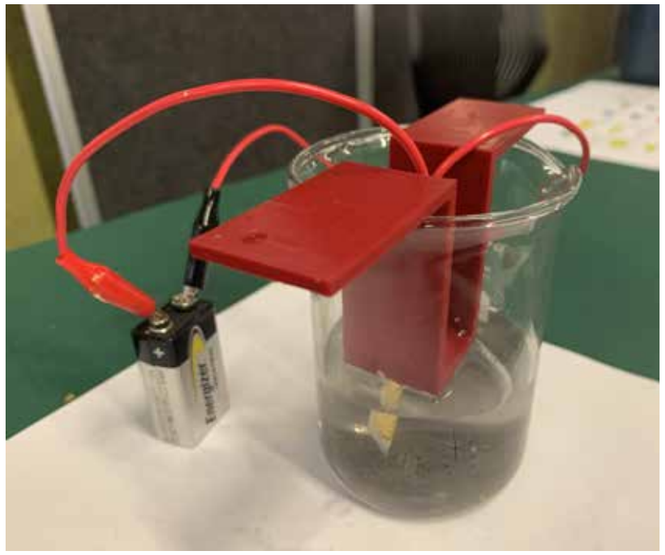
Above: Slide included in Anna Garden's talk at the ICCE 2024 conference. The slide features a flowchart of steps to achieving a scientific workforce, with MI outreach and education activities shown as inputs.

PhD student Shae Patel speaking with the ChemEd teachers during the lab tour.

Targeted support for science teachers

One objective for the Institute is to target better the needs of teachers. After consultation with several teachers across the motu, this year we sponsored and attended ChemEd BioLive – New Zealand secondary school teachers' conference – for the first time. Deputy Director Outreach and Education Associate Professor Anna Garden presented a workshop demonstrating a simple synthesis of gold nanoparticles that can be performed using only materials from the supermarket or craft store, making nanoscience experiments safe and affordable for use in the classroom.

We also offered tours of various MacDiarmid Institute labs at Te Herenga Waka Victoria University of Wellington, which were very popular and drew many interesting questions from the teachers. We are working to use the information we have regarding career outcomes of our graduates (see the *'Inspired One Hundred'* list in the following 'Into the Future section') to help provide resources for teachers. Examples of deep tech careers and non-academic career pathways in science are increasingly useful and sought after.



Left: Gold nanoparticles.

Above: Associate Professor Anna Garden speaking with chemistry teachers at ChemEd BioLive ahead of the tour of MacDiarmid Institute labs at Te Herenga Waka Victoria University of Wellington.

Te Urewera Livelihoods Expo, Tāneatua

We were privileged to be invited by Tūhoe (through their connection with Principal Investigator Professor Derek Kawiti) to deliver outreach and an evening talk at Te Urewera Livelihoods Expo 2024, the kaupapa of which was to re-engage the people of Te Urewera with their whenua and spark imagination for the future.

Principal Investigator Professor Geoff Willmott, Associate Investigator Dr Charlie Ruffman, Discovery Scholar and Paihau-Robinson Research Institute Materials Technician Tane Butler, and Te Herenga Waka Victoria University of Wellington PhD student Lara Browne joined Derek at Tāneatua in mid-May. Tane and Lara ran a 'build a berry solar panel' activity (kindly provided by Associate Investigator Dr Nate Davis). Charlie, Lara and Tane showcased a water electrolyser run by a (slightly bigger) solar panel, and Tane shared information on using harakeke membranes to filter water while Derek demonstrated his 3D printing. Attendance at the Expo across the two days included 13 schools, with a total of 250 students plus 30-40 teachers.

Geoff gave a 15-minute evening presentation to around 200 whānau members and 50 kaimahi/helpers, around increasing prosperity for Aotearoa New Zealand in a sustainable way through advanced materials and nanotechnology.

Lara Browne (left), Derek Kawiti (above right) and Tane Butler (opposite page) running outreach activities at Te Urewera Livelihoods Expo 2024.

Ōtākou Whakaihu Waka University of Otago chemistry outreach trips to Te Hiku

Institute Affiliate Dr Dave Warren has continued to build on his relationship with Ngāti Kahu in Te Hiku with visits by his Ōtākou Whakaihu Waka University of Otago (UoO) chemistry outreach team. The hapu and Iwi have had poor interactions with scientists in the past, resulting in loss of traditional tāonga (valuable resources). This led to the vaccine hesitancy and distrust of science prevalent in the community in 2022 when we first visited. This outreach project was established as an attempt to normalise science in schools and re-build community trust in science.

A key part of engaging students with science is in putting the science in the context of something important to them. On the outreach team's visit in June/July, the theme for the visit was water (a concern in many areas of the rohe); it included growing silver mirrors from 'water' (actually Tollens reagent, pointing out how hard it is to identify 'clean' water just by looking at it), nitrate testing procedures and a session with UoO PhD student Sam McIntyre delivering an activity to explain her research into nanoparticles for use in remediating nitrate pollution in water sources. We also included hydrogen fuel cell kits (from He Honoka Hauwai) for use in new schools (we had used them last year with schools in our November trip) demonstrating how energy can be produced from water. In November they visited again, introducing 'make-your-own' solar cells for the older students. They also added a new school (Kaitaia Intermediate) and were joined by Deputy Director Outreach and Education Associate Professor Anna Garden.

Dave's team has visited a number of times now, forming deeper relationships as they continue to come back. Dave notes, "The number of kids who come up and talk to us when we are stopping or walking around town, we are introduced to whānau as 'our scientists'. We were also invited to attend Oturu schools Matariki celebrations in the Kaitaia civic centre.

"While we were in the area we collected seven more kānuka samples as part of an ongoing collaboration with one of the local hapu (Liam Hewson's Masters work), and we are currently looking at developing some topical treatments based on kānuka extract for use in local schools to treat 'school sores' and other skin complaints (in partnership with Plant and Food). The development of the cream is a strong indication that the project is starting to do its job, breaking down some of these barriers and the community is more willing to accept and trust scientists."

Partnering with Tūhura Otago Museum

Direct MacDiarmid Institute outreach activities through Tūhura Otago Museum in 2024

	Numbers reached
School visits	395
Workshops	30
Total	**425**

MacDiarmid Institute content present in the Tūhura Otago Museum's wider outreach activities in 2024

	Numbers reached
Tūhura Tuarangi – Aotearoa in Space showcase	2438
Showcase of Showcases event at Parliament	250
Cleantech event at Parliament	50
Total	**2,738**

CLIMATE CHANGE OUTREACH AT WAKARI SCHOOL – DEVELOPING A GENERATION WITH THE KNOWLEDGE NEEDED TO TAKE ON THE SUSTAINABILITY CHALLENGES OF THE FUTURE

Tūhura Otago Museum's science engagement team spent several days at Wakari School delivering a climate change outreach programme to the entire school to help the school launch a participatory science project to reduce its carbon footprint and to work towards becoming a net zero school. The team adapted content from 'Far from Frozen' and MacDiarmid Institute-themed 'What Can We Do?' content for all age groups; students learned about what causes climate change, the research being done to mitigate it and what individual actions they can take to reduce their impact on the environment. With the focus on building climate resilience through mitigation and adaptation technologies being developed here in Aotearoa, the sessions left the students feeling empowered to enact change and excited to begin their science project.

Above: Nanoscience setup at Ōpoho School (top). Some of the activities for the nanoscience session (bottom).

Left and far left: Activities from the 'What Can We Do?' module being used during a climate change outreach session at Wakari School.

‘Showcase of Showcases’ event at Parliament

Dr Craig Grant (former Director, Visitor Experience and Science Engagement at Tūhura Otago Museum) coordinated the installation of many of the Museum’s science showcases in Parliament’s Banquet Hall on 21st May, and outside on the forecourt 22nd and 23rd May. The Museum team brought ‘Far From Frozen II: Going to Extremes’ to Parliament, which included the MacDiarmid Institute-focused ‘What Can We Do?’ module. The team also displayed the ‘100 women, 100 words…’ slideshow, which features several women associated with the MacDiarmid Institute.

Below: ‘Far from Frozen II: Going to Extremes’ in the Banquet Hall. Right: ‘100 women, 100 words…’ on display at Parliament.

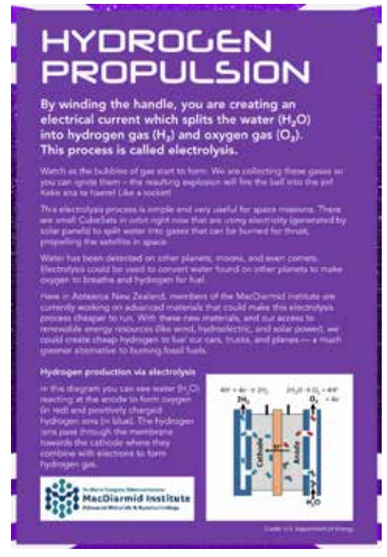
Lab in a Box on Parliament’s forecourt.

Adding MacDiarmid Institute-related content to the ‘Tūhura Tuarangi: Aotearoa in Space’ showcase

One of Tūhura Otago Museum’s most popular science showcases, ‘Tūhura Tuarangi: Aotearoa in Space’, includes an interactive that uses electrolysis to generate green hydrogen (an area of research underway at the MacDiarmid Institute).

Hydrogen kits for outreach

Tūhura Otago Museum and the Institute have co-purchased a Horizon DIY Fuel Cell Science Classroom Pack to use for MacDiarmid Institute-related outreach and education purposes. The cost of the kit was split with Silver Science, a Museum Unlocking Curious Minds project that uses interactive, hands-on workshops to engage with people who are over 65. Although this over 65 age group is not the Museum’s usual target audience, Silver Science aims to close the generation gap that currently exists on complex, multi-disciplinary issues like climate change. The project uses workshops to engage grandparents and kaumatua in STEM activities to empower them with new knowledge and help them set positive examples for younger generations. Reactions to the hydrogen fuel cell kit have been overwhelmingly positive so far, and Senior Science Engagement Coordinator Marijn Kouwenhoven is working on developing more outreach content that incorporates the kit.



Top: Hydrogen propulsion activity.

Bottom: Information display for the activity.

Silver Science attendees assembling their own hydrogen fuel cell.

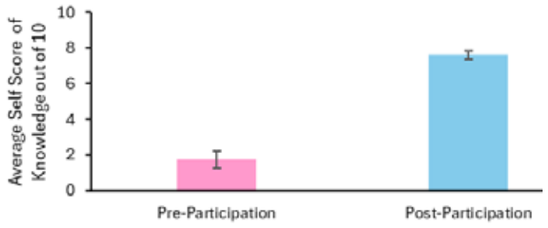
Gender	Age	Enjoyment Rating out of 10	Comments
F	51 - 65	10	It was great. Easy to understand and time for everyone to be at the same stage
M	76 - 85	10	Well done + well explained.
F	76 - 85	10	It was great
F	51 - 65	10	Great content. This was a great discussion and workshop. Very well presented and understandable for someone not science orientated.
M	66 - 75	10	Brilliant. - would like a repeat.

Feedback from the Silver Science hydrogen sessions.

Developing outreach and education capability within the MacDiarmid Institute

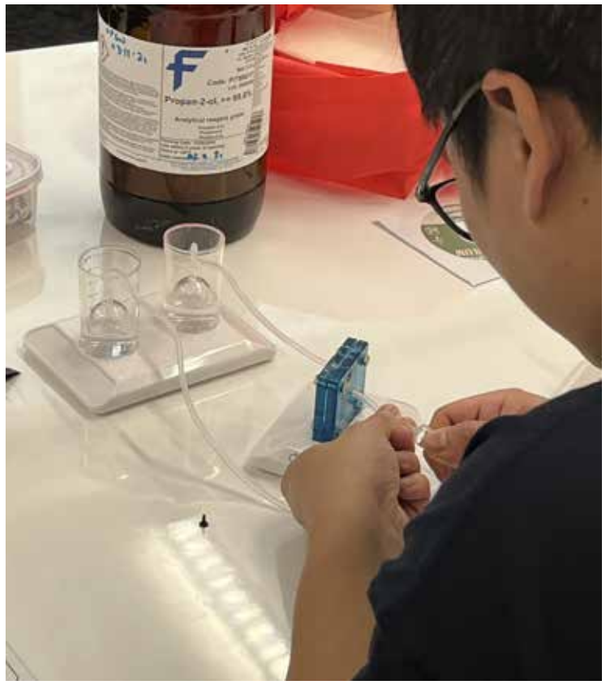
Our Outreach and Education portfolio has a long-term aim to enable more of our people to be involved in public engagement with our science. In 2024 we have been actively working to develop skills and confidence in outreach within the Institute. At the annual symposium, Deputy Director Outreach and Education Associate Professor Anna Garden gave a talk on 'best practice' of outreach, highlighting the need for relevance (regional, cultural), slowly developing relationships and the importance of having fun rather than teaching. Examples were drawn from outreach activities within the Institute and its partners from the last few years.

Two hands-on outreach workshops have been delivered through the Ōtākou Whakaihu Waka University of Otago (UoO) MacDiarmid Emerging Scientists Association (MESA) group. The first was run by Institute Affiliate Dave Warren and Anna Garden. We took this chance to conduct a numerical evaluation of the effectiveness of this workshop in increasing the confidence of our early career researchers and the likelihood of their participation in outreach activities in the next few months. Pre- and post-workshop surveys (N=6) showed that confidence increased by 13 % and likelihood of participation by 17 % as a result of this activity.



Self-scored rating of knowledge on the topic of hydrogen fuel before and after the first workshop.

The second outreach workshop was run as part of our Career and Relevant-to-Industry Skills Programme (CRISP) in November (again run by Anna Garden, with assistance from Marijn Kouwenhoven). A strong focus of the workshop was on emphasising fun and exploration, rather than teaching and facts. Students and early career researchers were asked to come up with ways of demonstrating scientific principles without key words and given specific age groups/demographics to demonstrate activities too. A particular highlight was attendees being able to act as the given audience.



CRISP outreach workshop held in November 2024.

5.

Into the future

In 2011 our founder, Sir Paul Callaghan, said ‘a hundred inspired New Zealand entrepreneurs could turn this country around’. We share here quotes from some of our alumni who have either founded their own deep tech start-up company, are working within other deep tech start-ups, or are working in wider research-led industry here in Aotearoa New Zealand. We continue to support our students to make this difference, with our ongoing soft skills training, internships and more.

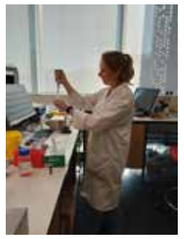
Graduate internships in industry and government

We funded a further ten of our graduates into internships with industry and government in 2024.

Employer	Intern	Project topic
MBIE (Science, Innovation and International Branch)	Anmol Mahendra	Extreme weather research in Aotearoa New Zealand
Daisy Lab	Faiza Arshad	Caseins co-expression
Cleantech Mission	Aljo Anand	NZ Cleantech Report 2024: Making it happen for New Zealand
Scentian Bio	Alaigne Maré	Mimicking nature to extend our sensors from liquid to gas
Sapro-Tech	Grace Drummond	Biopolymer-based coatings for leather substitutes
Liquium	Georgia Richardson	Improve the reactivity of the current Liquium catalysts via a new synthesis process, and examine the mechanistic pathway by identifying and testing possible reaction intermediate species
OpenStar Technologies	Ned Treacher	Experimental plasma physicist
Sapro-Tech	Yubing Mao	Polymer scientist placement
Climate Change Commission	Emma Matthewman	Research needs and opportunities to help Aotearoa New Zealand reduce emissions and adapt to the impacts of climate change
Climate Change Commission	Sahil Patel	Investigating ways agricultural waste could be utilised to move towards decarbonisation

The success of these internships is demonstrated by the positive feedback we've received from both interns and their hosts:

- **Grace Drummond**, intern at Sapro-Tech, a start-up developing a leather replacement material from mycelia: "I have participated in each stage of the production, acquiring new skills in the use of biosafety hoods and practices. I have also investigated several variations of the current procedures, with the aim of increasing the strength of the leather-like material. I would like to thank you for this opportunity, and let you know that Dr Keith has offered me a full-time position as Senior Scientist."
- **Sapro-Tech, Dr Keith Hudson**: "The MacDiarmid Institute internship program provided us with a very capable and personable researcher whose skills complemented our existing repertoire. The employment under an internship was also a real advantage as it allowed both parties to assess the situation with an easy exit if it did not work out, for us it did and the intern is now a valuable member of our team."
- Anonymous intern: "During this internship, I underwent significant personal growth and gained valuable insights into various aspects of professional life. Engaging with stakeholders throughout the project enhanced my ability to communicate effectively and foster teamwork. Moreover, involvement in government operations provided insight into interdepartmental collaboration and report writing, furthering my understanding of organisational dynamics within bureaucratic structures. Working in brilliant a team environment underscored the importance of kindness, teamwork, and adaptability in achieving collective goals. Overall, this internship provided a valuable learning experience, equipping me with essential skills for success in academic and professional settings."
- **Ned Treacher**, intern at start-up company OpenStar Technologies: "A highlight of my time at OpenStar was being in the control room during the spark of the company's first dipole-held plasma, watching the interferometer I had constructed collect real-time data on the density of plasma present in the chamber."



Career and Relevant-to-Industry Skills Programme (CRISP)

In 2024 we have held six CRISP workshops, offering a range of professional development opportunities for our students and postdocs.

April 2024:
- Inside Government – lifting the lid on how government works, where science fits in and where a career in government could take you
- Working with your Technology Transfer Office on Intellectual Property arising from materials research

November 2024:
- Sustainability of Products, Process and Business Models through Advanced Materials
- Outreach
- Tiriti o Waitangi Training
- An Introduction to Investment and Funding Dynamics

The variation in topics allows our research community to learn new things from experts within their respective employment areas. The 'Inside Government' CRISP session had 49 attendees. Dr George Slim spoke about science roles in government, drawing on his own experience including working with the Prime Minister's Chief Science Advisor during Covid, and the Ministry for the Environment ran a highly engaged policy simulation session. We also heard about Diversity, Inclusion and Equity in the public service, and a panel of our alumni and other scientists working in government answered some great questions from attendees.

The CRISP workshop on working with your Technology Transfer Office and intellectual property helped the 38 PhD students from across Aotearoa New Zealand think about their own roles, both now and in the future, and how they can participate in generating the impact offered by science at a global level.

In the summer sessions, we had the Sustainable Business Network delivering a workshop on the sustainability of products, processes and business models through advanced materials, run by Kimberley Savill and Tori Calver, with guest speaker Michael Maunsell, the Chief Operating Officer of Nilo. The 28 attendees were able to work interactively in groups and hear case studies specific to materials science.

We were also able to enhance our researchers' outreach capabilities with a half-day workshop run by Deputy Director Associate Professor Anna Garden allowing students to develop the skills and ideas for effective outreach to inspire our next generation of scientists.

Researchers hard at work during the Outreach workshop.

In parallel with the first day of workshops, Institute Programme Manager Gabrielle Holmes also organised on-site tours at OpenStar Technologies, Hot Lime Labs, Bspkl and Paihau-Robinson Research Institute. It was a great opportunity for students and postdocs to visit some of our local cleantech companies and see first hand the facilities and the teams working there.

Our last day in November had two separate workshops. We were lucky enough to have a Tiriti o Waitangi Training workshop facilitated by Raihānia Tipoki and Tāwhana Chadwick from Kūwaha Limited. This is an informative and powerful workshop that we also held in December 2023 for the CRISP cohort.

The final CRISP session, 'An Introduction to Investment and Funding Dynamics', ran in two parts with Emil Schroder of NZGCP and Mitali Purohit of Nuance Ventures guiding the attendees through the investment landscape and demystifying the system. In the afternoon they had Kristin Gozdzikowska (Funding Fundamentals) and Donato Romanazzi (Te Herenga Waka Victoria University of Wellington) explaining the research funding landscape with ideas on when to apply and how to get funded.

Global Young Scientists Summit – January 2024

The MacDiarmid Emerging Scientists Association (MESA) was able to nominate Atif Islam to attend the Global Young Scientists Summit in Singapore 8– 12 January, funded by the Institute. Atif has shared some highlights from this experience with us:

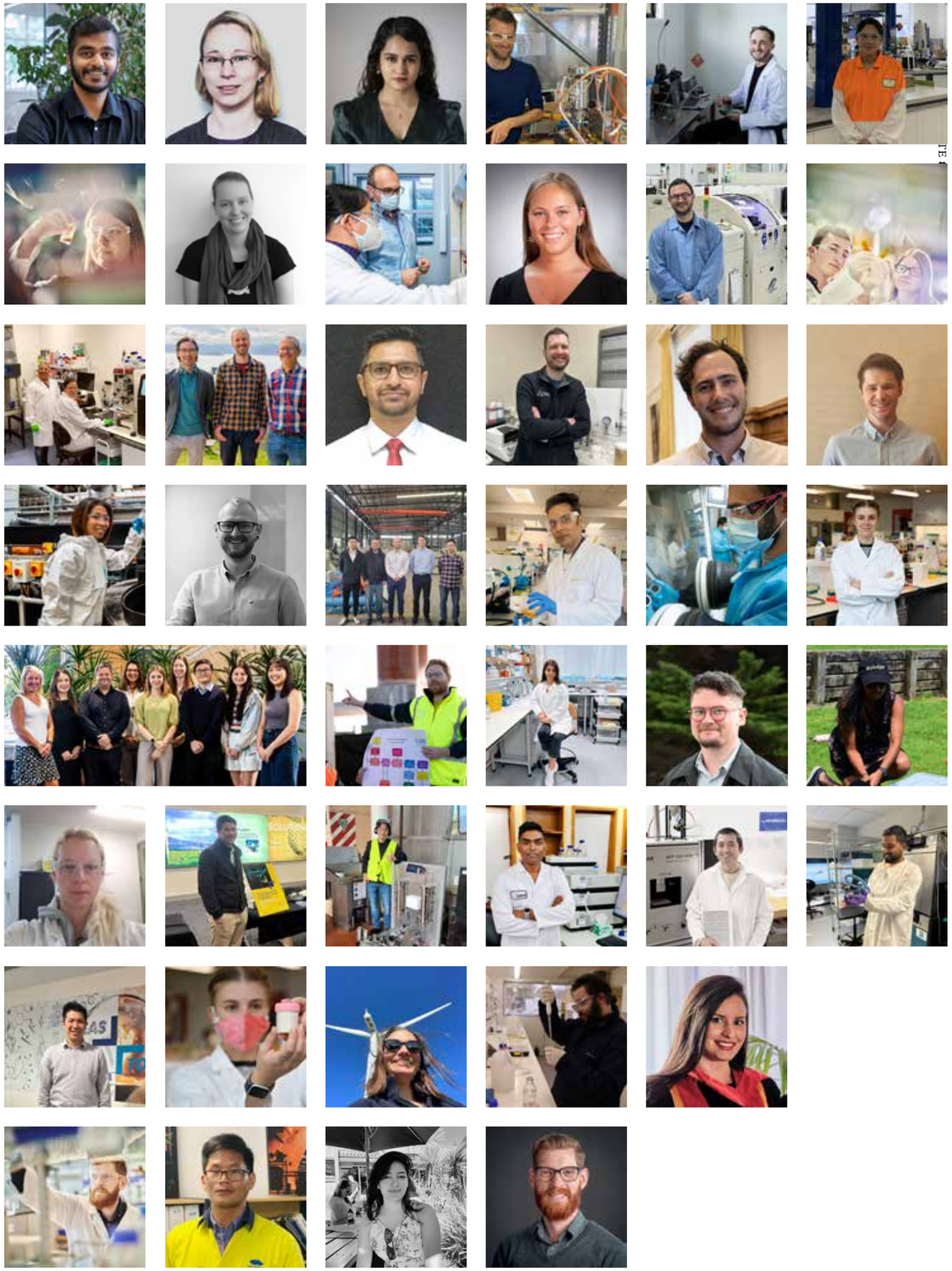
"I had the privilege of attending the Global Young Scientists Summit (GYSS) in Singapore, thanks to the MacDiarmid Emerging Scientists Association. From 8-12 January 2024, I joined 350 young scientists and 16 eminent scientists, engaging in plenary lectures, panel discussions, and interactive sessions. The event was enriching, with speakers like Sir Martin Green, Sir Kostantin Novoselov, and Sir Duncan Haldane sharing insights. Presenting my research during the poster session sparked meaningful discussions, and networking with established researchers widened my perspective. I extend my heartfelt thanks to the MESA, MacDiarmid Institute, and the National Research Foundation Singapore for this incredible opportunity, and I'm eager to integrate my learnings into my ongoing research and collaborations."

> “I’m eager to integrate my learnings into my ongoing research and collaborations.”

Atif Islam at GYSS, Singapore, January 2024.

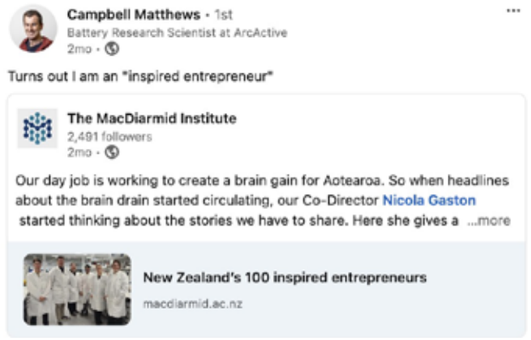
Engaging with our alumni through the *Inspired One Hundred* list

We created a list of our *'Inspired One Hundred'* alumni working in the deep tech sector in Aotearoa New Zealand in 2024, in many cases, working on new technology for climate mitigation and decarbonisation. These entrepreneurial alumni create economic value for New Zealand and they do so with purpose: in the following pages, we share with you the motivation for the work that they do, in their own words.
We thank them all for participating in this project.



"I'm motivated by navigating the intricate intersection of innovative biomedical technology and regulatory compliance, ensuring that Aroa Biosurgery's groundbreaking advancements reach patients safely and swiftly."

Isabel Monteiro



"I joined a deep tech company as they are the tip of the spear for answering the challenge of global warming and sustainable future."

Maxime (Jean Laurent) Savoie

"I am passionate about the deep tech sector because it allows me to contribute to groundbreaking innovations that can transform industries and improve lives. And what I love most about my work is as a Scientist, I love to be free."

Anindita Sen

"I'm passionate about commercializing great technologies that decarbonising industry to fight climate change, being part of a dedicated team to take an idea and create a profitable, sustainable business. It is an exciting time to be working in clean technology in New Zealand."

Leathan Landon-Lane

"I love working in deeptech in NZ because there's such an amazing community of talented scientist and engineers all working on problems that have a huge impact on society. Taking research out of the lab and into the real world is tough and not without risk, but it's these innovations that can change the way we live our lives."

Eldon Tate

"Working in a deep-tech company is like exploring the frontier of innovation—every challenge is an opportunity to push the boundaries of what's possible, and I thrive on turning complex problems into groundbreaking solutions."

Mohinder Naiya

"Working in the deep tech sector is like being at the forefront of a revolutionary frontier, where every breakthrough pushes boundaries and produces a more sustainable future. It's an unwavering search for answers that combines state-of-the-art technology with a strong desire to improve the world."

Olivia Ogilvie

"New Zealand deep tech is effectively translating technology into real-world solutions and elevating Kiwi scientists and engineers to global innovators."

Emma wrigglesworth

"I am driven by primarily by two things; the need to make new and useful things, and the strong desire to leave the world a better place than how I found it."

Thomas Kerr Philips

"I am passionate about developing impactful solutions to improve the health and well-being of people globally."

Vishal Kumar

"My work as a Lead Scientist at Kimer Med has allowed me to delve into the development of cutting-edge broad-spectrum antivirals."

Rishi Pandey

"We only have one earth and it crucial to look after it and its environment; clean technology is vital for all of our futures."

Lily Clague

"My passion for science and problem solving comes from my family and teachers encouraging questioning throughout my life. I've always enjoyed things that are logical or that can be figured out with some well placed thinking. My love for physics in particular came from the most wonderful physics teacher in college who was passionate about both the subject and about teaching."

Felicia Ullstad

"Science is not just a pursuit of knowledge, but a journey fuelled by curiosity and wonder. My love for science is rooted in my understanding that advancements in research and development can enhance the world in which we live."

Aljo Anand

MESA Co-Chairs' report

It has been potentially the busiest year for the MacDiarmid Emerging Scientists Association (MESA) since its inception with the number of events organised by our committee. This year we ran multiple workshops at each centre as well as having multiple coffee catch-ups to keep our members connected outside of their individual research projects.

Workshops included AI integration into coding run at multiple centres. Multiple centres also ran presentation skills workshops. Some highlights were the 3D printing workshop in Tāmaki Makaurau Auckland and the mayor of Palmerston North even put on a workshop for our Te Kunenga ki Pūrehuroa Massey University members!

Our annual bootcamp this year took us to Staveley with a theme of 'The Grindstone: Sharpen yourself into an academic weapon'. There were two days of workshops facilitated by the Te Whare Wānanga o Waitaha University of Canterbury graduate school and a workshop delivered by Principal Investigator Professor Aaron Marshall followed by a panel session made up of MacDiarmid Institute alumni at various stages of their careers. We also had a group trip to the Opuke hot pools in Methven to relax and recharge.

Our members at Ōtākou Whakaihu Waka University of Otago who attended the outreach workshop reported that it was a fun and engaging workshop which greatly developed their understanding of outreach and its importance. A massive thanks to Dr Dave Warren, Institute Affiliate, and Associate Professor Anna Garden, Deputy Director Outreach and Education, for helping us host this workshop.

We believe it would be beneficial for every centre to run an outreach workshop near the start of the academic year so that those who are inspired to volunteer for outreach activities have the maximum number of opportunities to do so.

We would like to say a massive thank you to all the MESA members who have participated this year, and we hope you have been able to develop some skills and relationships with fellow researchers along the way!

Finally, we would like to take the time to thank this year's amazing MESA committee for putting on so many amazing events and bringing their ideas to fruition for their peers.

Thanks for an amazing year!

Kieran DeMonte and Brooke Matthews
MESA Co-Chairs.

MESA commercialisation report 2024

Our two MacDiarmid Emerging Scientists Association (MESA) Commercialisation and Industry Engagement (CIE) Representatives, Sam Harris (Ōtākou Whakaihu Waka University of Otago) and Aston Pearcy (Te Herenga Waka Victoria University of Wellington), have had an enjoyable and fruitful year in their roles.

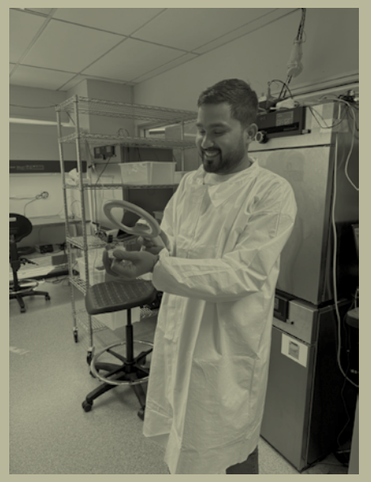
Along with Brooke Matthews and Winter Zakaria, Sam and Aston have supported the development and delivery of several engaging CRISP workshops, at both a stand-alone CRISP event and the MacDiarmid Institute annual symposium. These workshops were accompanied by site visits to Liquium, Marama Labs, BioOra, OpenStar Technologies, Bspkl and Hot Lime Labs. These CRISP sessions and site visits help prepare students for success in potential careers in deep tech start-ups or commercial R&D.

Sam and Aston supported the planning and had the privilege of attending Techweek at Parliament, with the theme 'NZ Science Forging Global Cleantech Solutions', at which the 2024 NZ Cleantech Report was released. Later in the year they attended the Nexus Summit, where they were able to learn from, and network with, commercialisation professionals in the ecosystem. It was great to represent the MacDiarmid Institute at this event and to spread awareness of MESA to this community. This summit was followed by the KiwiNet Awards, which was an excellent chance to speak with academics, investors, and entrepreneurs in deep tech, and to see the exciting innovations taking place.

Sam and Aston would like to welcome Ghadir Dahalan and William Sheard to the CIE roles for next year, as both Sam and Aston are moving onto future endeavours.

6.

Into the metrics



Financials

	2023	2024
Income		
CoRE Funding	$6,400,000.00	$6,400,000.00
Surplus Carried forward	$2,888,688.94	$2,066,898.02
Total Income	$9,288,688.94	**$8,466,898.02**
Salaries and salary related costs		
Directors and Principal Investigators	$746,753.80	$1,069,554.62
Associate Investigators	—	—
Post-Doctoral fellows	$1,066,925.65	$663,818.46
Research/Technical assistants	$280,955.99	$663,419.15
Others	$525,829.50	$623,797.55
Total Salaries & Salary-related costs	$2,620,464.94	**$3,020,589.78**
Other Costs		
Overheads	$935,071.53	$1,911,786.86
Project Costs	$1,476,764.02	$2,330,502.16
Travel	$175,870.33	$108,731.90
Postgraduate students	$1,988,722.90	$1,020,430.24
Equipment depreciation/rental	$24,897.21	$55,055.00
Subcontractors	—	—
Extraordinary expenditure	—	—
Total Other Costs	$4,601,325.98	**$5,426,506.16**
late partner invoices to be paid out in following financial year	$1,135,117.10	—
Total CoRE Expenditure		
Total Expenses	$7,221,790.92	$8,447,095.94
with late invoices	*$8,356,908.02*	—
Net Surplus/(Deficit)	$2,066,898.02	$19,802.08
with late invoices	*$931,780.92*	—

At a glance

Headcounts by category	
Emeritus Investigators	21
Principal Investigators	34
Associate Investigators	51
Students	333
Postdoctoral researchers and research assistants	99
Total	**538**
Peer reviewed research outputs by type	
Journal articles	414
Books	2
Book chapters	6
Conference papers	9
Reports	2
Total	**433**

Board, executive, staff and students

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University of Auckland

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Victoria University of Wellington

Associate Professor Anna Garden
Deputy Director Outreach and Education, MacDiarmid Institute
University of Otago

Associate Professor Pauline Harris
Deputy Director Māori, MacDiarmid Institute
Massey University

Associate Professor Natalie Plank
Deputy Director Commercialisation and Industry Engagement, MacDiarmid Institute
Victoria University of Wellington

Professor Charles Unsworth
Science Executive Representative, MacDiarmid Institute
University of Auckland

*Partial year

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*Partial year

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Associate Professor Anna Garden
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Associate Professor Chris Fitchett
Associate Investigator Representative
University of Canterbury

Dr Simon Granville*
Research Programme Leader: Future Computing
Victoria University of Wellington

Professor Derek Kawiti
Principal Investigator Representative
Victoria University of Wellington

Associate Professor Jenny Malmstrom
Research Programme Leader: Reconfigurable Systems
University of Auckland

Professor Shane Telfer
Research Programme Leader: Catalytic Architectures
Massey University

Professor Charles Unsworth
Principal Investigator Representative
University of Auckland

Keiran DeMonte
MESA Co-Chair
University of Otago

Brooke Matthews
MESA Co-Chair
University of Canterbury

* Partial year.

EX-OFFICIO

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Victoria University of Wellington

Rosie Wayte
Institute Manager, MacDiarmid Institute
Minute-taker
Victoria University of Wellington

Vanessa Young
Strategic Engagement and Communications Manager, MacDiarmid Institute
Victoria University of Wellington

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PhD student
University of Canterbury

Keiran DeMonte
Co-Chair
PhD student
University of Otago

Marco Vás
Secretary
PhD student
University of Auckland

Nicholas Smith
Treasurer
PhD student
University of Otago

Stefania Glukhova
Social Media Representative
PhD student
Victoria University of Wellington

Samuel Harris
Senior Commercialisation and Industry Representative
PhD student
University of Otago

Aston Pearcy
Junior Commercialisation and Industry Representative
Junior scientist
Victoria University of Wellington

Winter Zakaria
Diversity, Equity and Inclusion Representative
PhD student
University of Canterbury

Cynthia Andriani
Centre Representative
PhD student
University of Auckland/Massey University

Jodi Carter*
Centre Representative
Masters student
Victoria University of Wellington

Askin Eldiven
Centre Representative
PhD student
University of Canterbury

Elouan Hay-Fourmond
Centre Representative
PhD student
University of Otago

Alaigne Mare*
Centre Representative
Masters student
Victoria University of Wellington

Olivia Matich
Centre Representative
PhD student
Auckland University of Technology

Chris Mills
Centre Representative
PhD student
University of Otago

Brijesh Patel
Centre Representative
PhD student
Robinson Research Institute

Qayyum Shehzad
Centre Representative
PhD student
Massey University

Finnian Smith
Centre Representative
PhD student
Victoria University of Wellington

Campbell Tiffin
Centre Representative
PhD student
University of Canterbury

Carlie Watt
Centre Representative
PhD student
University of Auckland

*Partial year

PRINCIPAL INVESTIGATORS (34)

Martin Allen
Diane Bradshaw
Sally Brooker
Simon Brown
Chris Bumby
Laura Domigan
Anna Garden
Nicola Gaston
Keith Gordon
Michele Governale
Simon Granville
Pauline Harris
Justin Hodgkiss
Derek Kawiti
John Kennedy
Paul Kruger
Eric Le Ru
Nigel Lucas
Jenny Malmström
Aaron Marshall
Duncan McGillivray
Franck Natali
Volker Nock
Natalie Plank
Ben Ruck
James Storey
Shane Telfer
Jadranka Travas-Sejdic
Charles Unsworth
Geoff Waterhouse
Catherine Whitby
Grant Williams
Geoff Willmott
Ulrich Zuelicke

ASSOCIATE INVESTIGATORS (51)

Mathew Anker
Baptiste Auguie
Ebubekir (Ebu) Avci
David Barker
Catherine Bishop
Margaret Brimble
Philip Brydon
Peng Cao
Jack Chen
Kai Chen
Shen Chong
Martyn Coles
Matthew Cowan
James Crowley
Nathaniel Davis
Renwick Dobson
Courtney Ennis
Christopher Fitchett
Robin Fulton
Petrik Galvosas
Vladimir Golovko
Prasanth Gupta
Muhammad Hanif
William Holmes-Hewett
Patricia Hunt
Geoff Jameson
Marcus Jones
Vedran Jovic
Roshan Khadka
Jon Kitchen
Erin Leitao
Luke Liu
Taniela Lolohea
Ben Mallett
Steven Matthews
Kim McKelvey
Joseph Nelson
Michel Nieuwoudt
Emilia Nowak*
Elke Pahl
Kannan Ridings
Charlie Ruffman
Daniel Sando
Viji Sarojini
Jami Shepherd
Tilo Söhnel
Krista Steenbergen
Mark Waterland
Cameron Weber
Ben Yin
Alex Yip

* Indicates partial year

EMERITUS INVESTIGATORS (21)

Maan Alkaisi
Richard Blaikie
Penny Brothers
Ian Brown
Bob Buckley
Sally Davenport
Juliet Gerrard
Simon Hall
Shaun Hendy
Jim Johnston
Tim Kemmitt
Ken MacKenzie
Andreas Markwitz
Jim Metson
Roger Reeves
Mike Reid
Craig Rofe
Cather Simpson
Jeff Tallon
Richard Tilley
David Williams

PROFESSIONAL STAFF

Kirsty Doyle
Strategic Manager Māori, MacDiarmid Institute
Victoria University of Wellington

Gabrielle Holmes
Programme Manager, MacDiarmid Institute
Victoria University of Wellington

Kevin Sheehy
Commercialisation and Industry Engagement Manager, MacDiarmid Institute
Victoria University of Wellington

Rosie Wayte
Institute Manager, MacDiarmid Institute
Victoria University of Wellington

Vanessa Young
Strategic Engagement and Communications Manager, MacDiarmid Institute
Victoria University of Wellington

MacDiarmid Institute students in 2024

MASTERS (47)

Allen	Martin	Massey University
Anane	Timothy	Massey University
Anderson	Liam	Victoria University of Wellington
Arnerich	Olivia	University of Auckland
Bishop	Haig	University of Canterbury
Carter	Jodi	Victoria University of Wellington
Chaudhry	Muhammad (Musa)	Victoria University of Wellington
Chen	Haotian	University of Auckland
Devane	Harrison	Victoria University of Wellington
Du	Linjie	University of Auckland
Evans	Logan	Victoria University of Wellington
Faulkner	Logan	University of Otago
Filatov	Yuri	University of Canterbury
Fowler	Jackson	Victoria University of Wellington
Geng	Zhifei	University of Auckland
Gilchrist	Jake	University of Otago
Halliday	Josh	Victoria University of Wellington
Harper	Aimee	University of Canterbury
He	Jing	Massey University
Heywood	Jayden	University of Otago
Jin	Daniel	University of Auckland
Kuang	Ze	University of Auckland
Lewis	Jacob	University of Otago
Li	Chengyue	University of Auckland
Mare	Alaigne	Victoria University of Wellington
Moree	Lana	University of Otago
Poata	Joseph	Victoria University of Wellington
Quan	Bu	University of Auckland
Rex	Angelique	Massey University
Santos	Michelangelo	University of Canterbury
Sergent	Madison	University of Canterbury
Shi	Ji	University of Auckland
Siesicki	Jessica	Victoria University of Wellington
Summers	Hannah	Victoria University of Wellington
Tamorite	Hajie	University of Otago
Thatcher	Kathryn	University of Canterbury
Uda	Yuhka	University of Auckland
Wang	Liying	University of Auckland
Wang	Yuxin	University of Auckland
Wong	Emily	Victoria University of Wellington
Wung	Alexander	University of Auckland
Xie	Haotian	University of Auckland
Yu	Ruopu	University of Auckland
Yuan	Kun (Peter)	University of Auckland
Yue	Grace	University of Otago
Zhang	Xinyu	University of Auckland
Zheng	Haoning (Steven)	Massey University

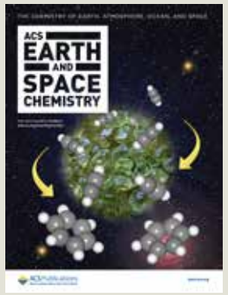
PHDS (286)

Abeysekera	Gayan	University of Canterbury
Acheson	Chris	Victoria University of Wellington
Adams	Ryan	University of Canterbury
Aguilar	Clouie Justin (CJ)	University of Auckland
Aitken	Mackenzie	University of Canterbury
Alidoust Ghatar	Azizeh	Victoria University of Wellington
Allan	Claudia	University of Canterbury
Ambadiyil Soman	Arya	Victoria University of Wellington
Anand	Aljo	University of Auckland
Andarini	Rizki Putri	Victoria University of Wellington
Andriani	Cynthia	University of Auckland
Antony	Irene	University of Canterbury
Anvari	Rezvan	University of Canterbury
Appletree (previously Smith)	Lun (Mark)	University of Auckland
Arul	Mohana	Massey University
Asad	Humna	Victoria University of Wellington
Auer	Bernhard Stephan	Massey University
Bailey	Elise	University of Auckland
Bandi	Bhanumathi	Auckland University of Technology
Barclay	Jaye	Victoria University of Wellington
Barrera Morelli	Josefina Andrea	University of Auckland
Baserisalehi	Farzaneh	University of Canterbury
Basharat	Sumaira	University of Auckland
Battley	Andrew	University of Auckland
Begzaad	Sangar	Victoria University of Wellington
Birchall	Finn	University of Canterbury
Booth	Tony	Robinson Research Institute
Bowler	Keely	University of Auckland
Browne	Lara	Victoria University of Wellington
Bryant	Devon	University of Auckland
Buzas Stowers-Hull	André	Massey University
Cahyanto	Harry	University of Canterbury
Cai	Yichao	Auckland University of Technology
Carleton	Daniel	Auckland University of Technology
Carlisle	Nicholas	University of Canterbury
Chahal	Harpreet Kaur	University of Auckland
Chalmers	Mitchell	University of Otago
Chan	Sanutep	Victoria University of Wellington
Chen	Qun (Queenie)	University of Auckland
Chen	Xize	University of Auckland
Chourasia	Shivangi	Massey University
Chung	Stephen	University of Auckland
Cowlishaw	Isabel	University of Auckland
Cutfield	Samuel	University of Auckland
Dahalan	Ghadir	Massey University
Data	Shailja	University of Auckland
Dayananda	Thakshila	Massey University
Deas	Robert	University of Auckland
DeMonte	Kieran	University of Otago
Dias Weththasinha	Bimali	University of Auckland
Dierkes	Marissa	Victoria University of Wellington
Dinachandran	Lekshmi	University of Otago
Donahue-Boyle	Erin	University of Auckland
Donaldson	Marryllyn	Massey University
Doran	Conor	University of Auckland
Drummond	Grace	University of Auckland
Duodo	John	University of Auckland
Ebardo	Irelie	Victoria University of Wellington

Edens	Samuel	University of Canterbury
Elahi	Asrar	University of Otago
Elbashier	Elkhansa	University of Otago
Eldiven	Askin	University of Canterbury
Emeny	Chrissy	University of Canterbury
Esmaeili	Fatemeh	University of Auckland
Fellner	Daniel	University of Auckland
Fontein	Danica	Victoria University of Wellington
Ford	Kathryn	University of Canterbury
Francis	Tait	University of Otago
Gater	Anastasia	University of Auckland
Gearing	Hayden	University of Auckland
George Koshy	Ben	Victoria University of Wellington
Geurts	Alisha	University of Auckland
Gilbert	Malachy	University of Auckland
Gisich	Alla	Victoria University of Wellington
Gito	Donn Adam	University of Auckland
Glasson	Judith	University of Auckland
Glukhova	Stefania	Victoria University of Wellington
Gordon	Hugo	University of Auckland
Grant	Mason	University of Auckland
Grant-Mackie	Emily	University of Auckland
Green	Lewis	University of Auckland
Gunukula	Venkata	University of Auckland
Haack	Alexander	University of Otago
Hardy	Jake	Victoria University of Wellington
Harris	Samuel	University of Otago
Harris	Shikeale	Massey University
Hasannasab	Maede	University of Auckland
Hay-Fourmond	Elouan	University of Otago
He	Qishu	University of Otago
Heenan	Alex	University of Canterbury
Hesabirad	Maryam	Massey University
Hibbert	Seth	University of Canterbury
Hirave	Panchami	University of Otago
Horrocks	Matthew	University of Auckland
Howat	Christina	University of Canterbury
Huang	Alston	University of Auckland
Hunt	Liam	University of Auckland
Hunter	Gray	University of Auckland
Islam	Atif	Victoria University of Wellington
Jangodaz	Elnaz	Massey University
Jena	Kumar (Debajyoti)	University of Auckland
Jia	Zong Hao (Bill)	University of Auckland
Jin	Ang	University of Canterbury
Johns	Ashleigh	University of Canterbury
Joshy	Elma	Victoria University of Wellington
Kabiri	Rayhaneh	Victoria University of Wellington
Kahlon	Navjot Kaur	University of Auckland
Kalan	Jude	University of Canterbury
Kan	Wen-Fa (Regis)	University of Auckland
Kaniyadan Baiju	Sajith	University of Canterbury
Kasim	Johanes Kevin	University of Auckland
Khanal	Kritika	University of Canterbury
Kim	Alex	University of Auckland
Kim	Irene	University of Auckland
Kim	Myungjin	Plant and Food Research
King-Hudson	Te-Rina	University of Canterbury
Kneisel	Kiersten	Victoria University of Wellington
Koia	Sydnee	University of Canterbury
Kuduva Janarthanan	Vishnu Charan	University of Auckland
Kumar	Aditi	Victoria University of Wellington
Lamba	Saurabh	University of Auckland
Leedham	Emily	University of Auckland
Li	Zoey	University of Auckland
Lin	Chao Yang (Sunny)	Victoria University of Wellington
Lin	Crystal Yongqi	University of Auckland
Lin	Rolland	University of Auckland
Liu	Tianzhao	University of Canterbury
Liu	Tingting	University of Auckland
Liu	Wenwen (Edin)	Victoria University of Wellington
Liu	Yuge	University of Auckland
Lopes Cavalcante	Larissa	University of Otago
Luo	Dong	Massey University
Luong	Tuan Minh	University of Auckland
Ma	Chao	University of Auckland
Mahendra	Anmol	Victoria University of Wellington
Maisuria	Bavinesh	Victoria University of Wellington
Mak	Daniel	University of Canterbury
Malone	Niall	University of Auckland
Manayath Mary Das	Dona	University of Auckland
Manners	Sarah	University of Canterbury
Mao	Yubing	University of Auckland
Marchant-Ludlow	Rhys	University of Canterbury
Markwitz	Martin	Victoria University of Wellington
Maslin	Thomas	University of Canterbury
Matheson	Brodie	Massey University
Mathew	Romina Marie	Auckland University of Technology
Mathew	Sneha	Auckland University of Technology
Matich	Olivia	Auckland University of Technology
Matinong	Andrea	Massey University
Matthewman	Emma	University of Auckland
Matthews	Brooke	University of Canterbury
Mautner	Ira Nathan (Cannon)	University of Auckland
McArdle	Sophie	University of Canterbury
McClea	Glen	University of Canterbury
McIntyre	Finn	University of Canterbury
McIntyre	Sam	University of Otago
Mendoza	Shaira	Victoria University of Wellington
Miller	Gillean	University of Auckland
Mills	Chris	University of Otago
Misiiuk	Kirill	University of Otago
Mogaveera	Akshita	Victoria University of Wellington
Montoya Mejia	Jessica Rocio	University of Canterbury
Mooney	Roisin (Rosie)	Auckland University of Technology
Mujuni	Viator	Victoria University of Wellington
Mulimbayan	Francis	University of Auckland
Murugan	Sri Varshini	Victoria University of Wellington
Na	Tae Ung (Tony)	University of Auckland
Nally	Brianna	University of Otago
Neiman	Alex	University of Canterbury
Newton-Vesty	Michael	University of Canterbury
Nieke	Philipp	University of Auckland
Omeje	Kingsley	Victoria University of Wellington
O'Reilly	Andrea	Victoria University of Wellington
Otter	Sam	Victoria University of Wellington
Owens	Adrian	Auckland University of Technology
Palpal-latoc	Dennise	University of Auckland
Pambudi	Agung	Victoria University of Wellington
Park	Luke Hyung-Keun	University of Auckland
Patel	Brijeshkumar	Victoria University of Wellington
Patel	Hamesh	University of Auckland
Patel	Hamza	University of Auckland
Patel	Sahil Dineshbhai	University of Auckland

Patel	Shae	Victoria University of Wellington
Patel	Suraj	Massey University
Peou	Patrick	University of Auckland
Petters	Ludwig	Massey University
Porritt	Harrison	University of Auckland
Posa	Luka	University of Auckland
Pot	Catherine	Victoria University of Wellington
Poudel	Pitambar	University of Canterbury
Prendergast	Peter	University of Canterbury
Punzalan	Jervee	University of Otago
Qicheng	Zhang	University of Auckland
Raghavan	Harikrishnan (Harry)	University of Canterbury
Rahmani	Kaveh	University of Canterbury
Ramezani	Ghazaleh	Victoria University of Wellington
Randall	George	University of Auckland
Rasheed	Mohammad Zarar	Victoria University of Wellington
Remoto	Peter	University of Otago
Richardson	Georgia Mae	Victoria University of Wellington
Ritchie	Logan	University of Auckland
Roake	Quentin	Victoria University of Wellington
Rokni	Mahsaalsadat	University of Auckland
Rosli	Zulfitri Danial	University of Auckland
Sale	Sarah	University of Canterbury
Sammon	Leah	University of Canterbury
Sarkar	Debolina	University of Canterbury
Schuurman	Joel Chris	University of Canterbury
Sheard	William	University of Auckland
Shehzad	Qayyum	Massey University
Shi	Shuotong	University of Auckland
Shiraz	Fathumma Rizana	University of Auckland
Shumilov	Nikita	Victoria University of Wellington
Silk	Ryan	University of Auckland
Singh	Varinder	University of Otago
Smith	Caitlin	University of Auckland
Smith	Finnian	Victoria University of Wellington
Smith	George	Victoria University of Wellington
Smith	Nicholas	University of Otago
Sobhana Joy	Midhuna	Victoria University of Wellington
Sohail	Amir	University of Otago
Spellauge	Tillmann	University of Auckland
Steel	Jamie	University of Canterbury
Stevenson	Sarah	Victoria University of Wellington
Stone	Madeline (Dana)	University of Canterbury
Studholme	Sofie	University of Canterbury
Sullivan	Jovarn	University of Canterbury
Sun	Xin	University of Auckland
Sweet	Tylah	Victoria University of Wellington
Tan Fui Jie	Angie	University of Canterbury
Taylor	Ross	Victoria University of Wellington
Thuruthel Kuriakose	Megha	University of Auckland
Tian	Chengcai	University of Otago
Tiban Anrango	Bryan Andres	Auckland University of Technology
Tiffin	Campbell	University of Canterbury
Titheridge	Laura	University of Canterbury
Tong	Juliana	University of Auckland
Treacher	Eddyn (Ned)	Victoria University of Wellington
Trewick	Edward (Ted)	Victoria University of Wellington
Trlin	Hamish	University of Canterbury
Truong	Chi Minh	University of Auckland
Tsui	Loksze (Vicky)	University of Canterbury
Ul Ain	Qurat	Victoria University of Wellington
van Koughnet	Kiri	Victoria University of Wellington
Vas	Marco	University of Auckland
Vaseghi Bakhshayesh	Reza	Massey University
Vella	Joe	University of Auckland
Verleijsdonk	Bert	Massey University
Vincent	Emma	University of Auckland
Walker	David	University of Canterbury
Wang	Tony	University of Auckland
Wang	Yuan	University of Auckland
Wang	Zhuoyue (Joy)	University of Canterbury
Watt	Carlie	University of Auckland
Watts	Benjamin	Victoria University of Wellington
Webb	Josh	University of Auckland
Webster	Claire	University of Auckland
Williamson	Joey	Victoria University of Wellington
Wislang	Kate	University of Canterbury
Withanage	Prasadini	Massey University
Wong	Chi Hung (Andy)	University of Auckland
Wong	Jie Long Jerome	Massey University
Wong	Peter	University of Auckland
Wood	David	University of Canterbury
Wu	Tianyuan (Daniel)	University of Canterbury
Xiao	Yuzhou	Victoria University of Wellington
Xie	Luyang	University of Auckland
Xu	Kristen	University of Auckland
Yang	Hui	University of Auckland
Yang	Kourtney	University of Auckland
Yellapurkar	Ishita	University of Auckland
Yi	Cindy	University of Auckland
Yoon	Soongseok	University of Canterbury
Young	Eilidh	University of Auckland
Yu	Tiantian (Diana)	University of Auckland
Zakaria	Amir (Winter)	University of Canterbury
Zare	Alireza	Victoria University of Wellington
Zemke-Smith	Chase	Victoria University of Wellington
Zeng	Chunyan	University of Canterbury
Zhang	Aicheng	University of Auckland
Zhang	Hongliang (Ryan)	University of Auckland
Zhang	Ruosong	University of Canterbury
Zhang	Yiming	Massey University
Zhu	Yufei	University of Otago
Zhurenkov	Kirill	University of Auckland
Zulfiqar	Anam	University of Otago

Journal covers



Clague, L. A., **Ennis, C.** & **Garden, A. L.**

A Computational Investigation into Hydrocarbon Growth on Extraterrestrial Mineral Surfaces toward Understanding the Carbon Discrepancy in Space.

ACS Earth and Space Chemistry **8**, 945-956 (2024)

Liu, T., Li X, Shim, J., Curnow, O., Choi, J. & **Yip, A.C.K.**

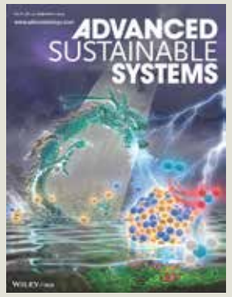
Accelerated crystallization kinetics of MFI zeolite via imidazolium-based synthesis.

Crystal Growth and Design **24**, 4122–4130 (2024)

Itumoh, E.J., Data, S., **Chen, J.L.-Y.**, Kah, M., Padhye, L.P. & **Leitao, E.M.**

Addressing the persistence of per- and poly-fluoroalkyl substances (PFAS): current challenges and potential solutions.

RSC Sustainability **2**, 3183-3201 (2024)



Wang, G., Wang, C., Zhao, X., Liu, S., **Waterhouse, G.I.N.**, Zhang, Y., Lv, X., Wang, C., Lv, X. & Xu., J.

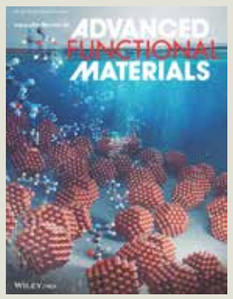
Back Cover: Visible Light-Driven Synthesis of PtCu Alloy Nanodendrites for Electrocatalytic Nitrogen-Conversion Reactions.

Advanced Sustainable Systems **8**, 2470034 (2024)

Rokni, M., Park, K.W., Leung, W.H., Zujovic, Z. & **Leitao, E.M.**

Converting commercial-grade silicone into a vitrimer using elemental sulfur.

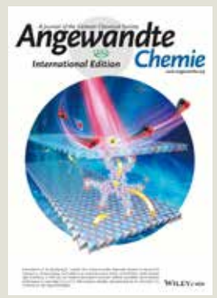
Materials Advances **5**, 5433-5441 (2024)



Cahyanto, H., Chen, X., Lam, F.L.Y., Iadrat, P., Wattanakit, C., Kidkhunthod, P., Singh, V., **Brooker, S.**, Pang, S., Choi, J. & **Yip, A.C.K**

Effective prevention of palladium metal particles sintering by histidine stabilization on silica catalyst support.

Advanced Functional Materials **34**, 2402983 (2024)



Li, S., Li, Z., Yue, J., Wang, H., Wang, Y., Su, W., **Waterhouse, G.I.N.**, Liu, L., Zhang, W & Zhao, Y.

Inside Cover: Photocatalytic CO2 Reduction by Near-Infrared-Light (1200 nm) Irradiation and a Ruthenium-Intercalated NiAl-Layered Double Hydroxide.

Angewandte Chemie International Edition **63**, e202415861 (2024)

Zhang, P., Athavale, O.N., **Zhu, B.**, **Travas-Sejdic, J.** & and Du, P.

Wet-printed Stretchable and Strain-insensitive Conducting Polymer Electrodes: Facilitating In-vivo Gastric Slow Wave Mapping.

Advanced Materials Technologies **9**, 2400849 (2024)

Publications

AUTHORS	TITLE	JOURNAL
De Silva, D.N.T., Dais, T.N., **Jameson, G.B.**, Davies, C.G., Jameson, G.N.L. & Plieger, P.G.	[Fe(μ2-OH)6]3− Linked Fe3O Triads: Mössbauer Evidence for Trigonal μ3-O2− or μ3-OH− Groups in Bridged versus Unbridged Complexes	*Molecules* **29**, 3218 (2024)
Chen, C., Wang, X., Wang, X., **Waterhouse, G.I.N.**, Jiang M., Qiao, X. & Xu, Z.	"One-Pot" Readout Cyano-Programmable SERS-Encoded Platform Enables Ultrasensitive and Interference-Free Detection of Multitarget Bioamines	*Analytical Chemistry* **96**, 12862-12874 (2024)
Chang, Z., Zhu, B., Liu, J., Dong, H., Hao, Y., Zhou, Y., **Travas-Sejdic, J.** & Xu, M.	"Signal-on" electrochemical detection of BACE1 for early detection of Alzheimer's disease	*Cell Reports Physical Science* **5**, 101632 (2024)
O'Reilly, A., Booth, A.M.S., McMullin, C.L., **Fulton, J.R.** & **Coles, M.P.**	1,4-Dialumination of benzene by sodium and potassium aluminyls	*Polyhedron* **264**, 117226 (2024)
Chung, S., Safaei, S. & **Willmott,G.R.**	3D assembly of Janus spheres: potentials, dynamics, and experiments	*Advances in Physics: X* **9**, 2341759 (2024)
Gao, C., Yang, Y., Chen, H., Gao, X., Zhang, X., Song, Z., Zhang, T., **Chen, K.**, Wang, X. & Han Y.	3D Hollow MoS2 Architecture Enabled Highly Sensitive SERS Detection	*Advanced Materials Interfaces* (2024)
Liu, Y., **Waterhouse, G.I.N.**, Jiang, X., Zhang, Z. & Yu, L.	A cathodically polarized PANI-based lead ion-selective electrode: achieving high stability with antibiofouling capabilities	*Microchimica Acta* **191**, 517 (2024)
Clague, L.A., **Ennis, C.** & **Garden, A.L.**	A Computational Investigation into Hydrocarbon Growth on Extraterrestrial Mineral Surfaces toward Understanding the Carbon Discrepancy in Space	*ACS Earth and Space Chemistry* **8**, 945-956 (2024)
Chen, C., Zhang, Y., Wang, X., Qiao, X., **Waterhouse, G.I.N.** & Xu, Z.	A core-satellite self-assembled SERS aptasensor containing a "biological-silent region" Raman tag for the accurate and ultrasensitive detection of histamine	*Food Science and Human Wellness* **13**, 1029-1039 (2024)
Smith, N.B. & **Garden, A.L.**	A Divide-and-Conquer Approach to Nanoparticle Global Optimisation Using Machine Learning	*Journal of Chemical Information and Modeling* **64**, 8743-8755 (2024)
Nafees, M., **Hanif, M.**, Muhammad Asif Khan, R., Faiz, F. & Yang, P.	A Dual Action Platinum(IV) Complex with Self-assembly Property Inhibits Prostate Cancer through Mitochondrial Stress Pathway	*ChemMedChem* **19**, e202400289 (2024)
van Hilst, Q.V.C., Pearcy, A.C., Preston, D., Wright, L.J., Hartinger ,C.G., Brooks, H.J.L. & **Crowley, J.D.**	A dynamic covalent approach to [PtnL2n]2n+ cages	*Chemical Communications* **60**, 4302-4305 (2024)
Gilkes, J.M., Frampton, R.A., Board, A.J., Hudson, A.O., Price, T.G., Morris, V.K., Crittenden, D.L., Muscroft-Taylor, A.C., Sheen, C.R., Smith, G.R. & **Dobson, R.C.J.**	A new lysine biosynthetic enzyme from a bacterial endosymbiont shaped by genetic drift and genome reduction	*Protein science : a publication of the Protein Society* **33** (2024)
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Kneisel, K., Maddah, M., Chan, J., Xu, Y., **Casey-Stevens, C.**, Van Koughnet, K., **Holmes-Hewett, W.**, **Trodahl, H.J.** & **Natali, F.**	Synthesis, Structural, and Raman Investigation of Lanthanide Nitride Powders (Ln = La, Ce, Nd, Sm, Gd, Tb, Dy, Er, Lu)	*ACS Omega* **9**, 47842-47847 (2024)
Palpal-Latoc, D., Horsfall, A.J., Cameron, A.J., Campbell, G., Ferguson, S.A., Cook, G.M., Sander, V., Davidson, A.J., Harris, P.W.R. & **Brimble, M.A.**	Synthesis, Structure-Activity Relationship Study, Bioactivity, and Nephrotoxicity Evaluation of the Proposed Structure of the Cyclic Lipodepsipeptide Brevicidine B	*Journal of Natural Products* **87**, 764-773 (2024)
Dang, C., Nie, H., Cao, X.E., Cao, Y., **Liu, L.**, Zhu, X., Zhu, Q., Zhu, L., Xu, G. & Zhu, M.	System integration for solar-driven interfacial desalination	*Device* **2**, 100361 (2024)
Titheridge, L.J. & **Marshall, A.T.**	Techno-economic modelling of AEM electrolysis systems to identify ideal current density and aspects requiring further research	*International Journal of Hydrogen Energy* **49**, 518-532 (2024)
Faulkner, L.A.V. & **Crowley, J.D.**	The beauty of low symmetry: Non-statistical assembly of [Pd2(LA)(LB)(LC)(LD)]4+ cages	*Chem* **10**, 440-442 (2024)
Sun, J., Pan, Y., Liu, Y., Kuang, F., Wu, X., **Cao, P.** & Lu, X.	The designed high-performance PM Ti-6Al-4V alloy via two-step pressureless sintering	*Journal of Alloys and Compounds* **976**, 173324 (2024)
Matthews, S. & O'Neil, F.	The effect of carbide decomposition and carbon loss on the steady state composition of WC-Cr3C2-Ni composite coatings at 900 °C	*International Journal of Refractory Metals and Hard Materials* **120**, 106634 (2024)
Hendy, S.C.	The effect of incorporating infectious disease dynamics into a social cost–benefit framework for COVID-19 policy decisions	*New Zealand Economic Papers* (2024)
Sun, X., **Gerrard, J.A.** & Anema, S.G.	The effect of succinylation on the properties of αs1-casein enriched protein	*International Dairy Journal* **154**, 105907 (2024)
Tan, A.F.J., Isnaini, M.D., Phisalaphong, M. & **Yip, A.C.K.**	The engineering of CO2 hydrogenation catalysts for higher alcohol synthesis	*RSC Sustainability* **2**, 3638-3654 (2024)
Geiregat, P., Erdem, O., Samoli, M., **Chen, K.**, **Hodgkiss, J.M.** & Hens, Z.	The Impact of Partial Carrier Confinement on Stimulated Emission in Strongly Confined Perovskite Nanocrystals	*ACS Nano* **18**, 17794-17805 (2024)
Ritchie, L., **Pahl, E.** & Anderson, I.A.	The incompressibility assumption and piezoresistivity in stretchable conductive composites	*Journal of Applied Polymer Science* **141**, e55855 (2024)
Yin, Z., Liu, X., Guo, L., Ren, M., Kang, W., Ma, C., **Waterhouse, G.I.N**. & Sun-Waterhouse, D.	The potential of dietary fiber in building immunity against gastrointestinal and respiratory disorders	*Critical Reviews in Food Science and Nutrition* **64**, 13318-13336 (2024)
Titheridge, L.J. & **Marshall, A.T.**	The Rationale for a Standardized Testing Protocol for Anion Exchange Membrane Water Electrolyzers	*ACS Energy Letters* **9**, 1288-1294 (2024)
Mak, D., Meffan, C., Menges, J., Marchant-Ludlow, R., Hashemi, A., Moore, C.P., **Dobson, R.C.J.** & **Nock, V.**	The reversible capillary field effect transistor: a capillaric element for autonomous flow switching	*Lab on a Chip* (2024)
Mukda, B.A., Chittim, C.L., Phillips, M.D., Fowles, S.M., Landee, C.P., Wikaira, J.L., **Telfer, S.G.** & Turnbull, M.M.	The synthesis and structure of adamantoid copper(II) clusters	*Journal of Coordination Chemistry* **77**, 1724-1745 (2024)
Poata, J., Taddei, F. & **Governale, M.**	Topological nano-switches in higher-order topological insulators	*New Journal of Physics* **26**, 53038 (2024)
Jia, Z.H., Pilkington, L.I. & **Barker, D.**	Total Syntheses and Absolute Stereochemical Correction of Negundin B, Vitexin 1, and Vitexin 6	*Journal of Organic Chemistry* **89**, 3644-3651 (2024)
Kim, I.J., Pilkington ,L.I. & **Barker, D.**	Total Synthesis of (−)-Amovillosumin A and Structure Correction of (−)-Amovillosumin C Using Chemical Synthesis	*Journal of Natural Products* **87**, 340-348 (2024)

AUTHORS	TITLE	JOURNAL
Tremlett, W.D.J., **Crowley, J.D.**, Wright, L.J. & Hartinger, C.G.	Towards building blocks for metallosupramolecular structures: non-symmetrically-functionalised ferrocenyl compounds	*Dalton Transactions* **53**, 14742-14751 (2024)
Weal, G.R., Sutton, J.J., Wechwithayakhlung, C., Packwood, D.M., **Hodgkiss, J.M.** & Hume, P.A.	Towards high-throughput exciton diffusion rate prediction in molecular organic semiconductors	*Journal of Materials Chemistry C* **12**, 8747-8758 (2024)
Chan, E.W.C., Sun, X., Uda, Y., **Zhu, B.**, **Barker, D.** & **Travas-Sejdic, J.**	Transient polymer electronics enabled by grafting of oligo-3-hexylthiophenes onto polycaprolactone	*Journal of Materials Chemistry C* **12**, 11157-11173 (2024)
Davies, J.S., Currie, M.J., **Dobson, R.C.J.**, Horne, C.R. & North, R.A.	TRAPs: the 'elevator-with-an-operator' mechanism	*Trends in Biochemical Sciences* **49**, 134-144 (2024)
Luo, Y., Li, Y., Feng, X., Pei, Y., Zhang, Z., Wang, L., Zhao, Y., Lu, B. & **Zhu, B.**	Triboelectric nanogenerators with porous and hierarchically structured silk fibroin films via water electrospray-etching technology	*Nano Energy* **75**, 104974 (2024)
Wang, H., Yang, C., Yu, X., Wang, M., Yang, R., Nie, X., **Yin, B.H.**, **Yip, A.C.K.**, Song, C., Zhang, G. & Guo, X.	Triple the steady-state reaction rate by decorating the In2O3 surface with SiOx for CO2 hydrogenation	*Journal of Energy Chemistry* **95**, 96-105 (2024)
Porat, O., Joshy, E., Miller, J.D., **Granville, S.** & **Holmes-Hewett, W.F.**	Tuneable magnetic behavior, electronic structure, and nitrogen vacancy formation in GdxSm1-x N	*Physical Review Materials* **8**, 116201 (2024)
Yang, T., Zhang, T., Christopher, T.D., Huang, S. & **Cao, P.**	Tuneable photoluminescence of β-K2SO4 phosphors with enhanced thermal stability and quantum efficiency by chemical substitution	*Ceramics International* **50**, 13862-13870 (2024)
Sikorska, C., Vincent, E., Schnepf, A. & **Gaston, N.**	Tuning the electronic structure of gold cluster-assembled materials by altering organophosphine ligands	*Physical Chemistry Chemical Physics* **26**, 10673-10687 (2024)
Ren, J., Xiang, Q., Yang, C., Yang, S., Liang, Y., Liu, J., Li, J., Qian, D. & **Waterhouse, G.I.N.**	Two Birds with One Stone: Self-Supporting Anodes and Cathodes for Quasi-Solid-State Asymmetric Supercapacitors via Reactions of 2-Thiobarbituric Acid with Fe and Co Foams	*Advanced Functional Materials* (2024)
Tanghe, I., Molkens, K., Vandekerckhove, T., Respekta, D., Waters, A., Huang, J., Beavon, J., Harankahage, D., Lin, C.Y., **Chen, K.**, Van Thourhout, D., Zamkov, M. & Geiregat, P.	Two-Dimensional Electron-Hole Plasma in Colloidal Quantum Shells Enables Integrated Lasing Continuously Tunable in the Red Spectrum	*ACS Nano* **18**, 14661-14671 (2024)
Zhu, B., Kerr-Philips, T., Ghaus, Z.A., Chan, E.W.C., **Barker, D.**, Evans, C.W., **Williams, D.E.** & **Travas-Sejdic, J.**	Ultra-Highly Sensitive DNA Detection with Conducting Polymer-Modified Electrodes: Mechanism, Manufacture and Prospects for Rapid e-PCR	*Journal of the Electrochemical Society* **169**, 37521 (2024)
Alsager, O.A., Kumar, S., Zhu, B., **Travas-Sejdic, J.**, McNatty, K.P. & **Hodgkiss, J.M.**	Ultrasensitive colorimetric detection of 17-estradiol: The effect of shortening dna aptamer sequences	*Analytical Chemistry* **87**, 4201-4209 (2024)
Wang, X., Chen, C., **Waterhouse, G.I.N.**, Qiao, X., Sun, Y. & Xu, Z.	Ultrasensitive SERS aptasensor using Au@Ag bimetallic nanorod SERS tags for the selective detection of amantadine in foods	*Food Chemistry* **453**, 139665 (2024)
Wang, M., Zhang, G., Wang, H., Wang, Z., Zhou, Y., Nie, X., **Yin, B.H.**, Song, C. & Guo, X.	Understanding and Tuning the Effects of H2O on Catalytic CO and CO2 Hydrogenation	*Chemical Reviews* **124**, 12006-12085 (2024)
Mariandry, K., Cheong, S., Gloag, L., Ramadhan, Z.R., Somerville, S.V., Benedetti, T.M., Gooding, J.J. & **Tilley, R.D.**	Understanding the Role of Small Platinum Island Size on Crystalline Nickel Nanoparticles in Enhancing the Hydrogen Evolution Reaction	*Journal of Physical Chemistry C* **128**, 9595-9601 (2024)
Smith, G.J., Koutsoukos, S., Lancaster, B., Becker, J., Welton, T. & **Hunt, P.A.**	Unravelling ionic liquid solvent effects for a non-polar Cope rearrangement reaction	*Physical Chemistry Chemical Physics* **26**, 12453-12466 (2024)
Zhang, Y., Ding, S., Yu, J., Sui, L., Song, H., Hu, Y., **Waterhouse, G.I.N.**, Tang, Z. & Lu, S.	Unveiling the photoluminescence mechanisms of carbon dots through tunable near-infrared dual-wavelength lasing	*Matter* **7**, 3518-3536 (2024)
Lopes Cavalcante, L., Czaplinski, E.C., Maynard-Casely, H.E., Cable, M.L., Chaouche-Mechidal, N., Hodyss, R. & **Ennis, C.**	Vacuum-ultraviolet irradiation of pyridine:acetylene ices relevant to Titan astrochemistry	*Physical Chemistry Chemical Physics* **26**, 26842-26856 (2024)
Anker, M.D., Evans, M.J., Cameron, S.A. & Laufersky, G.	Versatility of a diamidosilylether ligand supporting yttrium complexes: Synthesis, structure and reactivity	*Polyhedron* **247**, 116741 (2024)
Wang, G., Wang, C., Zhao, X., Liu, S., **Waterhouse, G.I.N.**, Zhang, Y., Lv, X., Wang, C., Lv, X. & Xu, J.	Visible Light-Driven Synthesis of PtCu Alloy Nanodendrites for Electrocatalytic Nitrogen-Conversion Reactions	*Advanced Sustainable Systems* **8**, 2400272 (2024)
Chien, W.-H.C., Liu, H.-A., Lin, J.-X., Liao, W.-H., Chang, Y.-Y., Hu, C.-K., Lee, J.-S., **Granville, S.**, Chen, J. & Hsu, H.-S.	Volatile and Non-Volatile Dual-Function Electrically Controlled Ultraviolet Magneto-Optical Effect in TmIG/Pt	*Advanced Electronic Materials* (2024)

AUTHORS	TITLE	JOURNAL
Zhang, P., Athavale, O.N., **Zhu, B.**, **Travas-Sejdic, J.** & Du, P.	Wet-Printed Stretchable and Strain-Insensitive Conducting Polymer Electrodes: Facilitating In Vivo Gastric Slow Wave Mapping	*Advanced Materials Technologies* **9**, 2400849 (2024)
Kim, S., Lee, S., Sung, S., Gu, S., Kim, J., Lee, G., Park, J., **Yip, A.C.K.** & Choi, J.	Zeolite Membrane-Based Low-Temperature Dehydrogenation of a Liquid Organic Hydrogen Carrier: A Key Step in the Development of a Hydrogen Economy	*Advanced Science* **11**, 2403128 (2024)
Dai, Y., Lu, R., Zhang, C., Li, J., Yuan, Y., Mao, Y., Ye, C., Cai, Z., Zhu, J., Li, J., Yu, R., Cui, L., Zhao, S., An, Q., He, G., **Waterhouse, G.I.N.**, Shearing, P.R., Ren, Y., Lu, J., Amine, K., Wang, Z. & Mai, L.	Zn2+-mediated catalysis for fast-charging aqueous Zn-ion batteries	*Nature Catalysis* **7**, 776-784 (2024)
Gao, X., Cao, L., Wang, L., Liu, S., Zhang, M., Li, C., **Waterhouse, G.I.N.**, Fan, H. & Xu, J.	Z-scheme heterojunction g-C3N4-TiO2 reinforced chitosan/poly(vinyl alcohol) film: Efficient and recyclable for fruit packaging	*International Journal of Biological Macromolecules* **268**, 131627 (2024)

Books

AUTHORS	BOOK TITLE	PUBLISHER
Murthy, H., Pillai, V.J., Kumar, K.P. & **Cowan, M.**	*Novel Anti-Corrosion and Anti-Fouling Coatings and Thin Films*	Wiley
Cao, P. & Zhang, L.	*Titanium Alloys: Basics and Applications*	World Scientific Publishing Co

Book chapters

AUTHORS	CHAPTER TITLE	BOOK TITLE	PUBLISHER
Taylor, S., Baiju, S.K., McQuinlan, M.K. & **Cowan, M.G.**	Ionic Liquids in Marine Anti-Fouling Coatings	*Novel Anti-Corrosion and Anti-Fouling Coatings and Thin Films*	Wiley
Simpson, C.	Looking for Problems to Solve	*Shaping the World: The Vital Role of Scientists in Industry*	SPIE
Das, S., Swain, S., Rautray, T.R. & **Kennedy, J.V.**	Metals for Smart Drug Delivery	*Smart Micro-and Nanomaterials for Drug Delivery*	CRC Press
Jena, K.D. & **Cao, P.**	Processing of Magnesium Alloys by Mechanical Alloying	*Advanced Structured Materials*	Springer
Cao, P., Jena, K.D. & Xu, D.	Processing of titanium alloys by mechanical alloying	*Mechanical Alloying of Ferrous and Non-Ferrous Alloys: Processing, Properties, and Applications*	Elsevier
Hawkins, B.C., Bissember, A.C., Wales, S.M., **Chen, J.L.-Y.**, Petersen, W.F., Tague, A.J., Fleming, C.L., Green, N.J., Shephard, J.P., Johnstone, M.D., Harrison, S.D.L. & Cording, A.P.	Seven-membered rings	*Progress in Heterocyclic Chemistry*	Elsevier

Conference papers

AUTHORS	TITLE OF CONFERENCE PAPER	TITLE OF PROCEEDINGS
Marchant-Ludlow, R., Hashemi, A., Mak, D., **Dobson, R.**, **Nock, V.** & Moore, C.P.	Automated Flow Tracking Software for Capillary Microfluidic Devices	*International Conference Image and Vision Computing New Zealand*
Tian, C., Sedlmeir, F., Becker, P., Bohatý, L., **Blaikie, R.** & Schwefel, H.G.L.	Cascaded Raman Lasing in Lithium Tetraborate (LB4) Whispering Gallery Mode Resonator	*2024 Conference on Lasers and Electro-Optics, CLEO 2024*
Ritchie, L., Henke, E.-F.M., **Pahl, E.** & Anderson, I.A.	Electromechanical Characterization of Piezoresistive Carbon-Elastomer Composites	*Proceedings of SPIE - The International Society for Optical Engineering*
Pollock, R., Glowacki, J., Goddard-Winchester, M., Hellmann, S., Huang, X., **Mallett, B.**, Olatunji, J., Pavri, B., Shellard, C., Strickland, N., Webster, E., Rao, A., Wright, D. & Parashar, T.	Hēki: A High Temperature Superconductor Technology Demonstration Mission to the International Space Station	*IEEE Aerospace Conference Proceedings*
Lumsden, G., Kalsi, S., **Storey, J.** & Badcock, R.	High Speed Superconducting Machine for Aircraft Turbo-generator Applications	*AIAA Aviation Forum and ASCEND, 2024*
Demir, K., Nguyen, B.H., Rooney, J.S., Xue, B., Zhang, M., Lagutin, K., MacKenzie, A., **Gordon, K.C.** & Killeen, D.P.	Improving Inference of Biochemical Composition in Marine Biomass via Genetic Algorithm-Based Feature Selection on Raman Spectroscopic Data	*2024 IEEE Congress on Evolutionary Computation, CEC 2024 - Proceedings*
Kalsi, S., Lumsden, G., **Storey, J.** & Badcock, R.	Motors Employing Superconducting DC Field Windings and Cryogenically Cooled Conventional Conductor AC Windings for Aircraft Applications	*AIAA Aviation Forum and ASCEND, 2024*
Tanghe, I., Samoli, M., Wagner, I., Cayan, S.A., Khan, A.H., **Chen, K.**, **Hodgkiss, J.**, Moreels, I., Van Thourhout, D., Hens, Z. & Geiregat, P.	Solution processed bulk colloidal nanocrystals as gain material in photonic crystal surface emitting lasers across the green-red spectrum	*Proceedings of SPIE - The International Society for Optical Engineering*
Tanghe, I., Samoli, M., Wagner, I., Cayan, S.A., Khan, A.H., **Chen, K.**, **Hodgkiss, J.**, Moreels, I., Van Thourhout, D., Hens, Z. & Geiregat, P.	Understanding the mechanisms behind optical gain in bulk solution processible semiconductors	*Proceedings of SPIE - The International Society for Optical Engineering*

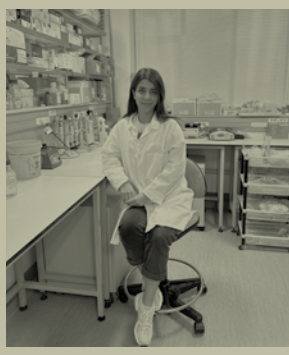
Reports

AUTHORS	TITLE OF REPORT	PUBLICATION TITLE
Dumaru, P., **Bradshaw, D.**, Sajkowski, L., Rogers, K.M., Parsons, N. & Barnes, C.	*Geothermal mineral extraction, Māori engagement and social licensing in Whakarewarewa Village*	GNS Science internal report 2024/14
Sajkowski, L., **Bradshaw, D.** & Barr, A.	*Toward more holistic environmental governance of geothermal mineral extraction in Aotearoa New Zealand*	GNS Science report 2023/22

Keynote and invited speaker addresses

NAME	DETAILS	PUBLICATION TITLE
Mathew Anker	OZRE, Perth, Australia, 9 February 2024. "My Adventures in Ln(II) Chemistry"	
	ICCC, Colorado, USA, 28 July 2024. "Synthesis and reactivity of Sm(II) hydride"	
Diane Bradshaw	Plenary speaker at the 2024 New Zealand Archaeological Conference, Nelson, New Zealand, 2-5 July 2024. "Navigating Infrastructure & Archaeology: the road to least resistance in heritage protection"	
Margaret Brimble	Plenary speaker at the 24th Annual R. Bryan Miller Symposium, Davis, California, USA, 14-15 March 2024. "Paving the way to new therapeutics"	
	Plenary speaker at Genentech, San Francisco, USA, March 2024. "Paving the way to new therapeutics"	
	Plenary speaker at Organic24, Adelaide, Australia, 18-20 November 2024. "Natural Product Synthesis: A Crucible for New Method Development and Drug Discovery"	
	Plenary speaker at the New Zealand Institute of Chemistry Conference (NZIC), Dunedin, New Zealand, 24-28 November 2024. "The Role of Medicinal Chemistry in the Search for New Therapeutic Agents: Natural Products vs Peptides"	
	Keynote speaker at the 4th Winter In-Person Organic Symposium (WIPOS 2024), Honolulu, Hawaii, USA, 16-19 December 2024. "Natural Product Synthesis: A Crucible for New Method Development and Drug Discovery"	
Sally Brooker	Plenary speaker at the 9th Asian Conference on Coordination Chemistry (ACCC9), Bangkok, Thailand, 19-22 February 2024. "Discrete spin crossover complexes: solid state and solution phase correlations, tuning and sensing"	
	Keynote speaker at the 45th International Conference on Coordination Chemistry (ICCC-45), Fort Collins, USA, 28 July-3 August 2024. "Spin crossover correlations: applications in sensing and in predictable tuning of ligand field"	
	Keynote speaker at H2Wheels Synergy: A milestone event in green hydrogen technology, Wellington, New Zealand, 2 September 2024. "He Honoka Hauwai / German-New Zealand Green Hydrogen"	
	Keynote speaker at Innovative Minds and Inclusive Science, Karlsruhe, Germany, 21-22 October 2024. "Soluble 3d-4f SMMs and predictable SCO"	
	Keynote speaker at the 4th Modern Trends in Molecular Magnetism and 3rd Spins in Molecular Systems (MTMM/SiMS) Conference, Bangalore, India, 5-8 November 2024. "Spin crossover - switches, sensors and towards predictable T1/2"	
	Invited speaker at the Royal Australian Chemical Institute (RACI) Inorganic Division Meeting IC24, Parramatta, Australia, 8-12 December 2024. "German-NZ Green Hydrogen Centre: hydrogen storage materials and electrocatalysts for future fuels production"	
Simon Brown	Keynote speaker at the Workshop on Neuromorphic Learning, Toulouse, France, 9-10 October 2024. "Brain-like computing with percolating networks of nanoparticles"	
	Keynote speaker at the Workshop on Unconventional Computing, Erice, Italy, 6-12 July 2024. "Brain-like computing with percolating networks of nanoparticles"	
Peng Cao	Keynote speaker at Powder Metallurgy and Additive Manufacturing of Titanium 2024 (PMTi 2024), Madrid, Spain, 4-6 September 2024. "In situ alloying of copper-coated titanium powder via laser powder bed fusion"	
Martyn Coles	Keynote speaker at the RSC Main Group Interest Group Annual Meeting and AGM, Birmingham, UK, 10-11 April 2024. "Aluminyl Anions as a Platform for the Synthesis of Bimetallic Al–M Complexes"	
Renwick Dobson	Keynote speaker at Crystal24, Fremantle, Australia , 6 November 2024. "TRAPped in an elevator"	

Robin Fulton	Keynote speaker at Frontiers in Sustainable Catalysis and Organometallic (FISCO-2024), Jaipur, India, 11-12 July 2024. "The 'Metallo'-Diels-Alder Reactions: Examining the Metalloid Behavior of Germanimines"
	Plenary speaker at the 30th International Conference on Organometallic Chemistry ICOMC, Agra, India, 14-18 July 2024. "The properties and chemistry of tetrylene-alumylene, E-Al (E = Ge, Sn Pb) complexes, a new class of frustrated pairs?"
	Keynote speaker at New Zealand Institute of Chemistry Conference (NZIC), Dunedin, New Zealand, 24-28 November 2024. "Group 14-aluminyl complexes"
Petrik Galvosas	Plenary speaker at the 45th FGMR Annual Discussion Meeting, Rostock, Germany, 9-12 September 2024. "NMR and MRI off the Beaten Track"
Anna Garden	Keynote speaker at the 2024 Fall Meeting of the European Materials Research Society (E-MRS), Warsaw, Poland, 16-19 September 2024. "Computational modelling of clean and safe production and storage of hydrogen"
Keith Gordon	Keynote speaker at the International Conference on Raman Spectroscopy(ICORS 2024), Rome, Italy, 28 July – 4 August 2024. "Low Frequency Raman Spectroscopy as a Method of Investigating Pharmaceutical Polymorphs"
	Keynote speaker at the 18th Annual PSSRC Symposium, Dortmund, Germany, 27-29 August 2024. "Exploring the Solid-State Dynamics of Carbamazepine during Dehydration: A Low Frequency Raman Spectroscopy Perspective"
	Keynote speaker at SciX 2024, Raleigh, NC, USA, 21-25 October 2024." Low-Frequency Raman Spectroscopy: Probing Order in Solid State Materials"
Patricia Hunt	Plenary speaker at Spring ACS 2024: In-silico Organic Chemistry, Virtual, 18-20 March 2024. "Exploring the Concept of Solvent Polarity with Application to Ionic Liquids"
	Opening keynote speaker at the 11th Australasian Symposium on Ionic Liquids (ASIL11) Deakin, Australia, 2-3 May 2024. "Describing the Charge Distribution within Ionic Liquid Systems"
	Keynote speaker at the 3rd Women in Science-Erlangen Symposium, Erlangen, Germany, 22-24 July 2024. "Exploring a Non-Polar Cope Rearrangement in (Polar) Ionic Liquids"
	Keynote speaker at the Ionic Liquids Gordon Research Conference, Newry, Maine, USA, 24 July-9 August 2024. "Exploring the potential for ionic liquid derived bio-relevant proton conducting membranes"
John Kennedy	Keynote speaker at the 5th International Conference on Emerging Advanced Nanomaterials (ICEAN 2024), Newcastle, Australia, 4-8 Nov 2024. "Energy harvesting devices utilizing transparent thermoelectric materials"
Erin Leitao	Keynote speaker at the 38th Australasian Polymer Symposium (38APS), Auckland, New Zealand, 18-21 February 2024. "Siloxane cross-linked polysulfides"
	Keynote speaker at the International Symposium on Silicon Chemistry, Hiroshima, Japan, 14 May 2024. "Siloxane cross-linked polysulfides"
Aaron Marshall	Keynote speaker at the 75th Annual ISE Meeting, Montreal, Canada, 18-23 August 2024. "From bulk copper to gas-diffusion electrodes for CO2 reduction"
	Keynote speaker at PRiME 2024, Hawaii, USA, 6-11 October 2024. "Copper Cathode for Electrochemical CO2 Reduction: Unanswered Questions on Reproducibility"
Shane Telfer	Keynote speaker at ACCC9, Bangkok, Thailand, 20 February 2024. "Multicomponent Metal-Organic Frameworks"
Jadranka Travas-Sejdic	Plenary speaker at the International Conference on Science and Technology of Synthetic Electronics Materials 2024 (ICSM), Dresden, Germany, 23-28 June 2024. "A strategy towards biomimetic and transient polymer (bio)electronics"
	Plenary speaker at the 5th International Conference on Emerging Advanced Nanomaterials (ICEAN 2024), Newcastle, Australia, 4-8 November 2024. "A strategy towards biomimetic and transient polymer (bio)electronics"
	Keynote speaker at the Australian Future Sensing Conference, Melbourne, Australia, 27-29 November 2024. "Functional Conducting Polymers for Biosensing and Biomimetic Bioelectronics"
Geoff Waterhouse	Plenary speaker at the 1st International Symposium on "Greater Food Approach": Future Food Science and Technology Innovation, Beijing, China, 15-18 May 2024. "Essential Role of Nanotechnology in Precision Agriculture and Food Safety Monitoring"
	Plenary speaker at the 5th International Symposium on Food Science and Human Health, Wuhan, China, 3-4 August 2024. "Recent Advances in the Application of Surface-Enhanced Raman Spectroscopy (SERS) for Food Safety Monitoring"
	Plenary speaker at the International Conference on the Advanced Materials and Development Performance 2024 (AMDP2024), Tokushima, Japan, 23-25 September 2024. ""Designing Metal Single Atom Catalysts for Tomorrow's Energy Sector"
	Keynote speaker at the 5th International Conference on Emerging Advanced Nanomaterials (ICEAN 2024), Newcastle, Australia, 4-8 November 2024. ""Designing Metal Single Atom Catalysts for Tomorrow's Energy Sector"



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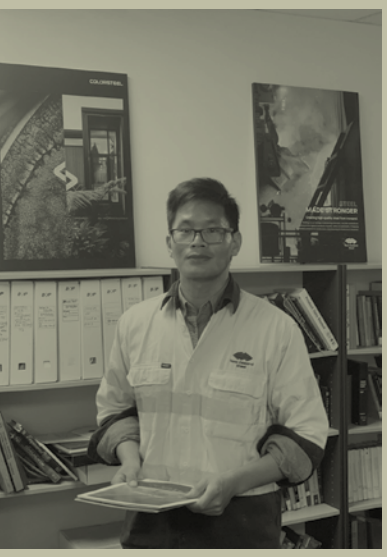

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