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From 2002 - 2021

758

PhD graduates

22

affiliated start-up
companies created

925

research alumni

80

inventions patented

40000+

conference attendees

Nicola Gaston and Justin Hodgkiss

Co-Directors

Despite the ongoing challenges from the Covid pandemic, 2021 was a year of new directions and growth for the MacDiarmid Institute.

We embarked on a new research plan organised around four programmes exploring different aspects of materials science for sustainability. Each of these programmes and some of the people contributing to them will be introduced in this report.

With these new research directions comes further renewal of our people. A number of PhD students have already begun their projects in our new programme, and we welcomed 14 new investigators to our ranks in 2021. These new investigators add breadth and depth to our interdisciplinary programmes – spanning from theoretical materials science to neural engineering – as well as building our cohort of Māori and Pacific researchers. We invite you to read their profiles in this report.

Beyond our research programme, we have much to highlight from strategic activities of the Institute.

Our Discovery Scholarship programme for Māori and Pacific students continues to grow and strengthen thanks to an energetic and engaging cohort of existing scholars, along with new support for additional scholarships from other organisations. Alongside their studies, many of our Discovery Scholars have undertaken research projects with MacDiarmid Institute researchers, and shared their journeys, including through a series of public-facing video profiles.

Support for people is a thread that runs through all of our other strategic areas highlighted in this report, whether growing tech entrepreneurs, involving PhD students in a radio series, or providing career stepping stones via internships in local industry.



Paul Atkins

Board Chair

It has been a privilege to be part of the Institute for these past four years - an amazing time to be part of an incredible organisation.

The vision upon which the Directors launched the Institute's new contract in July this year has never been more imperative or time-critical - this vision that shapes the Institute into four new research programmes leading Aotearoa New Zealand towards Zero Carbon, Zero Waste, Low Energy Tech and Sustainable Resource Use is truly inspiring. I can't think of a more worthwhile area to apply the minds and hearts of the MacDiarmid Institute's researchers than to support Aotearoa New Zealand and the world out of this climate emergency. And I again acknowledge the brilliance and foresight of the Institute's founder, the late Sir Paul Callaghan, who 20 years ago when he set up the Institute, saw the critical state of the planet and knew the vital role a materials science Institute would play in mitigating this coming crisis.

I thank the Board for the amazing support you have given me and the Institute. To the Deputy Directors and to the Directors in particular - it's been fabulous working with you. I also acknowledge the management team who make everything happen. A huge thank you to you all.

This is my last report as Chair of the MacDiarmid Institute Board - I hand over to the very capable Hēmi Rolleston who has been part of the MacDiarmid Institute Board for several years now and brings a wealth of knowledge of, and connections within, both the science system and Te Ao Māori, as well as extensive experience in the commercial world of innovation.

I invite you to read these stories of continued science excellence, key collaborations with our Māori partners, commercialisation of materials research through start-ups and with industry, the drive to improve public understanding of technology for sustainability, and the creation of a high-earning NZ-trained science workforce.



The life of a logo

Everything has a life span, even a logo. Ahead of launching our new logo, we took a look at the whakapapa of our current one.

In logo terms, 20 years is a long time. That's what the designer of the original MacDiarmid Institute logo believes. Bridget Stocker (now Associate Professor of Biomedical Chemistry at VUW) was doing her first PhD in Chemistry at Victoria University of Wellington (VUW) when Sir Paul Callaghan (founding Director of the MacDiarmid Institute - below) asked her to sketch some ideas for a logo.

"I was a science student, not a professional artist, but I did draw things for people and that was known around the department. Paul knew of TEC's plans for CoREs, and said - 'we're going to need a logo'. Then he asked me if I could come up with some ideas."



In 2001, Sir Paul had recently moved to VUW and was spearheading the campaign to launch a Centre of Research Excellence (CoRE).

The Institute's first manager, Margaret Brown, remembers Sir Paul asking Bridget Stocker for some ideas, and says that the design that became the logo was a clear front runner in their eyes.

"We liked the design. We didn't want a strictly 'science' thing - we liked that it was arty and suggested that science would evolve and change over time." Emeritus Investigator and University of Otago Professor Richard Blaikie (who was Deputy Director of the Institute when it was founded, and then Director from 2008 to 2011, and is a member of the Institute's Governance Board) said that the logo was a very personal thing to Sir Paul Callaghan.

"It was a real passion of Paul's to get the name and the logo right."

EMERITUS INVESTIGATOR, PROFESSOR RICHARD BLAIKIE
FORMER DIRECTOR AND MEMBER OF MACDIARMID INSTITUTE
GOVERNANCE BOARD

The Institute is, of course, named after one of Aotearoa New Zealand's Nobel Prize winners, Professor Alan MacDiarmid. At about the same time as the Government was launching the CoRE initiative, the eminent scientist visited Wellington and Sir Paul Callaghan, as VUW's Alan MacDiarmid Professor of Physical Sciences, spent time with him.

So how does the original designer feel about her logo having lasted 20 years?

"Twenty years is a chunk of time. I'm glad it's worked for the Institute for this long. Things shift and the breadth of the Institute has changed too."

Co-Director Professor Justin Hodgkiss agrees, and says the Institute has evolved over the past two decades.

"The make-up and focus of the Institute has moved considerably over this period. We have evolved diversity of knowledge and research areas. Along with chemists and physicists we have biochemists, materials engineers and mātauranga Māori experts. We wanted the new logo to reflect this."

And not only the Institute has changed. Co-Director Professor Nicola Gaston says that over the past 20 years the shift to digital has changed the way logos are used. "Our logo now sits not only on our website, but on the websites of our contract and engagement partners, and our social media platforms. Plus the logo needs to be read on all kinds of digital devices, from a large screen to an iPhone. So what makes a good logo in 2021 is very different to what made a good logo in 2001."

With this eye to the future of the Institute, the Co-Directors initiated a logo process involving investigators and Stakeholder Relations Partner Iwi Diane Bradshaw. Professor Hodgkiss says they wanted the new logo to provide a nod to our current identity and future research while acknowledging and maintaining the history of the Institute.

The process started with our 'who we are' statement -

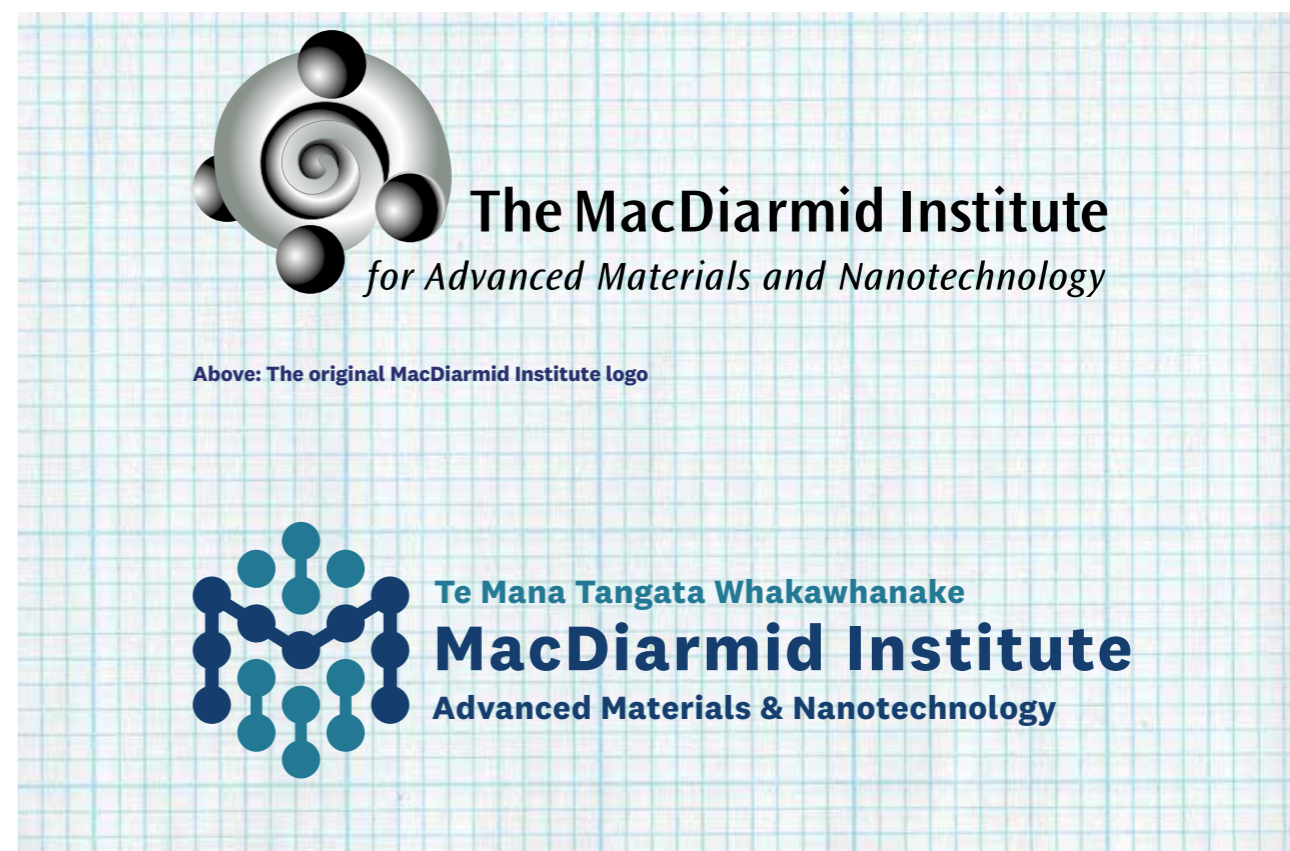
Tangata whakawhanake - to improve people's lives

We are a network of leading researchers united in a common goal: to create and explore innovative, sustainable materials that will improve the lives of people in Aotearoa and around the world. We work together and partner with industry and government to address global challenges such as clean water, renewable energy and climate change.

We knew the logo needed to communicate our connectedness, our networks, our whakapapa, our science focus, among other ideas.

New MacDiarmid Institute logo

Professor Gaston says it was wonderful to see so many aspects of the Institute come through in the logo design process.



Above: The original MacDiarmid Institute logo

"We could see the researchers who stepped up for the panel really understood and shared our vision. As the work progressed, we could all see many aspects of the Institute reflected in the new logo - a connected network, joining the dots, partnerships. Atoms as building blocks - a simplified metaphor for materials science. And we've purposefully chosen earth-related colours - blues and greens - connecting us to our sustainability research focus."

Diane Bradshaw gifted the te reo 'Te Mana Tangata Whakawhanake - Leadership to Innovate Sustainable Materials' into the new logo. She says in contemporary Aotearoa New Zealand English, the word 'mana' refers to a person or organisation of people of great personal prestige and character.

"Traditionally, mana tangata refers to the power and status gained through one's leadership talents, strength of character, from basic human rights, or by birth right. Here we acknowledge the mana of our namesake, Professor Alan MacDiarmid."

DIANE BRADSHAW, STAKEHOLDER PARTNER IWI
THE MACDIARMID INSTITUTE

"Whakawhanake means to improve people's lives, to advance, develop, renew, recycle, reuse."

She also says that the logo sets and acknowledges the Institute's future direction.

If we were to say a few words about our original logo - give it a proper poroporoaki - what would they be? We asked some of our investigators and students:

"It's cool that it was designed by a scientist."

"That logo links us back to our founder, Sir Paul Callaghan, because as first Director of the Institute he was directly involved in the logo's genesis and selection."

"It's been the face of the front door of the Institute for twenty years. It's done the mahi for a long time. That's no mean feat for a logo."

So haere rā to our first logo. Thank you for bringing us to where we are today. And a big thank you to all who were involved in bringing it together 20 years ago.

Whakamārama

*Ka poroaki tia atu kia tomo mai
ka tika ā muri, ka tika ā mua
Tēnā koutou katoa*

*(Farewell, moving toward a new logo.
Acknowledging our past to prepare for the future.
Greetings to all.)*





Te Moana Nui a Kiwa

Over the past year our work at the interface with Te Moana Nui a Kiwa has embarked on an exciting journey of new co-design research, supporting Māori and Pacific students through scholarship and internships and creating videos to showcase some of our up and coming talent. Our ongoing collaborations with Whakarewarewa Living Village have grown to include the co-design of a Mātauranga Māori Science Education Centre.

Discovery Scholarships programme grows with new sponsorship

Our Discovery Scholarship programme for Māori and Pacific peoples in tertiary science received continued funding to fund a further 23 scholarships for 2021, paying up to \$8,000 fees and up to \$3,000 cash awards. The programme continues to be led by Principal Investigator Dr Pauline Harris, Senior Lecturer at Victoria University of Wellington. Our widespread advertising through social media and our partners has led to high numbers of applications from students of diverse backgrounds from all around Aotearoa.

We recognise that there are still significant barriers to Māori and Pacific Island students entering and staying in science, so this year we were fortunate to be able to make short (90-second) videos of eight of our Discovery Scholarship recipients from 2020 and 2021 with the intention to inspire others to apply. We also introduced a fifth award category for 2021: Te Huarahi Ki Mua Award. This category is for students who have been previous recipients of a Discovery Scholarship and are continuing their study in a relevant field.

New sponsors

Once again, the Scholarships were hugely over-subscribed, showing the urgent need for this kind of support only growing. The programme is being continued for 2022, and we are delighted to welcome onboard GNS Science as our first Discovery Scholarship co-sponsor, made possible through the MBIE-funded Aotearoa: Green Hydrogen Platform, as part of the wider Kaupapa Hauwai Kākāriki Aotearoa (Green Hydrogen Programme NZ), led by our Principal Investigator Dr John Kennedy and his team at GNS Science. The funding will support at least five additional scholarships per year in 2022 and 2023 and promote the development of skills and knowledge in green hydrogen and renewable energy technology in Aotearoa.

Bioprotection Aotearoa became our second co-sponsor to champion our Discovery Scholarships programme, also supporting the programme for 2022 and 2023, and helping us nurture a pathway for Māori and Pacific students interested in STEM.



Once again, the Scholarships were hugely over-subscribed, showing the urgent need for this kind of support only growing. The programme is being continued for 2022, now with the support of our co-sponsors GNS Science and Bioprotection Aotearoa

Opposite page, top row from left:

Te Rina Kotara - Piki Ake Award recipient at the University of Canterbury

Eady Manawaiti - Te Huarahi Ki Mua Award recipient at Waikato Institute of Technology (Wintec)

Alyssa Thomas - Te Mātauranga Pūtaiao Award recipient at Victoria University of Wellington

Middle row, from left:

Shannon Macdonald - Te Taumata Award recipient at the University of Auckland

Nicky Hambrook - Te Huarahi Ki Mua Award recipient at Massey University

Heamasi Vaoleti - Te Kainga Rua Award recipient at the University of Auckland

Bottom row: Maia Dean - Te Taumata Award recipient at the University of Otago

“I’m really excited to be part of the growing electricity sector in the future”

TE RINA KOTARA



“Even if you might not have the same opportunities as every one else, either because of financial hardship or discrimination, take every opportunity that you get”

SHANNON MACDONALD



MOU celebrates ongoing partnership with Whakarewarewa Living Village

Celebrating our existing partnership with Whakarewarewa Living Village, together we signed a second memorandum of understanding (MOU) and a Statement of Intent.

This new MOU and Statement of Intent set a path towards a shared vision for:

- A world-class Mātauranga Māori science education centre based at Whakarewarewa Village;
- Science career development for Village rangatahi, and much more, including support for commercialisation of research within the Village through targeted funding.

“Our shared values of manaakitanga, kotahitanga and whanaungatanga, which underpin this relationship, have led to the success of our collaboration over the past three years. Together we’ve been combining materials science knowledge with traditional knowledge, understanding more around the colours in the rocks and waters of Whakarewarewa and surrounding areas, weaving together the legends, waiata, stories and science.”

WVCT CHAIRPERSON JAMES WARBRICK

A significant part of the collaboration includes a co-design process to develop a new Mātauranga Māori Education Centre based at Whakarewarewa. Leadership on the MacDiarmid Institute side is by Māori Programme Leader and Principal Investigator Dr Pauline Harris, and Victoria University of Wellington Master of Architecture student Ben Nielsen. A successful series of wānanga and hui have been conducted during the co-design process this year. The centre will bring together both Mātauranga Māori and science with a key focus on Mātauranga Māori.

Opposite top: Representatives from the Whakarewarewa Village Charitable Trust and MacDiarmid Institute signing the MOU

Opposite below: Masters student Ben Nielsen presenting his research to the team at Whakarewarewa Village

Whakarewarewa Village Charitable Trust (WVCT) Chairperson James Warbrick says that the new MOU would build on the existing relationship and the shared values of the MacDiarmid Institute and the WVCT.

“Our shared values of manaakitanga, kotahitanga and whanaungatanga, which underpin this relationship, have led to the success of our collaboration over the past three years. Together we’ve been combining materials science knowledge with traditional knowledge, understanding more around the colours in the rocks and waters of Whakarewarewa and surrounding areas, weaving together the legends, waiata, stories and science.” He says he hopes the partnership would also provide support and pathways into science careers for Whakarewarewa people, through internships and scholarships.

World Geothermal Congress in collaboration with Whakarewarewa Living Village

Principal Investigators Associate Professor Franck Natali and Dr Pauline Harris gave online oral presentations at the World Geothermal Congress (WGC). Associate Professor Natali’s presentation “Exploring Synergies Between Māori Knowledge and Western Science on the Formation of Natural Colours” focused on bringing together Whakarewarewa Village’s stories, legends and materials science through the understanding of the formation of natural colours on rocks at geothermal vents and deposits from geothermal waters.

Dr Harris’ presentation “Whakarewarewa Thermal Village as a Living Laboratory for Indigenous Materials, Science Outreach and Education” outlined the plan and development of the Mātauranga Māori Science Museum space which will be located in or around Whakarewarewa Village. Dr Harris also attended the Q&A session, during which co-creation and what that looked like from a Māori perspective was discussed.



Summer of lab

Discovery Scholarship recipient Shannon Macdonald spent the summer making gold nanoparticles and hydrogels (respectively) in the labs of Principal Investigators Professor Duncan McGillivray and Associate Professor Jenny Malmström. The University of Auckland (UoA) Biomedical Engineering and Chemistry student says she loved being part of research labs.

“I loved being part of the research teams – seeing how passionate they are about their research, understanding what it’s like to be in a lab and how important it is to refer back to the basics. I can definitely see myself being happy doing that in the future.”

She also met up with MacDiarmid Institute Associate Investigator based at AUT, Dr Taniela Lolohea (page 36).

“Taniela had done his PhD in Duncan’s lab so he came over and we spent time together talking about being Pacific peoples in science. It was so cool to meet him. We’re going to work together on the Tuākana Tutor Programme, developing and expanding the academic support in science for Pacific peoples to cultural support and identity within science.”

Shannon’s next goal is to try an internship in industry.

“There are two paths for me as a biomedical engineer and chemist – research or industry. I know I love research. Now I need to see what industry is like.”

For now, though, Shannon is focusing on the year ahead. She was successful in being accepted into the Biomedical Engineering stream at UoA, and has been selected as a Resident Advisor at her hall – UniHall Towers.

“I just can’t wait for uni to start. I’m so pumped for it.”

Discovery Scholarship recipient Eady Manawaiti interned with our Stakeholder Partner Iwi Diane Bradshaw. His project was two-fold – firstly to research the origins of how the maunga Karioi received its name (for more about Karioi see the article about Dr Oliver McLeod’s research on page30). Secondly, Eady, who is from Ngāti Maniapoto but also has whakapapa to Ngāti Te Wehi at Aotea harbour, spent time at Aotea and on Karioi looking at the impacts of the forthcoming Harvesting of Pine Trees project and how any damage to taonga species and to whenua could be mitigated. He also spent time at the University of Waikato with Dr McLeod in the lab.

Eady enjoyed the internship so much he’s adding an Earth Science paper this year as part of the completion of his Environmental Management degree.

“The internship helped me process a lot of things. This is it for me. It really brings together everything I value – my Māori whānau and whakapapa, and science.”

EADY MANAWAITI

Right: 2021 Discovery Scholarship recipient Shannon Macdonald (far right) with her colleagues Dr Anaïs Chalard (left) and Harrison Porritt in the University of Auckland materials engineering lab of Principal Investigator Associate Professor Jenny Malmström (second from left)



Shannon Macdonald casting a hydrogel while interning in Associate Professor Malmström’s lab





Out of the lab

Whether they are used in smartphones, wind turbines, or for building homes, material technologies that are essential to our lives are inextricably linked to the environment we live in. MacDiarmid Institute researchers spanning diverse scientific backgrounds are pursuing ways to add hi-tech functionality to abundant materials and waste, and to reduce the impact of materials at their end of their life.

Here, we introduce you to some of our people and their work.

To 2028 and beyond

Zero carbon, low energy computing, zero waste - towards a sustainable Aotearoa.

Ahakoā he iti, he pounamu – the smallest things are the most precious.

From atoms, to molecules, to nanostructures and complex materials: we bring physicists, engineers, chemists and biologists together to explore the sustainable use of our most fundamental natural building blocks – atoms – in designing materials that add value to our lives. Our expertise in control of atomistic and nanoscale structure has been used since 2002 to create materials with a vast range of new functions.

From July 2021 through to December 2028, our new research programmes will address some of the greatest challenges facing Aotearoa New Zealand today – the interrelated issues of climate change, economic dependence on carbon, and the energy requirements of the modern world, together with the sustainable use and re-use of materials.

Our ‘materials science for sustainability’ focus leads to our highly collaborative research programmes – Zero Carbon, Low Energy Computing, Zero Waste and Sustainable Resource Use.

From atoms, to molecules, to nanostructures and complex materials: we bring physicists, engineers, chemists and biologists together to explore the sustainable use of our most fundamental natural building blocks – atoms – in designing materials that add value to our lives.



Towards Zero Carbon - Catalytic Architectures

Our research will support Aotearoa New Zealand’s goal for ‘net zero’ carbon emissions by 2050 by exploring new materials that will:

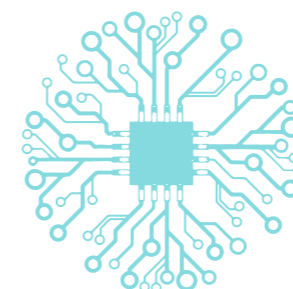
- Capture CO₂ from air and waste streams, through clever chemistry that attracts CO₂ to the surfaces of 3D spongelike materials (such as metal-organic frameworks, or MOFs);
- Decarbonise the energy sector by designing new catalysts that will transform captured CO₂ into green fuels using renewable energy inputs. These new fuels (including hydrogen) will replace carbon-based fuels and remove carbon from energy systems.



Towards Zero Waste - Reconfigurable Systems

Biological systems are incredibly efficient at reusing and recycling. In fact, if we used the world’s resources as efficiently as our bodies treat the nutrients in the food we eat, our planet would be in a far better state. Using nature as an inspiration for next-generation sustainable materials we will:

- Work towards reconfigurable systems - self-regulating, self-repairing systems inspired by nature;
- Develop new materials that are recyclable or reconfigurable. We’ll study the physical properties of biological materials and developing pathways to create value from abundant raw materials or waste. And we will explore the reconfiguration of locally available materials to create objects with cultural value, drawing on Māori understanding of place, along with digital design, hybrid formulations, and additive manufacturing.

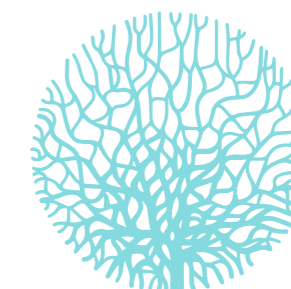


Towards Low Energy Tech - Hardware for Future Computing

Our smartphones and tablets have become an integral part of our lives. But the massive data centres worldwide that support this digital lifestyle use almost ten times as much electricity per year as the whole of Aotearoa New Zealand. And current research aiming to improve computing systems based on silicon transistor technology is hitting a technological roadblock.

We will develop:

- Computers able to process information more like the brain. We’ll be studying cellular networks and biological neurons using molecular electronics, nanomaterials, and soft matter;
- Computing that uses far less energy compared to conventional electronics, based on quasiparticles using superconductivity, spin order (magnetism), or topological order within a solid material.




Sustainable Resource Use - Mātauranga Māori Research Plan

Crosscutting these research programmes sits our Mātauranga Māori Research Plan that intersects with the theme of sustainability and explores both old and new knowledge to grow innovative approaches and techniques based on Mātauranga Māori.

Our research and development plan will:

- Develop the capability and capacity of Māori and Pacific peoples in the sciences, both western and Māori, through the Discovery Scholarships, camps, internships and education programmes;
- Develop the capability of scientists within the MacDiarmid institute to engage with Māori communities;
- Contribute to the growth of Mātauranga Māori through research into:
 - Māori ways of understanding sustainability; the geological origins and whakapapa of the whenua; and
 - the development of endemic materials to use in innovative technologies.

We partner with Whakarewarewa Living Village in Rotorua to explore synergies between the two knowledge systems, Mātauranga Māori and contemporary science.

A man in a dark polo shirt is working on a 3D-printed replica of a Hawaiian outrigger canoe. The replica is a tall, narrow, white structure with a dark band around its middle. The man is standing at a workbench, looking down at the object. In the foreground, there are two large rolls of material, one white and one dark. To the right, a blue container with the text '55UM' is visible. The background is a plain wall with a window.

**Principal Investigator
Derek Kawiti is creating
a full-size replica of a
230-year-old Hawaiian
outrigger canoe — wa'a
in Hawaiian — using the
latest in 3D-printing
technology.**

Biodegradable electronic devices for wildlife conservation and livestock management thanks to clever proteins

MBIE funds research into a new generation of Radio Frequency Identification (RFID) tags

In 2019, the world's mountain of electronic waste, or e-waste, reached its peak-to-date: 53.6 million metric tons, equivalent to the mass of 150 Empire State Buildings. Across the globe, researchers are developing more sustainable alternatives – materials that biodegrade, and devices that can be made, disassembled and remade, leaving behind a much smaller environmental footprint. As University of Auckland (UoA) Associate Professor Jenny Malmström explains, this is also a key motivator for one of the four core MacDiarmid Institute research strands. “The overall goal of the Reconfigurable Systems programme is to create materials that are efficient and generate zero waste. It's also about using natural or biological materials instead of more problematic materials.” Associate Professor Malmström's focus is on exploring the role that particular proteins could play in this effort. More specifically, she's interested in exploring “the other things that proteins can do, beyond their obvious ‘day job.’”

For example, some species of migratory birds have proteins in their retina that are sensitive to both light and magnetic fields, making them a key navigation aid. In addition, a large number of other proteins and biological materials are piezoelectric. This means that if you stress or bend them, they can accumulate electric charge which can then be collected as a voltage. Piezoelectric materials have long been touted – and widely tested – as a means to transform mechanical motion into electricity. And Associate Professor Malmström believes that proteins with this property could be the key to making small, fully biodegradable electronic devices.

“We started with some of the fundamental science, but I wanted to push it further and see how we could make it more applied,” she says. Conversations with GNS materials scientist and MacDiarmid Institute Associate Investigator Dr Jérôme Leveneur led Associate Professor Malmström to an idea. Perhaps they could use biological materials to make RFID tags – simple, battery-free electronic circuits that can store information and be read by a radio transmitter/receiver unit. After meeting with people from different industry sectors, it became clear that there was an appetite for biodegradable ID tags. “Wildlife tracking for conservation was one key sector, as were livestock management and the food supply chain,” says Dr Leveneur. So the team decided to apply for a Smart Ideas grant from MBIE, and in October 2021 were informed that they'd been successful.

To find the right materials for the job, Associate Professor Malmström will work with her UoA colleague and fellow MacDiarmid Institute Principal Investigator Professor Jadranka Travas-Sejdic, a leading expert in degradable polymers. “Finding the right biological material to do that – one that is sensitive to the environment, but that stays stable over time – will be an important step.”

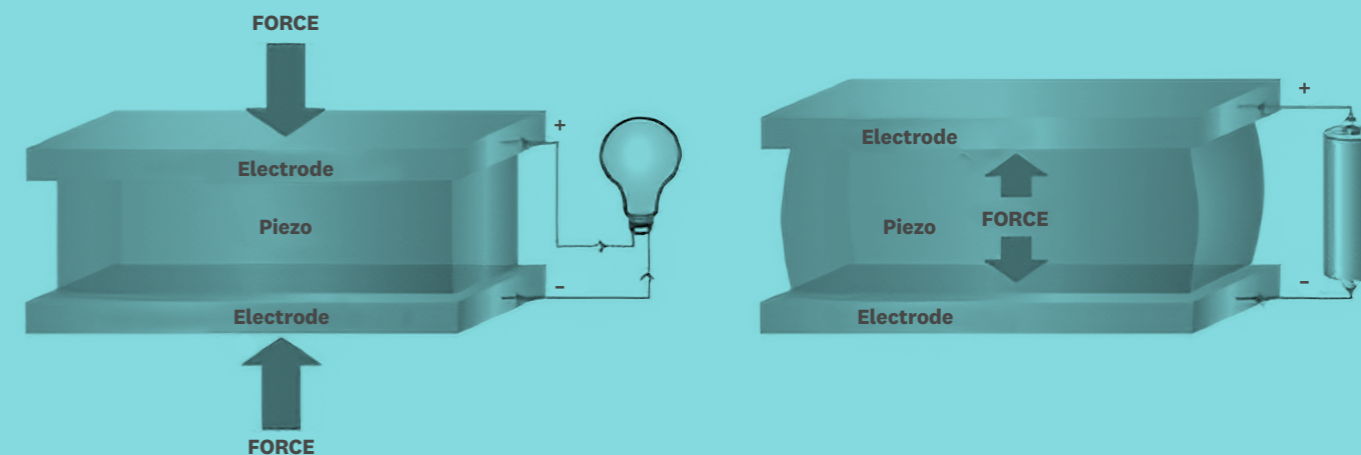
Incorporating piezoelectric properties into the RFID tag will lead to a battery-free device that is powered by the motion of the animal wearing it. “This tag codes information about that specific animal, and it'll be able to transmit that as a signal over a short distance to a nearby receiver station.”

“This project sits at the interface between different disciplines, which means that we need the input of every single team member.”

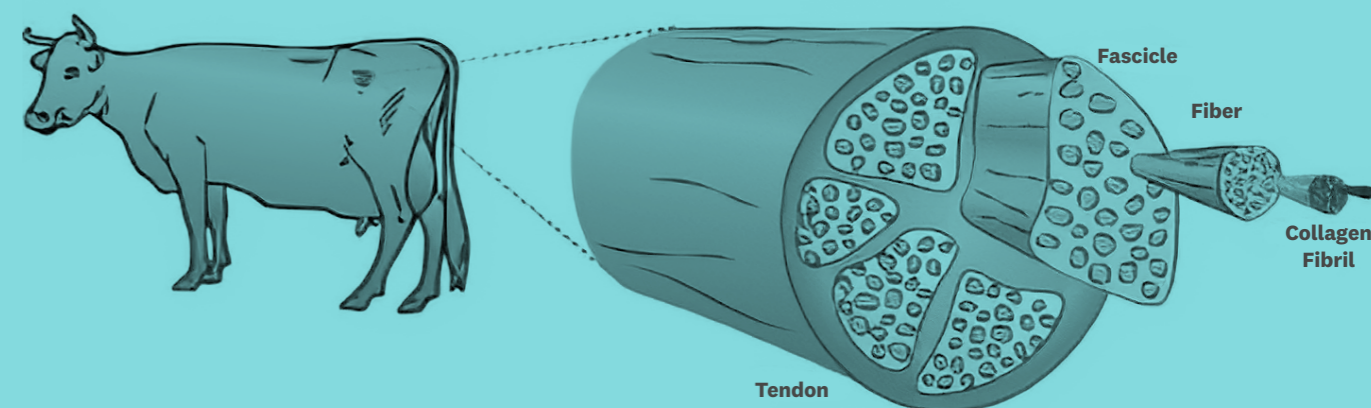
Associate Professor Malmström is particularly interested in the technology's potential for use in wildlife conservation, as a way to gather population-level data about different species. “Currently, devices that aim to do this are quite expensive, and you need a lot of them. They're also made from plastic and metal and often incorporate batteries, so if they're left behind in nature, they can become a waste problem.”

Though already thinking about these longer-term goals, she is cautiously optimistic about where this project can take them. “At the end of the three years, we hope to have some prototypes – something to show that the idea is viable. We know there are challenges ahead.”

She continues, “This project sits at the interface between different disciplines, which means that we need the input of every single team member. Jérôme, Jadranka, Dr KC Aw (a UoA Associate Professor of mechanical engineering), Dr David Pattemore (an ecologist at Plant & Food Research), myself, and our students and post-docs. Everyone will play a role, which is exciting.”



<https://pubs.rsc.org/en/content/articlelanding/2021/ra/d1ra03557f>



“Finding the right biological material – one that is sensitive to the environment, but that stays stable over time – will be an important step.”

ASSOCIATE PROFESSOR JENNY MALMSTRÖM

Reconnecting hapū and whānau with their whenua

Using geological data and isotope research to develop new composite materials for building eco-papakāinga

He papā te whatitiri, hikohiko te uira, kia kotahi ai ngā maunga. Ngā tohu me nga mahitahi ngā e ki ai I te tangata he rangatira.

We acknowledge the land as a gateway, a journey that can develop and unite minds across many disciplines to increase Māori research capability in unlocking the potential of Māori people, knowledge and resources. Our leadership and empowerment is based on traditional values and a Te Ao Māori worldview.

MacDiarmid Institute Stakeholder Relations Partner Iwi Diane Bradshaw, from Ngāti Te Wehi, Ngāti Mahuta hapū of Waikato Tainui, and Te Uri o Hau ki Te Rarawa Iwi, is working with geologists and hapū to look at developing composite materials for building eco-papakāinga. Ms Bradshaw, who works at GNS Science at their Wairakei Research Centre in Taupō), says the project looks to the past and to the future.

“Ancient Romans used low-carbon concrete 2000 years ago using volcanic materials, and Māori mainly used pumice deposits. Integration of mātauranga a hapū and technical learning aims to investigate rocks materials and provide insights into Māori architectural and philosophical worldviews.

“We are fortunate here in Aotearoa New Zealand to have a world-class scientific community alongside an innovative ‘problem solving’ culture. When we apply these together to climate action and emissions reduction plans, we bring benefits across the economy and to the whole of society.”

She says those fields were the domain of the geologist, and can be used to constrain the location, quantity and quality of rock/sediment for use in construction.

“A project of such significance requires a bold and, at the same time, sensitive but gradual approach to the use of whānau and hapū resources.”

“Ohaaki provides an opportunity to facilitate cascade utilisation for materials recovery, such as silica, metals and clays. The area also has efficient low temperature electric power (with small or off-grid plants of a few hundred kW) and a range of feasible direct uses, such as space heating, horticulture and other agricultural applications.”

Ms Bradshaw says a project of such significance requires a bold and, at the same time, sensitive but gradual approach to the use of whānau and hapū resources. She says the Tahorakuri A130 Trust’s position is therefore unique in several respects, and that the next steps are to examine how

sustainable the building market is, especially concerning materials use and energy.

She says interest in a holistic view of building and construction technology can influence the materials choice and fabrication and that the choice of construction systems, technique, building components and materials is usually based on a multi-criteria approach. Ms Bradshaw says this includes adverse effects on extracting natural resources from the earth as well as impacts on waterways.

“Māori land and buildings are independently the largest fixed asset and investment in tribal estates, so the importance of an economical and sustainable building process is enhanced. We hope the new research and discussion will be of some interest to other ‘Corridors of Indigenous Practitioners’ societies in Aotearoa. Experience in new models of development to reuse, renew and recycle materials in Aotearoa is very limited to date especially since the material mass in the buildings is high.”

Ms Bradshaw has now brought in as a MacDiarmid Institute Research Assistant Dr Oliver McLeod who will provide the geological information used to select rocks/sediments

“Ohaaki provides an opportunity to facilitate cascade utilisation for materials recovery, such as silica, metals and clays.”

for extraction as building materials. Following field investigation, Dr McLeod will use thin section petrography and X-Ray Diffraction (XRD) to analyse the mineralogy of geological materials to assess their physical and chemical suitability (i.e micro-texture, glass and hydrous mineral content) for the development of different building materials (e.g. cut stone blocks, pumice-ash based composites, silica glazes).

“We continue to co-design in partnership to develop our advice and incorporate Te Ao Māori into the research. It is critical to navigate both the cultural and scientific elements, plans and policies, especially where kaitiakitanga and traditional mātauranga is a high-level strategic area led by the Trust.”

For Ms Bradshaw, the work brings her back to the vision of the Institute’s pioneering namesake, Nobel prize winner Alan MacDiarmid, who she treasures. She particularly likes one of the quotes he had on his office wall – ‘The harder I work, the luckier I seem to be’.

“I acknowledge Alan MacDiarmid as the namesake for the Institute and the inspiration for all the work we do.”



TAHUMATUA

Left to right: Dr. Rupert Craggs (NIWA), Diane Bradshaw (GNS), Tess Kora (Ngāti Tahu), Tuana Kuka and Chris Tanner (NIWA) at the Ohaaki Marae and Tahumatua meeting house

How to map an ancient stratovolcano

The ancient volcano Karioi rises above the black sands of Raglan, the iconic surf town on North Island's west coast. Between turquoise swell and emerald-green forest, its immense cliffs of basalt lava and ash tell a story of past eruptions over two million years ago.

For the past six years, Dr Oliver McLeod has dedicated his time to meticulously mapping and sampling Karioi and its sister volcano Pirongia, which together form the two largest peaks in the Alexandra Volcanic Group between Te Awamutu and Raglan.

Equipped with traditional field gear – the rock hammer and hand lens – and more modern devices (GPS and drone), he sets out each week in search of new discoveries for his geological maps.

“Karioi is one of only three volcanoes on Earth where the subduction-related volcanism and intraplate-volcanism have occurred together at the same time. It’s like Ruapehu and Tahiti combined into one volcano.”

Each field trip is different. Weather ranges from icy cold and thundery in winter, to scorching hot in the summer months. Days are spent climbing through forested valleys and peaks or wandering lonely stretches of coastline between tides.

Karioi maunga is culturally revered by the Tainui people, who have a 700-year history of settlement on the slopes and harbours surrounding the volcano. Remnants of stone gardens for kumara and taro, set among hand cut drainage ditches, and storage pits in sand dunes are all common features of the maunga.

Dr McLeod says one of his biggest moments was presenting the Pirongia map to the Māori Kingi Tūheitia on behalf of Ngāti Maniapoto, at Purekireki marae in 2020. “To be in the company of hapu who shared an equal or deeper appreciation of the Pirongia maunga left an impression on me. Every peak and stream has a name, and a story, which relate back to the tangata whenua and their generational experience of the maunga.”

Originally from Auckland, Dr McLeod completed his Honours degree at the University of Otago in Applied Geology, studying the Dunedin Volcano. After a year in Mexico observing eruptions at Colima Volcano, he returned to complete a PhD at the University of Waikato.

“While in Mexico, I had a kind of vision to study the geology of Pirongia. I considered Pirongia one of the last geologically unexplored places in Aotearoa New Zealand”.

Now working as a researcher for the MacDiarmid Institute alongside Diane Bradshaw (Stakeholder Partner Iwi) of Ngāti Te Wehi, Ngāti Mahuta, Ngāti Maniapoto, Waikato Tainui, Dr McLeod is excited about the next phase of the work.

“In 2021, we studied taonga at Kawhia together, matching toki/adze with their source rocks from the region. We were astounded to find how many rocks were brought in from Motutapu and Rangitoto ki te Tonga (D’Urville Island).”

Dr McLeod says he aspires to be a professor of Geology, whose research will encompass the materials and cultures of the South Pacific. Future aside, he fully embraces the present moment to complete his maps while the research world recovers from the pandemic.

“To be young, to map mountains, and to do it with complete conviction and passion. This time will never be repeated.”

The new work Geology of Karioi Maunga, Aotearoa-New Zealand will be published by the Geoscience Society of Aotearoa New Zealand in mid-2022. The publication includes a large printed geological map and illustrated full-colour explanatory text. Public lectures are planned for Wellington, Auckland and the Waikato Region, dates to be announced.



Above: Photo of Karioi maunga. Photo by Lloyd Homer, GNS Science.

Opposite: Dr Oliver McLeod in the field





Dr Kannan Ridings teaching at the University of Auckland Tuākana programme

Bridging the divide between theoretical and experimental physics

Fresh from a second year of working on COVID-19 modelling with Associate Investigator Professor Shaun Hendy, Dr Kannan Ridings from Rongowhakaata is himself one of the MacDiarmid Institute’s newest Associate Investigators, having recently taken up a lectureship in physics at the University of Auckland (UoA).

With strengths in mathematical modelling and computer simulation, Dr Ridings is used to working with theory on a range of problems – from the COVID modelling he has recently been involved with, looking at the way the disease spreads across networks of people, to the work simulating the thermodynamic stability of nanowires that he focused on previously in collaboration with Professor Hendy.

“The nanowire work was based on the use of classical molecular dynamics, which can study larger systems at the expense of accuracy. We can alternatively use quantum mechanical methods that can describe the fine details of the electronic structure of a material with great accuracy, but this comes at the expense of the size of the system you can study.”

Dr Ridings is now keen to engage with the Institute further to leverage his previous experience working on metal nanowires, and on networks of COVID spread, to study nanowire networks. This work aligns closely with the goals of the Institute’s new Future Computing research programme, where for example Principal Investigator Dr Natalie Plank, experimental physicist and Senior Lecturer at Victoria University of Wellington, is looking at the electronic transport properties of silver and zinc oxide nanowire networks.

“I am keen to help bridge precise electronic structure calculations, and the experimental results from the lab. Our theory can help experimentalists understand deeply the phenomenon they observe in the lab. Then what they see in their labs gives us insights into the theory. It’s a really positive feedback loop.

“That’s where the best science will come from.”

“That’s where the best science will come from.”

Actively involved in the Tuākana Programme at the UoA, Dr Ridings is passionate about training the next generation of role models for Māori and Pacific students.

He cites the influence of Nobel laureates in growing science in their countries.

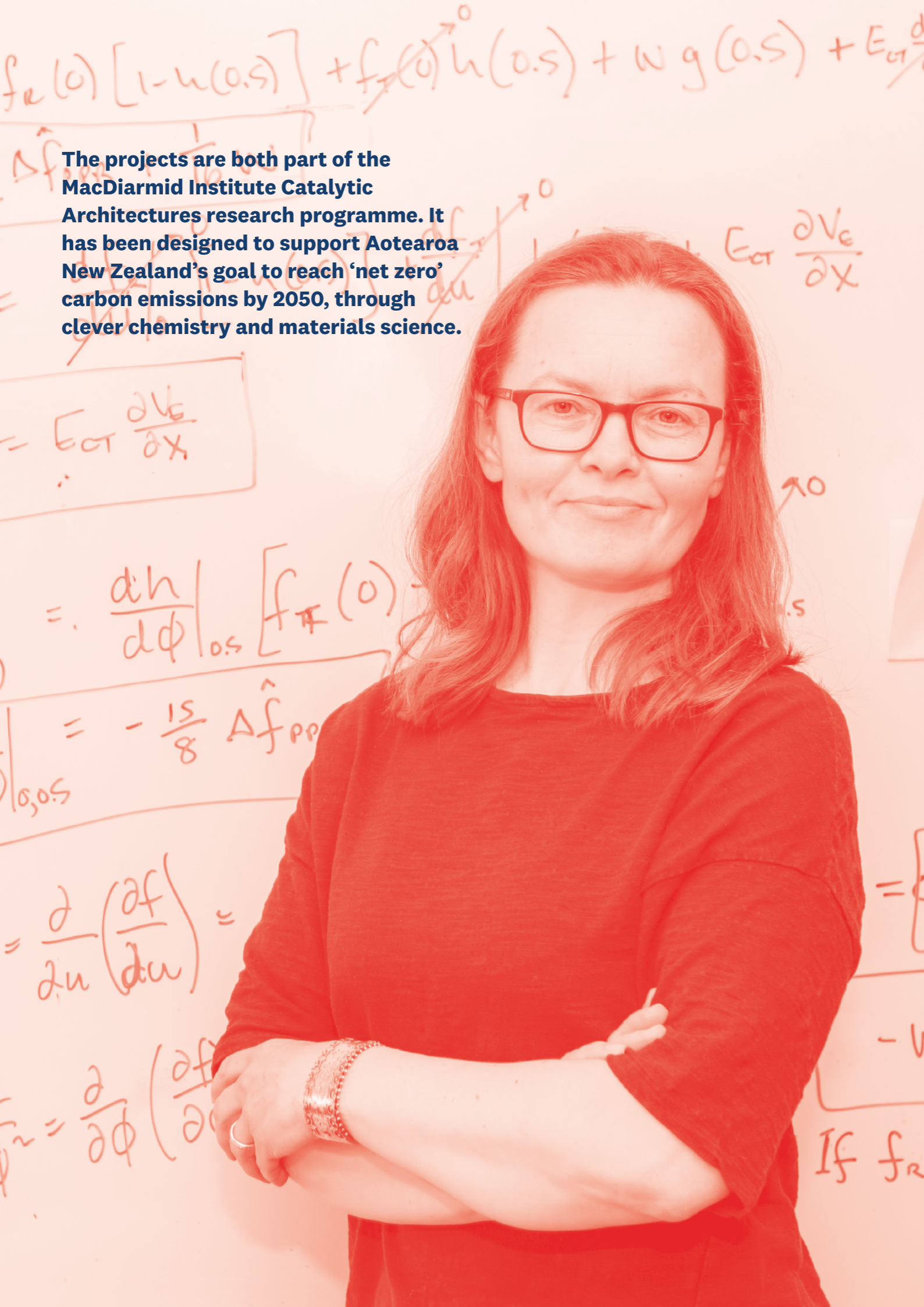
“I remember reading about the influence Niels Bohr and Hideki Yukawa had on their countries. Physics in Denmark and Japan were not well established in the early 20th century, but both of these scientists won a Nobel prize early in their careers. This put them into the public eye and inspired a generation of physicists.”

“If you can see someone else with your background, you can see your future.”

Dr Ridings is passionate about seeing more Māori and Pacific researchers being a part of the MacDiarmid institute and the scientific research space of Aotearoa. “People need role models. If you can see someone

else with your background, you can see your future, you can feel that they’re relatable.

“I like the direction of research development within Mātauranga and the active encouragement and inclusion of Māori and Pacific in the sciences within the MacDiarmid Institute. It’s a privilege to be part of.”



The projects are both part of the MacDiarmid Institute Catalytic Architectures research programme. It has been designed to support Aotearoa New Zealand's goal to reach 'net zero' carbon emissions by 2050, through clever chemistry and materials science.

Producing technology-critical materials for a low-emission future

MacDiarmid Institute scientists try to tip the carbon balance in NZ's favour

Across the world, numerous countries have developed lists of 'critical minerals' – materials that are of strategic importance to that economy, because of how and where they are used. Rare-earth elements like neodymium, and metals such as titanium, lithium and tantalum are just some examples of these. Each one plays an important role in our daily lives, used in everything from smartphone chips to wind turbines.

Such materials are not easy to produce. Extracting and refining them comes with significant environmental and financial cost. Despite this, many critical minerals end up in waste streams, while others become low value by-products. This is a situation that Associate Investigator Professor Catherine Bishop has been working to change for several years. Alongside her colleagues at the University of Canterbury (UoC), Professor Bishop has been exploring the use of a process called molten oxide electrolysis (MOE), which may be able to reduce the carbon footprint of the metallurgical sector. And now, thanks to a successful application for funding from the most recent round of MBI's Smart Ideas programme, she will be able to take this work a step further.

"We had originally looked at secondary resources; so we were asking 'what can we recycle?' or 'what can we gain back from this process?'" she explains. In that research, the focus was on finding smarter ways to utilise the titanium oxides generated by New Zealand's steelmaking industry. "We wanted to see if we could do something with this waste material – it is typically crushed up and used as road fill." The idea was that by heating up this oxide and subjecting it to a specialist, high-temperature type of electrochemistry, they might be able to extract the titanium metal. "It was stretchy science, we didn't know if it would work. Ultimately, we concluded that it is possible to obtain titanium from NZ steel slag, but you also get silicon at the same time. It wasn't a straightforward win, but it got us to some of the underlying science."

From there, Professor Bishop, working closely with her Canterbury colleagues Professor Matt Watson and Professor Aaron Marshall, wondered if a similar technique could be applied to primary processing, particularly of critical minerals. "Could we use electrolysis as a near-zero emission way to extract a rare-earth element from ores of mixed oxides? Or could it be used to pull one metal from chemically similar metals that naturally occur together?" That's what led the team to identify their two target materials – neodymium and tantalum, both crucial for use in clean energy technologies.

These materials are likely to appear on the forthcoming critical minerals list for New Zealand, as outlined in the government's Minerals and Petroleum Resource Strategy in 2019. And according to the New Zealand Institute for Minerals to Materials Research, neodymium

is just one of the rare-earth elements present in the West Coast's mineral sands. If Professor Bishop and her multidisciplinary team can find a more efficient, less destructive way to tap into those resources, it could be big business.

She admits that this won't be without its challenges. "In previous work, we looked at compositions that were fairly common in the steel industry, which meant that some of the fundamental parameters were already known. We had things like phase diagrams, which tell you how stable the different forms of a material are. For this work, we have to establish and map out those parameters ourselves. The 'knowns' are somewhat spotty... though we have identified one materials system that might have legs!"

The experiments, too, will push the boundaries of what's been done before. Conducted at high temperatures, they will rely on some new facilities at UoC, as she explains, "Aaron and our colleague Matt Watson previously had to go to Australia to do high temperature x-ray diffraction measurements, but we are setting up a similar capability here, which is exciting. Matt also acquired a simultaneous thermal analyser which will allow us to validate other aspects of the phase relations of our materials."

"It was stretchy science"

She continues, "This funding mechanism is made for high risk – and maybe high payoff – science. We're hopeful that within three years, we can demonstrate that there's something to this idea. Something we can potentially build on in the future."

This is an attitude shared by Professor Marshall, who was additionally successful in a separate bid for Smart Ideas funding. In that project, he and his team (which includes Principal Investigator Dr Anna Garden) will focus on redox flow batteries. These are long-life energy storage systems that are effective at capturing the intermittent energy generated from renewable sources, like solar and wind. Currently, these batteries are very expensive, but his aim is to develop new catalysts that speed up the reactions within the battery, improving their efficiency and reducing operating costs.

These projects are both part of the MacDiarmid Institute Catalytic Architectures research programme, which has been designed to support New Zealand's goal to reach 'net zero' carbon emissions by 2050, through clever chemistry and materials science.

Developing highly functional and tailorable surface coatings

New MacDiarmid Institute Associate Investigator Dr Taniela Lolohea says that in his first year of university STEM study, he was part of a cohort of 40-50 Māori and Pasifika students.

“But this quickly changed. By the end of my 3rd year there were only a handful of us. And from Honours onwards, it was just me.”

“You look around and there’s no one else like me.”

Now a lecturer in Chemistry at Auckland University of Technology (AUT), Dr Lolohea says these experiences are behind his work to try and motivate younger generation of Māori and Pasifika students into the STEM fields.

So how far behind is the next Pasifika STEM student?

“It’s hard to find even Honours Pasifika students with STEM backgrounds – so they’re some years behind. It’s hard to get them to see academia as a fruitful pathway. Often the organisations are saying all the right things in their Terms of Agreement documents, but whether it’s fruitful or just words is hard to say.

“This has been weighing on my mind a lot lately. It looks like movement but feels like words till things happen.

“It’s like inviting people to your house – it’s not great if your house isn’t ready to take on guests.”

“Similarly, how can I genuinely say to Māori and Pasifika students that science is cool and expect them to come all bright eyed, when the reality is harsher and they’re going to face turmoil.

“So my thought at the moment – is it better for me to prepare the ‘home’ before I invite them? When I speak with them, I tend to give a realistic view of things – and explain that it’s not always nice and people are not always welcoming. In my culture, people respect a more honest view of things.”

So how do we help Māori and Pasifika students to see academia as a fruitful pathway?

“You want to trust that your supervisor knows your background.”

“We want to show role models, trail blazers leading the way. As a student you want to trust that your supervisor knows your background.”

Dr Lolohea was born in Rotorua to Tongan parents who came to New Zealand in the 1980s. The middle child of five siblings – four sisters and one brother – he says he’s passionate to change things for others in his community.

His own research spans two disciplines, plasma jet printing and Pasifika knowledge systems.

Dr Lolohea says the plasma jet printing work follows from his PhD and postdoc research.

“If you can control the chemistry you can create specific surface coatings fit for purpose”

“Plasma jet is a reactive medium, with free electrons and ionised gas particles. When you inject material into this plasma you get what we call ‘interactive species’ – so a mist of tiny droplets that interact with the plasma in ways that lead towards highly functional and tailorable surface coatings. If you can control the chemistry you can create specific surface coatings fit for purpose, smoother or rougher, more porous or more dense.”

He says there are many potential real-world applications ahead.

“You can deposit coatings onto surfaces – for example, onto plastic for self-cleaning windows or as anticorrosive coatings for metals, or for use in gas sensors.”

He says his natural links in the Institute are with his MacDiarmid Institute colleagues at the University of Auckland (UoA): Principal Investigators Professors Duncan McGillivray and David Williams, Associate Professor Geoff Willmott, and Professor Jadranka Travas-Sejdic and Associate Investigator Associate Professor Viji Sarojini.

The collaborations extend to bioprinting, and fit within the Institute’s new ‘Towards Zero Waste - Reconfigurable Systems’ research programme.

“We’re heading in the direction of bioprinting, with a high material-to-coating efficiency. We’re wanting to get to the position where the hi-tech application of biomaterials and coatings will be environmentally benign and having good cost-benefit ratios.”

His second area of research aims to shed more light on Pasifika science knowledge systems. He says the work is multidisciplinary, and not yet well defined.

“Too often Māori and Pasifika knowledge systems are lumped together. They face similar hardships but the journey should be from individual aspects cause they’re coming from different backgrounds.”

He says this is a really new space for New Zealand.



Associate Investigator Dr Taniela Lolohea (back right) with DiscoveryCamp attendees in 2020



Associate Investigator Dr Taniela Lolohea

“If you can control the chemistry you can create specific surface coatings fit for purpose”

Dr Lolohea is using some of his MacDiarmid Institute funding for Pasifika science projects – working to have these ready to offer to students.

“I’m designing 4-5 projects that will be ready to go when the right student comes along.”

He says AUT has been doing a good job in the last five years with the Eke Tangaroa Programme.

“And it’s really encouraging to have Damon Salesa as our new VC. This definitely influences how I see my long term stay at AUT.”

(AUT announced in November that Pacific Scholar, Associate Professor Damon Salesa, will move from pro-VC Pacific at UoA to the AUT top job early in 2022.)

As an undergraduate student Dr Lolohea joined the Tuākana network at UoA.

“That was cool. I bugged the guy that ran it to let me be a mentor by my 3rd year, and then ended up coordinating the Tuākana Chemistry programme by the end of my PhD. I’m passionate about changing the landscape and helping the Māori and Pasifika cohort. I’m really wanting to address some of the inequities we’re seeing in Institutions.

“There are lots of people trying to make change, so it won’t be long.”

“I’m passionate about changing the landscape”

Putting wellbeing at the heart of student supervision

2021 was a particularly important year for the MacDiarmid Institute's focus on wellbeing. With the start of the new Tertiary Education Commission (TEC) Centre of Research Excellence (CoRE) contract in July, we took the initiative to develop new policy for all members of the Institute as per recommendations from the student-informed Wellbeing Report written the year prior. Working with the MacDiarmid Emerging Scientists Association (MESA), we developed a new Supervision Policy and the Supervision Expectations document, which is meant to be used in addition to existing University policies around supervision, as a useful document to either follow or use as a guideline for discussions around supervision expectations and responsibilities between a student and their supervisor/s. The premise of these documents is to ensure a good research experience that is based in good faith and trust.

Working with Stakeholder Relations Partner Iwi Diane Bradshaw, we also developed a Mātauranga Māori Research Policy. This complements our new Mātauranga Māori Research Programme by way of supporting Māori and Pacific capability within the MacDiarmid Institute at all levels, through targeted strategies of representation and inclusion, through improving the cultural competency of all Institute members, and supporting sustainable research based on Mātauranga Māori.

Tying these new policies together is the Investigator Agreement.

Whilst responsibility to uphold and practice these policies is shared across the Institute at all levels, as senior members of the MacDiarmid Institute, the Investigators are officially expected to imbed these into their work therefore becoming role models to the students and early career researchers (ECRs).

In addition to these policies, we have continued our Exit Interviews for graduating students and postdoctoral researchers, and we continue to celebrate student and ECR successes in our monthly internal newsletter in a dedicated 'Highlights' section.

PhD recruitment

PhD stipend increases to \$35k

We have over 30 fully funded PhD scholarships, have filled a number of them, and recruiting efforts targeting domestic students are in full swing.

With the start of the new CoRE contract in July, we are able to offer over 30 fully funded PhD scholarships within our new research programmes. With COVID-19 still in our midst, we recognised a new cohort of domestic students that would otherwise move abroad. We hosted PhD recruitment events across the country in-person and via Zoom. In addition, we created a poster for a targeted social media campaign, as well as sent targeted emails to relevant Universities and Institutes across Aotearoa New Zealand and Australia. We pride ourselves in being a leader in offering liveable PhD stipends for three years at \$35,000 NZD per annum plus all student fees.

New Associate Investigators 2021

Dr Mathew Anker is a Lecturer in Inorganic Chemistry in the School of Chemical and Physical Sciences at Victoria University of Wellington (VUW). His main research interests are in developing the synthesis of novel organometallic complexes, investigation of their underlying electronic structure and delineation of fundamental patterns of reactivity.

Professor Catherine Bishop joined the Department of Mechanical Engineering at the University of Canterbury in 2008, where she currently leads the Materials Cluster@UC, a large network of materials researchers at the University of Canterbury. Professor Bishop's research bridges structure-property-processing-performance interrelationships in alloys and ceramics.

Dr Kai Chen is a Scientist at the Robinson Research Institute, having previously worked with Professor Justin Hodgkiss' Ultrafast Spectroscopy group at VUW. Dr Chen's research focuses on advanced optoelectronic materials and spectroscopy technologies. As a spectroscopist, he has experience in optics, nonlinear optics, and advanced laser and spectroscopy systems.

Dr Courtney Ennis is a Lecturer in the University of Otago's Department of Chemistry. His research is focused on the vibrational signatures of crystalline materials, such as metallic- and hydrogen-bonded organic frameworks;

specifically, how these signals are altered under changing environment and with the uptake of adsorbed gases.

Dr Prasanth Gupta works as an Ion Beam Scientist at GNS Science, having previously completed his PhD with VUW and GNS Science in 2017. He currently leads research in GNS Science to develop alternative catalysts to platinum in the hydrogen industry and design novel electrochemical systems for ammonia production.

Dr Muhammad Hanif is a Senior Research Fellow at the University of Auckland (UoA). His research is underpinned by molecular design and synthetic inorganic chemistry. Over the years, most of his research has been focused on the design and functionalisation of organometallic compounds. More recently, Dr Hanif has been investigating metal complexes as molecular spintronics and photosensitisers.

Professor Patricia Hunt joined VUW in 2020 as a Professor of Theoretical and Computational Chemistry. Professor Hunt is a world leading expert on molecular level interactions within liquids/solvents, particularly in understanding ionic liquids and deep eutectic solvents/electrolytes. She is also an expert in molecular orbital theory and hydrogen bonding.

Dr Luke Liu is a Lecturer in Inorganic Chemistry at VUW, having previously worked

as a Postdoctoral Fellow at Northwestern University. Dr Liu's current research projects, supported by Royal Society Te Apārangi and VUW, focus on tackling challenges in storing, distributing, and potentially exporting green hydrogen generated from renewable sources.

Dr Taniela Lolohea is a Lecturer at Auckland University of Technology (AUT). His research involves exploring the fundamental aspects of plasma-material interactions and how these interactions can be utilized to control features of novel surface coatings. Alongside this, Dr Lolohea is endeavouring to discover Pacific science knowledge systems, creating research with real life impact on his community.

Associate Professor Steven Matthews is a Senior Lecturer within the Department of Chemical and Materials Engineering at UoA. His research focuses on novel coating functionalities through manipulation of carbide/oxide microstructures, the use of thermal spraying to promote environmental remediation and biodiversity in marine environments, and the development of novel catalytic coatings for wet oxidation.

Dr Kim McKelvey has been working as a Senior Lecturer in the School of Chemical and Physical Sciences at VUW since 2020, following three years at Trinity College Dublin as an Associate Professor. His research involves using nanoscale

electrochemical methods to study energy storage and conversion technologies (such as batteries, fuel cells, electrolysis cells, sensors).

Dr Kannan Ridings is a Lecturer in Physics at UoA. He is also the coordinator for the Tuākana programme at UoA which offers tutoring and mentoring to Māori and Pacific students. Dr Ridings' research is in theoretical and computational materials science, specifically looking at memristive properties that emerge from nanowire networks.

Dr Cameron Weber is currently a Senior Lecturer and Deputy Director of the Centre for Green Chemical Science at UoA. His research interests are in the understanding of intermolecular interactions and use of alternative solvents such as ionic liquids, deep eutectic solvents and switchable solvents, and he has a particular focus on addressing issues around sustainability.

Dr Ben Yin is a Principal Engineer at the Robinson Research Institute at VUW. His research interests span the creation of inorganic and organic materials and their applications in the environmental and energy industries. Dr Yin's work includes the membrane separation process, fabrication and applications of porous materials, and hydrogen production and applications.

Rethinking computing and communication, by combining cell biology with nanotechnology

Systems that blend biology with electronics could answer some big questions

Associate Professor Charles Unsworth started his scientific career with a degree in mathematical physics from the University of Liverpool and a PhD in millimetre wave physics from the University of St. Andrews. The latter led him to work on the hardware for the first passive millimetre wave radar imaging systems for the UK's Ministry of Defence. But these days, the MacDiarmid Institute Principal Investigator is more likely to be found probing cells at the Centre for Brain Research labs or developing artificial neural networks algorithms in the Department of Engineering Science at the University of Auckland (UoA).

At first glance, it might seem like a surprising path, but it's one that has given him a breadth of scholarship and expertise from hardware right through to software. After a postdoctoral fellowship in radar signal processing, Associate Professor Unsworth became one of the first Engineering and Physical Sciences Research Council (EPSRC) postdoctoral mobility fellows, applying engineering to the biomedical sciences in the area of epilepsy. "I used very similar techniques in my fellowship at the Royal Hospital of Sick Children in Edinburgh, as I did in my radar work. The only difference was the application – this time, they were being used for studying epilepsy signals in the brain. I went basically from radar signal processing to biomedical signal processing; and signal processing is still a major thread of my research."

Associate Professor Unsworth directs a Neural Engineering group at UoA's Faculty of Engineering which sits at the interface of engineering, neuroscience and computing, and so his projects often cut across disciplines. His group have developed artificial neural networks for novel electronic noses (or e-noses) biosensors with Plant & Food Research which detect molecules in gaseous environments which could find use in everything from the wine industry to biosecurity. These can predict odorants from the electrical signals of ultrasensitive insect olfactory neurons. He's currently collaborating with fellow MacDiarmid Institute Principal Investigator Dr Natalie Plank, on her Marsden funded project, to extend this research into ultrasensitive devices known as electric tongues (e-tongues) to detect human hormones in liquid environments, such as blood, that have point of care applications for GPs and in the home. "It's a really lovely project," he says. "Our role in it involves training our artificial neural network models with Natalie's data, to see if we can identify the specific molecules of interest at picomolar concentrations in their complex liquid environments."

One major area of focus for Associate Professor Unsworth and his team is the development and application of bespoke in vitro neural chip platforms for neuroscientific discovery. These novel platforms, based on silicon chip devices, provide a means to grow and precisely organise

human brain cells into regular grid arrangements on a patterned biomaterial. "We're trying to understand how certain cell types communicate, but because cells move around, it's often very difficult to know exactly what's talking to what," he explains. "Using biomaterials, optical methods and multi-electrode arrays (MEAs) built into the chip technology, we can move, remove and organise cells accurately, and stimulate and record from them electronically or with light. We can watch – through image and signal processing – how information propagates cell by cell around a network." Originally developed to look at the behaviour and relationships that exist between healthy human neurons and astrocytes, and funded through a Marsden programme grant, he is now extending his technology to understand the communication in both rare and incurable adult and child brain cancers, supported recently by his James Cook Research Fellowship and funding from the Health Research Council.

At first glance, it might seem like a surprising path, but it's one that has given him a breadth of scholarship and expertise from hardware right through to software.

These chip platforms have also seen Associate Professor Unsworth join forces with another MacDiarmid Institute colleague, Professor Bill Williams from Massey University, on a research project into future computing. "Asking how cells communicate with each other is one thing, but I've long been interested in how they then use that information to solve problems." The goal of this project is to combine Professor Williams' work on gels with Associate Professor Unsworth's neural platforms, to produce 2D organic networks. "The gel-like extracellular matrix that surrounds cells in the body plays an important role in communication, so we think that by incorporating some of Bill's gels, we could make the whole network more realistic. We might even be able to get them to perform simple calculations," he says.

Performing experimental research has become very difficult these days: "Like everyone here in Auckland, COVID has had a big impact on our projects," explains Unsworth. "We've only just been able to get back into the lab." But, he says, they're excited to make progress. "It's been so refreshing to get back to the rockface, as it were. There are a lot of challenging, fundamental questions to answer about computation within cells. I'm grateful that the MacDiarmid Institute has given us the opportunity to explore that."



Professor Neil W. Ashcroft (1938–2021)

Cornell researcher and MacDiarmid Institute International Science Advisory Board member helped shape the Institute in the early 2000s

Highly acclaimed physicist Professor Neil Ashcroft, who passed in 2021, was a great friend of many within the physics community throughout Aotearoa New Zealand, and especially of the MacDiarmid Institute. He was an assiduous member of the Institute's International Science Advisory Board (ISAB), contributing much to strengthening our governance and research structures. It was at his suggestion that we set up our Science Executive, a key part of our representative, collective decision making.

As Emeritus Investigator Professor Jeff Tallon writes in his obituary for Professor Ashcroft for the Royal Society Te Apārangi website, Professor Ashcroft came with his family to New Zealand after the Second World War and studied mathematics and physics at Victoria University of Wellington (then known as Victoria College of the University of New Zealand) graduating BSc (1958), MSc and DipHons (1960). He then headed overseas to the University of Cambridge to do his PhD, where he investigated the Fermi surface of metals as it relates to their electronic properties, before going on to the University of Chicago and then Cornell University.

Professor Tallon says one of Professor Ashcroft's most notable contributions was to propose that highly compressed hydrogen would not only become a metal but a room temperature superconductor and this might be the origin of the huge magnetic field of Jupiter. Later, Professor Ashcroft suggested that by using compounds rich in hydrogen (including H_2S) the necessary pressures could be lowered to laboratory-achievable levels. Professor Tallon said this drove a decades long quest which culminated in Professor Ashcroft's prediction of room temperature superconductivity in LaH_{10} and its subsequent experimental confirmation – albeit still at pressures of the order of 2 million atmospheres.

Professor Tallon says Professor Ashcroft was immensely likeable. “He was always courteous, always kindly, always thoughtful, always wanting to help”.

“A man of huge intellectual capacity, a man of warm and generous spirit, a man respected and loved around the globe.”

PROFESSOR JEFF TALLON (ORIGINAL SOURCE ROYAL SOCIETY TE APĀRANGI)



Professor Ashcroft (second from left), with Sir Anthony Leggett, Sir Richard Friend and Sir Paul Callaghan, at AMN5 in 2011

Emeritus Professor Alan B. Kaiser (1946-2021)

Founding Investigator pioneered condensed matter research in New Zealand

Founding MacDiarmid Institute Investigator Emeritus Professor Alan Kaiser, who passed away in 2021, was one of the scientists who established condensed matter research in New Zealand in the 1970s and helped to grow the study of advanced materials.

Associate Investigator Professor Shaun Hendy worked closely with Emeritus Professor Kaiser and said that he was known internationally for his work in condensed matter physics. “Alan worked at the interface between theory and experiment, and made particularly important contributions to our understanding of conducting polymers, helping to take them from a scientific curiosity to a household technology.

“His teaching in Victoria University of Wellington's School of Chemical and Physics Sciences was very highly regarded, and he was known as a warm and generous colleague to everyone in the school. He will be greatly missed by New Zealand's physical sciences community.”

Associate Professor Ben Ruck from Victoria University of Wellington's School of Chemical and Physical Sciences remembers Emeritus Professor Kaiser as one of his first physics lecturers in 1990.

“His wonderfully clear explanation of projectile motion still sticks with me today. Ultimately, that course was instrumental in helping me to realise my passion for physics.”

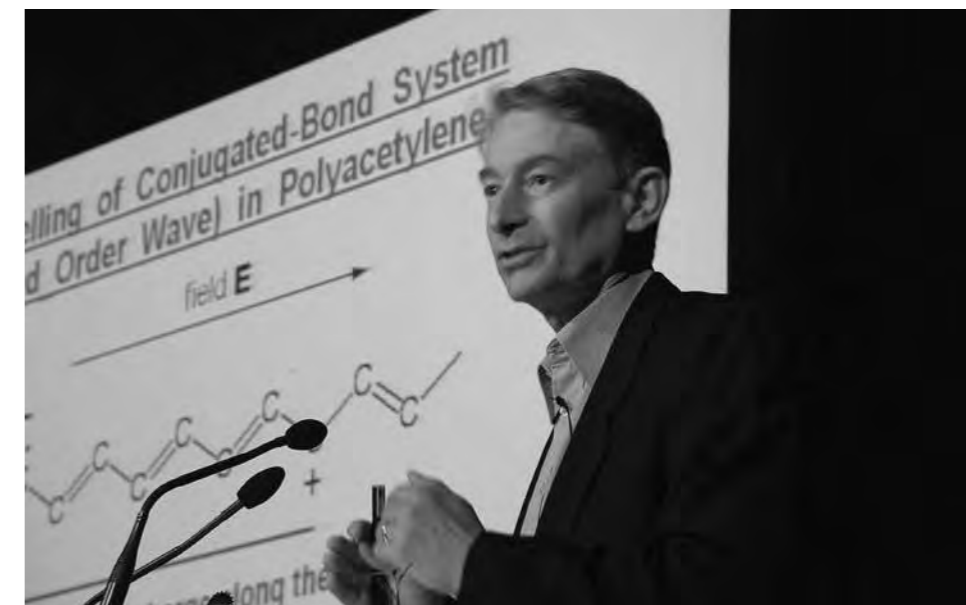
He also remembers Emeritus Professor Kaiser as an important colleague.

“My first physics research project conducted during my Honours year was supervised by Alan. He was extremely supportive and patient, and he had a fantastic way of explaining things. I'm very proud that the first two papers on which I co-authored were published with him. He had an especially important impact on my career as a physicist, and I'll always remember him fondly.”

Emeritus Professor Kaiser was a founding Investigator with the MacDiarmid Institute in 2002, firstly as a Principal Investigator and then (from 2013) as an Emeritus Investigator.

“He was known as a warm and generous colleague to everyone in the school. He will be greatly missed by New Zealand's physical sciences community.”

ASSOCIATE INVESTIGATOR PROFESSOR SHAUN HENDY (original source <https://www.stuff.co.nz/science/127481393/obituary-alan-kaiser-internationally-renowned-physicist>) used with permission from Professor Hendy)



Emeritus Professor Kaiser speaking at AMN2 in 2005

Awards 2021

Mathew Anker – Victoria University of Wellington

2021 Early Career Research Excellence Award - Victoria University of Wellington

Ebu Avci – Massey University

Finalist of Best Paper Award - The 7th International Conference on Advanced Mechatronics (ICAM 2021), Japan

Falling Walls Lab Winner – Royal Society Te Apārangi

Jack Chen – Auckland University of Technology

Advisory Board Member - Science of Synthesis Early Career Board

Martyn Coles – Victoria University of Wellington

2021 Maurice Wilkins Centre Prize for Chemical Science - New Zealand Institute of Chemistry (NZIC)

Nathaniel Davis – Victoria University of Wellington

2021 Early Career Research Excellence Award - Victoria University of Wellington

Vebleo Fellowship - Able contribution in the field of materials science research

Laura Domigan – University of Auckland

Early Career Research Excellence Award – University of Auckland

Anna Garden – University of Otago

2021 Easterfield Award – New Zealand Institute of Chemistry (NZIC)

Muhammad Hanif – University of Auckland

Alan Sargeson Lectureship Award - Royal Australian Chemical Institute

Shaun Hendy – University of Auckland

2020 Te Puiaki Pūtaiao Matua a Te Pirimia Science Prize - Prime Minister’s Science Prizes

Eric Le Ru – Victoria University of Wellington

Hector Medal – Royal Society Te Apārangi 2021 Research Honours Aotearoa

Nigel Lucas – University of Otago

Fellowship - New Zealand Institute of Chemistry (NZIC)

Shane Telfer – Massey University

2021 Individual Research Medal – Massey University

Krista Steenbergen – Victoria University of Wellington

2021 HOT PCCP article - 2021 Collection of the Hottest Work Published in PCCP

Geoff Waterhouse – University of Auckland

Research Excellence Medal – University of Auckland

2021 Clarivate Web of Science Highly Cited Researcher List

Funding successes 2021

2021 Marsden Grants

Mathew Anker - Victoria University of Wellington

“Molecular Indium Phosphide: A Bottom-Up Approach to the Synthesis of InP Materials”

Martin Allen, Roger Reeves and Nicola Gaston* – University of Canterbury and University of Auckland

“Thinking outside the square! Discovering the design rules for a new class of highly-functional nanomaterials”

Peng Cao – University of Auckland

“Keeping spatters at bay and in situ synthesis”

Simon Granville, Joe Trodahl* and Kai Chen* - Victoria University of Wellington

“Magnetism without angular momentum; High speed low power cryogenic memory”

Nicola Gaston and Krista Steenbergen - University of Auckland and Victoria University of Wellington

“Designing nanopatterns: exploring the “dark world” of binary liquid metals”

Eric Le Ru - Victoria University of Wellington

“Electromagnetic scattering by particles of arbitrary size and shape with application to microplastics”

Natalie Plank - Victoria University of Wellington

“How the nose knows? - Understanding the mechanisms in insect olfactory biosensor devices”

*Contributing as an AI

Royal Society Fellowships

Geoff Waterhouse – University of Auckland

“Catalysing the Decarbonisation of New Zealand’s Energy Sector” (James Cook Research Fellowship in Physical Sciences)

2021 MBIE Smart Ideas Funding

Catherine Bishop – University of Canterbury

“Production of technology-critical, strategic metals using molten oxide electrolysis”

Shen Chong – Victoria University of Wellington

“Optics-based distributed magnetic field and temperature sensor for enhanced power infrastructure reliability”

“Three-dimensional fluorescent optical memory for long-term data storage and preservation”

Jenny Malmström – University of Auckland

“Harnessing the magic of biological materials to make biodegradable electronic devices”

Aaron Marshall – University of Canterbury

“Designing electrocatalytic electrodes to increase performance and lower the cost of redox flow batteries”

Viji Sarojini – University of Auckland

“Sequentially knock out Phytophthora life stages: An effective solution to protect plants”

2021 Other MBIE Funding

Sally Brooker – University of Otago

“Aotearoa: Green Hydrogen Technology Platform” (Advanced Energy Technology Platform, Strategic Science Investment Fund)

“APRA Project Green Hydrogen” (Catalyst: Strategic Fund)

Shaun Hendy - University of Auckland

“Covid Modelling” (Covid Innovation)

John Kennedy – GNS Science

“Wirelessly Powered Transport Infrastructure for a Low-carbon Future” (Research Programme, Endeavour Fund)

“Sustainable and recyclable battery technology” (Catalyst: Seeding General)

Ben Mallett – Victoria University of Wellington

“Thrust measurement of small-scale electric propulsion systems incorporating cryogenic technologies and high magnetic fields” (Catalyst: Strategic Fund)

Aaron Marshall – University of Canterbury
“New Zealand - Germany Green Hydrogen Research” (Catalyst :Strategic Fund)

Volker Nock – University of Canterbury
“Growing Futures Horticulture Goes Urban programme - New Plants for a New World” (Strategic Science Investment Fund, Plant and Food Research Programme)

Grant Williams – Victoria University of Wellington
“Developing semiconductor thin films as radiation sensors” (Catalyst: Seeding General)

2021 HRC (Health Research Council) Grants

Charles Unsworth – University of Auckland
“Neural Chip Platforms for Drug Translation in Paediatric brainstem Gliomas”

Jadranka Travas-Sejdic – University of Auckland
“Printed sensing strips for sensitive and reliable detection of SARS-CoV-2”

2021 NSC (National Science Challenge) Grants

Jack Chen – Auckland University of Technology
“Commercialisation Development of Spherulose (2021-SFTI-IAP03-AUTV)”
“ISO Standards testing of cellulose-based surfactants (2021-SFTI-IAP02-AUT)”

Prasanth Gupta – GNS Science
“Novel Hybrid-Plasma Synthesis of Single Atom Catalysts”

Jadranka Travas-Sejdic – University of Auckland
“Tools for detection and management: Phytophthora agathidicida biosensor development”

2021 Domestic Funding – Other

Baptiste Auguié – Victoria University of Wellington
Summer Scholarships Scheme (Dodd-Walls Centre)

Ebu Avci – Massey University
“Pill Sized Robotic Capsule to Collect Gut Microbiota and Digesta” Palmerston North Medical Research Fund

Jack Chen – Auckland University of Technology
KiwiNet PreSeed Accelerator Funding

Matthew Cowan – University of Canterbury
Consulting work for OSSIS

Renwick Dobson – University of Canterbury
KiwiNet Tier 1 Funding

Vladimir Golovko – University of Canterbury
“Enabling green hydrogen future of New Zealand: Medium Energy X-ray Absorption Spectroscopy studies of novel catalysts for H₂ production and utilisation and NZ rock samples from potential H₂ storage reservoirs” (New Zealand Synchrotron Group Strategic)

Shaun Hendy – University of Auckland
“COVID-19 Modelling Services” DMPC

Volker Nock – University of Canterbury
“Multiplexing plant physiological research using a novel bi-directional dual-flow-RootChip platform” Brian Mason Trust

Geoffrey Jameson – Massey University
“Stopping cancer evolution with inhibitors of APOBEC3 enzymes” KiwiNet Tier 1 Funding

Geoff Willmott – University of Auckland
“Spray and particle testing” Fee for service

2021 International Funding

Catherine Bishop – University of Canterbury
Heavy Industry Low-carbon Transition CRC

Laura Domigan – University of Auckland
Consulting project - Novoviah Pharmaceuticals Pty Ltd

Vladimir Golovko – University of Canterbury
“Narrow Bandgap Photocatalysts for High-Efficiency Renewable Hydrogen” AC21

Kim McKelvey – Victoria University of Wellington
“An electricity to fuels research and deployment platform for Ireland” SEAI Research, Development & Demonstration Funding Programme

2021 University Internal Funding

Matthew Anker - Victoria University of Wellington
“Styrene based plastics: doing the dirty work of the green economy” Faculty Strategic Research Grant
“Green Plastics” Faculty Strategic Research Grant

Ebu Avci – Massey University
“Capsule Robot to Advance Management of Gastrointestinal Disease” Massey University Strategic Research Excellence Fund

Peng Cao – University of Auckland
“Magnesium hydride nanoparticles for hydrogen storage with high ambient-temperature absorption and desorption kinetics” Faculty Research Development Fund

Jack Chen – Auckland University of Technology
“Sustainable cellulose-based surfactants” AUT Ventures

Matthew Cowan – University of Canterbury
College funding to support development of an online adsorbent database

Nathaniel Davis – Victoria University of Wellington
“Grant to develop LSC fabrication capacity” University Research Fund

Simon Granville – Victoria University of Wellington
“Toward next-generation terahertz spectrometer with spintronics emitter and advanced femtosecond laser” Faculty Strategic Research Grant

Muhammad Hanif – University of Auckland
“Design of light-activatable metal complexes as anticancer agents” Performance Based Research Fund

Jonathan Kitchen – Massey University
“Supramolecular Materials Discovery: On surface lanthanide based systems” Massey University Strategic Research Excellence Fund

Erin Leitao – University of Auckland
“Mechanoradical-Mediated Fine Chemical Synthesis” Performance Based Research Fund

Luke Liu - Victoria University of Wellington
“Porous Organic Materials as Both Cathode and Anode Materials for Non-Flammable Batteries” Faculty of Science Additional Research Support Grant

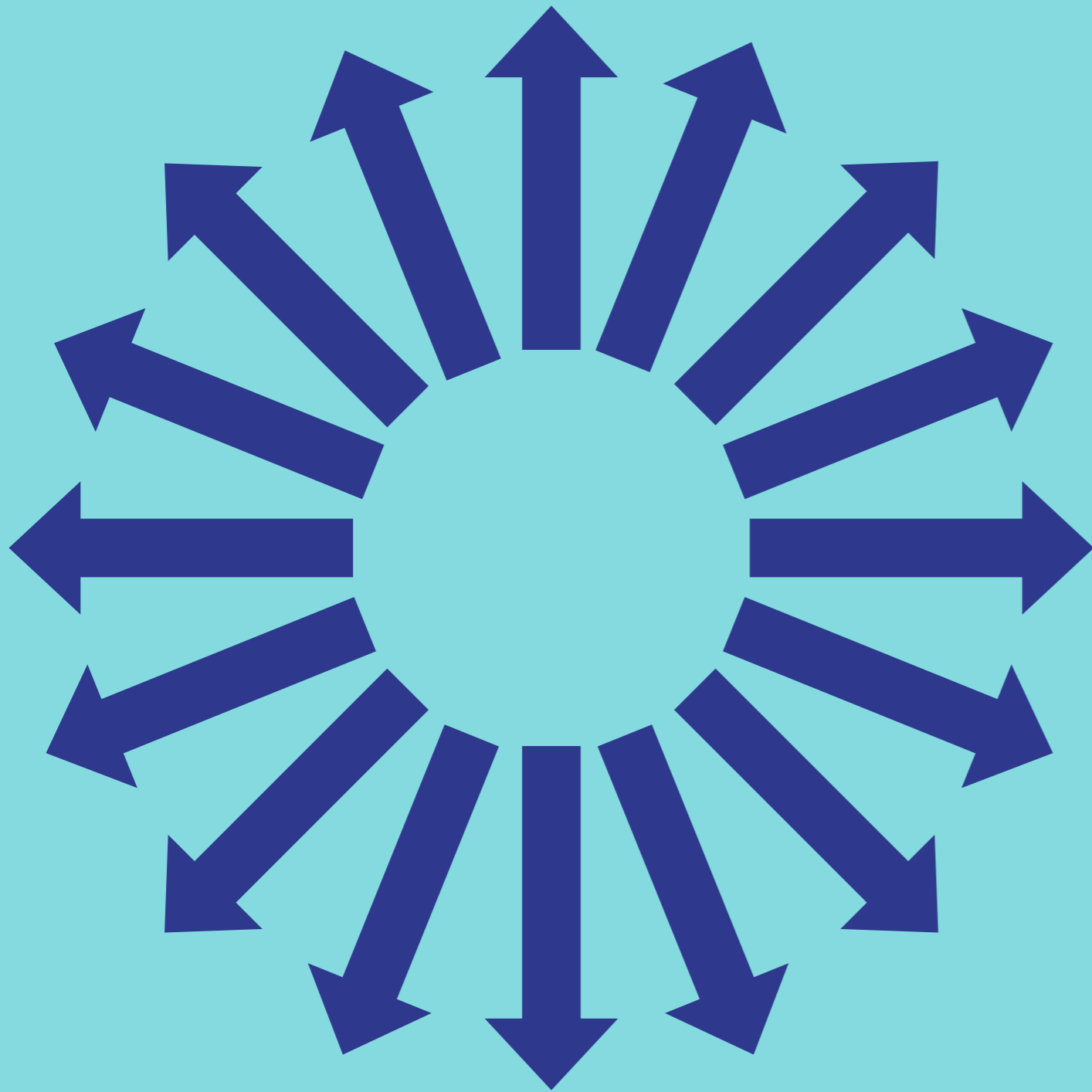
Jenny Malmström – University of Auckland
“Making artificial scars to understand heart healing and treatment” Faculty Research Development Fund
“Low-cost, point-of-use water treatment system with conductive polymer-based photocatalyst” Faculty Research Development Fund

Kim McKelvey – Victoria University of Wellington
Faculty Strategic Research Grant

Volker Nock – University of Canterbury
“Capillary microfluidics for improved testing in the wine industry” Innovation Jumpstart
“Multiplexing plant physiological research using a novel bi-directional dual-flow-RootChip platform” Summer Studentship
“Multiplexing plant physiological research using a novel bi-directional dual-flow-RootChip platform” College of Engineering Strategic Research Grant
“In the dark, but well informed: How do plant roots sense water stress and pathogens?” BIC PhD Scholarship
“A flexible microdevice for mechanical cell stimulation and compression in microfluidic settings” Open Access Fund

Jadranka Travas-Sejdic – University of Auckland
Faculty Research Development Fund x2 (AI)

Geoff Willmott – University of Auckland
“Nature-inspired smart carriers for targeted delivery of antimicrobials into food and agricultural systems” University of Auckland Food and Health Programme



Into the marketplace

After another year of strong commercial achievement for the MacDiarmid Institute and our alumni, it is worth reflecting on how this success is achieved – because it doesn't happen by accident. We know that making an impact can be a matter of serendipity, but it becomes much more likely when our people have a strong and supportive foundation. Some activities highlighted here (advisory panels, networking and seed funding) give concrete examples of how this is achieved. Our success is critically dependent on our friends and partners within the innovation ecosystem, as well as our culture of encouraging applied research, and our commitment to learning and personal growth.

MacDiarmid Institute students, scientists and affiliated start-up companies achieved many notable milestones and featured in a number of awards this year. The pipeline of deep tech IP and companies that our teams work on continues to grow and many of these companies are well positioned to compete internationally. In doing so, they are following in the footsteps of our founder Sir Paul Callaghan, whose start-up Magritek (founded in 2004) now has a product range based on 8 patents sold globally through over 20 distributors.

“Leveraging excellent local research and development, we’re able to show serious value to our sophisticated clients across wine and other high value liquid production systems.”

MARAMALABS CO-FOUNDER AND MACDIARMID INSTITUTE ALUMNUS DR BRENDAN DARBY

Capital raised

Litmaps recently raised a \$1 million seed round to focus on expanding the user base for their graphical bibliographic analysis tool, and to refine the value their technology can deliver for high performing research teams in R&D intensive companies.

The round was led by Icehouse Ventures, with participation from Quidnet Ventures, Angel HQ, K1W1, Exponential Founders Fund, and several strategic independent angel investors.

Over 30,000 researchers from public and private institutions worldwide have already used Litmaps since their launch in November 2020. The team continues to develop new product features and have recently taken on further MacDiarmid Institute alumni through targeted advertising to our graduate pool.

“Raising capital (led by MacDiarmid Institute alumnus Kyle Webster) from the maturing start-up ecosystem locally and the growing international investors interested in New Zealand technology, means that we can tackle the global R&D intensive markets who desire our actionable research insights.” — Axton Pitt, co-founder and incoming CEO



Litmaps co-founders Axton Pitt and Kyle Webster

MaramaLabs raised \$1.25 million in an investment round co-led by US-based venture capital firm Quidnet Ventures and New Zealand Growth Capital Partners (NZGCP). MaramaLabs provides UV-Vis Spectroscopy chemical analysis tools and a cloud-based data-analytics platform. These products provide unique chemical insights into the products of industrial customers such as wineries. The capital will help to expand the team, to grow MaramaLabs’ customer base, and to further develop the proprietary hardware and software platform. The investment will also enable MaramaLabs to continue to expand its reach to international customers and markets in the US and Europe.

The company was a finalist in the Gold Innovation category of Wellington’s annual business awards.

Awards received

The MacDiarmid Institute again performed strongly in the KiwiNet Research Commercialisation Awards. Two alumni were finalists for the Breakthrough Innovator Award – in this category there have now been six nominations with strong MacDiarmid Institute connections in the past three years.

The winner of the Breakthrough Innovator Award was Dr Shalini Divya (top right), co-founder and Chief Technology Officer of Tasmanlon. Dr Divya worked on a new cathode material during her PhD, and has since been developing a new aluminium-ion battery technology, working closely with Wellington UniVentures to drive the project to the investor level.

The other finalist was Dr Matheus Vargas (below right), Chief Technology Officer at Orbis Diagnostics, a start-up from the Photon Factory in Auckland with long-term support from the MacDiarmid Institute and the Dodd-Walls Centre. Dr Vargas has been the driving force behind a ‘lab on a disk’ testing platform for COVID-19 antibodies.

Serial research entrepreneur Professor Jadranka Trivas-Sejdic and her team (including both a MacDiarmid Institute student and a postdoctoral researcher) won the Academic Category award of the annual Velocity Entrepreneurship Challenge at the University of Auckland for a carbon fibre technology for wound dressings and face masks.

Dr Maryam Shojaei and Professor Aaron Marshall won the Value Added Product category and the Research Runner Up Prize in the Food, Fibre & Agritech Supernode Challenge run by KiwiNet, ChristchurchNZ, the University of Canterbury, AgResearch and other supporters. The team aim to commercialise an environmentally friendly material to optimise flow batteries using natural fibres.



MacDiarmid Institute-affiliated companies founded between 2002 and 2021



2021 Alumni Business Scholars

Maryam Shojaei

Postgraduate Certificate in Business at the University of Canterbury

With this scholarship, Dr Shojaei intends to develop the skills in 2022 that are required to take her science to a commercial space, enhancing her interest in the intersection between science and industry.



Samuel Martin Treceño

Postgraduate Certificate in Business (Professional) at Victoria University of Wellington

With this scholarship, Dr Treceño (Policy Advisor at the Ministry of Business, Innovation and Employment) intends to build on his business acumen and lead strategic conversations in the policy space.



Seeding success

Over the past two decades, the potential commercial benefits of technologies which emerge from scientific research have been widely recognized in New Zealand. The nature of this process has been increasingly scrutinized, and nuances have emerged such as recognition of the particular potential of research-intensive ‘deep’ tech. However, it is very tricky to describe exactly how research makes economic impact, as attempts to build impact frameworks invariably show. It is a non-linear process, with many interwoven pathways.

So how has the MacDiarmid Institute encouraged and achieved commercial success? Here we highlight our seed funding for commercialisation, a key practical step. For the last five years we have provided regular competitive funding rounds for projects with commercial potential, with four or five projects funded each year through a transparent internal process. A diverse range of activities may be funded, and the amount of funding for each project is small – perhaps enough to achieve a proof-of-principle result, to buy materials for a prototype, or to scope the IP landscape.

Critically, we support people and projects to get from A to B – i.e. to take practical steps that can make a difference. We fund activities that are too risky, too early-stage, too small and too urgent to be funded by others. We identify prospects at the ‘glint in the eye’ stage, often driven by the passion of our researchers.

The impact is clear. The development of Tasmanlon was supported by international travel funds; we enabled Kyle Webster, Litmaps co-founder, to develop his ideas as a PhD student; and we helped to fund Advemto’s prototype spectrometer. Projects are emerging regularly enough that we now have a tangible commercialisation ‘pipeline’.

Just as important are the indirect benefits. Many projects do not play out as expected, but they prepare our people for the next opportunity, or even serve to improve fundamental research impact. Likewise, projects which are unsuccessful in the competitive funding rounds provide information that helps the Commercialisation and Industry team to promote and support talent and technological prospects. We are striving to create a virtuous circle of talent identification, development, success, and institutional knowledge to help seed the next generation of start-ups.

“You have just MADE MY YEAR!!!!!! That is AWESOME news!! [Thank you for] your continued enthusiasm and support for me and the project.”

A MACDIARMID INSTITUTE INVESTIGATOR FOLLOWING THE AWARD OF SEED FUNDING

Science Advisory Panels for companies seeking R&D support

The Commercialisation and Industry team runs Science Advisory Panels, which provide a regular opportunity for companies to present their technical challenges to a group of relevant materials science researchers from across NZ. These Panel sessions have evolved into a regular, flexible, videoconference format, allowing companies to receive rapid-turnaround advice.

The service is aimed at helping R&D intensive companies, and those who aspire to do more R&D, to develop new products, processes and services, or to troubleshoot existing issues in high-value manufacturing. Prior to each session, we typically engage with the company to get a preliminary understanding of their issue so that we can arrange for scientists who have expertise in the company’s technology area to sit on the panel.

Both companies and participating scientists have enjoyed this efficient interaction and the sessions have led to successful R&D project partnerships.

The Panel sessions deliver a range of potential impacts, including:

- Direct suggestions about how the R&D could be further developed or approached;
- Links to specific scientists (on the panel or through our networks) who can deliver some of the R&D that companies are seeking;
- Input on the facilities that are available across our networks - specialised laboratory equipment and the capability to run it;
- Contacts with graduates with very specific skills who may be placed into company R&D projects;
- Suggestions about research funding streams, including consideration of joint funding applications.

Recent participants have included Mint Innovation, Avertana, Humblebee Bio, Hydroxsys, Resene and others, each of which have an advanced product portfolio and an innovative culture.

“Watching a group of technical experts from the company discuss their complex technological hurdles and seeing scientists pitching insightful, pragmatic solutions is a real privilege”

KEVIN SHEEHY, MACDIARMID INSTITUTE COMMERCIALISATION AND INDUSTRY ENGAGEMENT MANAGER

Techweek

We hosted *Techweek* events in both Wellington and Christchurch, that included talks about a wide range of industry related, materials science projects, from hydrogen in steel-making through to jet propulsion systems. We were pleased to host Minister Megan Woods, and to be able to collaborate with the Momentum Committees, CHIASMA, and the Biomolecular Interaction Centre on these events that raise awareness of exciting materials science projects that provide excellent career prospects for STEM students.

“Innovation with purpose: where magic happens.”

HON DR MEGAN WOODS SPEAKING AT OUR TECHWEEK EVENT IN CHRISTCHURCH.



Dr Shalini Divya, founder of Tasmanlon, speaking at our Wellington Techweek event in 2021



Associate Professor Geoff Willmott speaking during Techweek

(From left) Professor Wendy Lawson, Minister Megan Woods and Professor Nicola Gaston at our 2021 Techweek event in Christchurch

Patent activity

Note: where multiple inventors are named on a patent, only the MacDiarmid Institute member inventors are listed here.

Patent Applications

Matthew Cowan	Selective adsorption of gaseous alkenes into non-porous copper(i) complexes: controlling heat of adsorption and loading pressure US20210394155A1
Aaron Marshall	Process to electrochemically extract dissolved metals and an apparatus thereof
Volker Nock and Renwick Dobson	Microfluidic devices, systems and methods for providing an indication of a rheology of a substance AU2021902589A0 Microfluidic sealing valve and microfluidic circuit WO2021161229A1
Shane Telfer	Metal-organic frameworks for gas adsorption CA3123380A
Mathew Anker	Hydroarylation of olefins AU 2021901090
Jadranka Travas-Sejdic, Natalie Plank	Biosensor device and methods US20210255184A1
Jadranka Travas-Sejdic, Jenny Malmström	Electrospun matrix and method US20210128792A1
Geoff Jameson	Single stranded DNA enzyme inhibitors AU2021900164A0
Bill Williams, Rob Ward	Syringe pump WO2021194359A1

Patents Granted

Simon Granville, Eva Anton, Franck Natali, Ben Ruck, Joe Trodahl and James McNulty	Magnetic Materials and devices comprising rare earth nitrides - Granted South Korean patent application 10-2016-7030672
Eric Le Ru, Brendan Darby, Matthias Meyer, Assignee MaramaLabs Ltd	Spectrometer apparatus for measuring spectra of a liquid sample using an integrating cavity US10983045B2

Our pipeline is strong

In addition to formal patenting, a range of invention disclosures were made by our researchers to their local technology transfer office. An invention disclosure is generally the step that commences the path to commercialisation for a scientific invention.

Our researchers have indicated that up to six startup companies are in planning to be spun out during 2022, and the majority of these will be seeking private investment. In addition, six of our affiliated startups have indicated they will be raising capital during 2022.

Affiliated Start-ups activity

(data reported for nine of our affiliated start-up companies)

Capital raised	\$9.3 million
R&D spending	\$2.7 million
Employees	98
New employees commenced in 2021	21
Number of PhD employees	19
Number of MacDiarmid alumni employed	14



Into the community

Running educational outreach and engagement programmes under the cloud of COVID-19 was enormously challenging, but we learnt from our experiences in 2020. Our annual regional lecture series promoted our new research themes and ran as a blend of face-to-face and Zoom and was well attended and received.

Materials: Fact or Fiction, the third year of our immensely popular partnership series with RNZ Nights, continued apace and has spun into a new podcast *Sci-Fi/Sci-Fact* which will drop weekly every Saturday under the RNZ flagship. As ever, our partners provide magnificent engagement and we proudly sponsored the launch of a new House of Science centre in the Manawatū/Kapiti. And our MacDiarmid Institute team at the University of Otago ably assisted by Otago Museum, wowed young and old audiences alike on Te Wai Pounamu.

Spinning out a podcast

Our fortnightly popular science 'Materials: Fact or Fiction' segment continued for its second year. The series is a collaboration between the MacDiarmid Institute and RNZ. Each fortnight a MacDiarmid Institute researcher looks at a fictional sci-fi material from a book or a movie and discusses whether the sci-fi stands up to scientific scrutiny. This year we featured many students and early career researchers, providing them a safe yet fun opportunity to gain some media experience. An array of materials, technology and sci-fi elements were discussed, including magic carpets, MacGyver's laser, Proton Packs from Ghostbusters, hypermatter and the Force from Star Wars, and even how Rumpelstiltskin made straw into gold.

In December a spinoff of the series was released as a podcast titled *Sci Fi/Sci Fact*. Nights host Bryan Crump says that one of the great things about the new *Sci Fi/Sci Fact* podcast is the link between science and the imagination, between the empirical and the hypothetical.

"Imagination is a key part of the scientific endeavour, and I love how so many of our brilliant guests from the MacDiarmid Institute reconnect with their childhood sense of wonder and curiosity during our conversations," he says.

"The real world is such a rich and strange place, and sometimes science fiction is the route to unlocking a new discovery, and sometimes, it's just lots of fun. It's great to see the best of these discussions turning into a new RNZ podcast."

MacDiarmid Institute Co-Director Professor Nicola Gaston says she is thrilled that so many researchers from across physics, chemistry, materials engineering and biochemistry have gotten involved.

"One of the best things about asking scientists to assess fictional science is that there isn't always a right or wrong answer to the questions Bryan comes up with! The angles that different scientists take on a given topic can also be really different based on their own areas of study, which in itself I find really interesting," she says.

"Bryan's style of questioning really encourages people to have fun with ideas while thinking out loud; in that sense it echoes the scientific tradition of the thought experiment, as used extensively in the work of Albert Einstein. I like to think it gives listeners some insight into how scientists think about unexpected problems, when the answers are not all known."

Sci Fi/Sci Fact is available on Saturdays at rnz.co.nz/scifi, Spotify, Apple, iHeartRadio and wherever you get your podcasts.

"Bryan's style of questioning really encourages people to have fun with ideas"

PROFESSOR NICOLA GASTON,
MACDIARMID INSTITUTE CO-DIRECTOR



"I love how so many of our brilliant guests from the MacDiarmid Institute reconnect with their childhood sense of wonder and curiosity during our conversations."

RNZ HOST BRYAN CRUMP



Sponsoring our first House of Science branch

We continue our long-time sponsorship of the House of Science, having been their first national sponsor back in 2016. This time we have sponsored the House of Science Horowhenua Branch (which covers Kapiti, Horowhenua and Manawatū). Launching our sponsorship in Palmerston North, House of Science hosted Associate Investigators Professor Mark Waterland and Dr Emilia Nowak. Dr Emilia Nowak also visited the House of Science Headquarters in Tauranga with Principal Investigator Associate Professor Franck Natali where they got some hands-on practice demonstrating the latest kit in development – “A Load of Rubbish” about circular bioeconomy. We look forward to continuing this incredibly rewarding and worthwhile relationship over the coming years.



Associate Professor Franck Natali (left) and Dr Emilia Nowak (right) at the House of Science Headquarters, Tauranga



Professor Mark Waterland (left) and House of Science CEO Chris Duggan (right) speaking at the House of Science Horowhenua Branch launch

Juliet Gerrard: Science in Dark Times

Science in Dark Times, a new documentary directed by Shirley Horrocks, screened as part of the NZ International Film Festival. The film follows the work of the Prime Minister’s Chief Science Advisor, and MacDiarmid Institute Emeritus Investigator, Professor Dame Juliet Gerrard, through three years of crises, including the Whakaari White Island eruption and the unfolding of the COVID-19 pandemic.



Science for a sustainable future

The 2021 Regional Lecture Series was able to go ahead in-person this year, with the theme of *Science for a Sustainable Future*. Our researchers around the country introduced our new research programmes, talked about the MacDiarmid Institute and what the start of the new contract means for us, and shared their own interesting research with the public. An apt end to 2021 by looking into the future.

Our researchers shared their excitement for the new research programmes and their research in Nelson, Wanaka, Napier and Tauranga. This year’s researchers were Dr Paul Hume, Principal Investigators Professor Sally Brooker, Associate Professor Carla Meledandri, Associate Professor Franck Natali, Associate Professor Jenny Malmström, Dr Anna Garden, Dr Pauline Harris, and Associate Investigators Professor Mark Waterland, Dr Kim McKelvey and Dr Emilia Nowak.



Reaching out to the deep south

Our partnership with the Otago Museum continued with the ongoing *100 Women, 100 Words... Infinite Possibilities* exhibition, the GirlBoss Workshops – *ChangeMakeher* and LEAD (which saw over 60 girls between school years 7-13 participating in a robot programming challenge) – and the Reverse Science Fair (an opportunity for all school students, as well as the public to engage with women working in STEM). Finally, the People Like Me series of workshops connected students with role models in their own community who are pursuing careers in STEM.

“Don’t be afraid to try things that may be viewed as uncommon, and be confident in branching out of your comfort zone”

“[I feel] confident of my dream”

ATTENDEES AT THE GIRLBOSS WORKSHOPS – CHANGEMAKEHER AND LEAD

Joining forces with University of Otago chemistry outreach

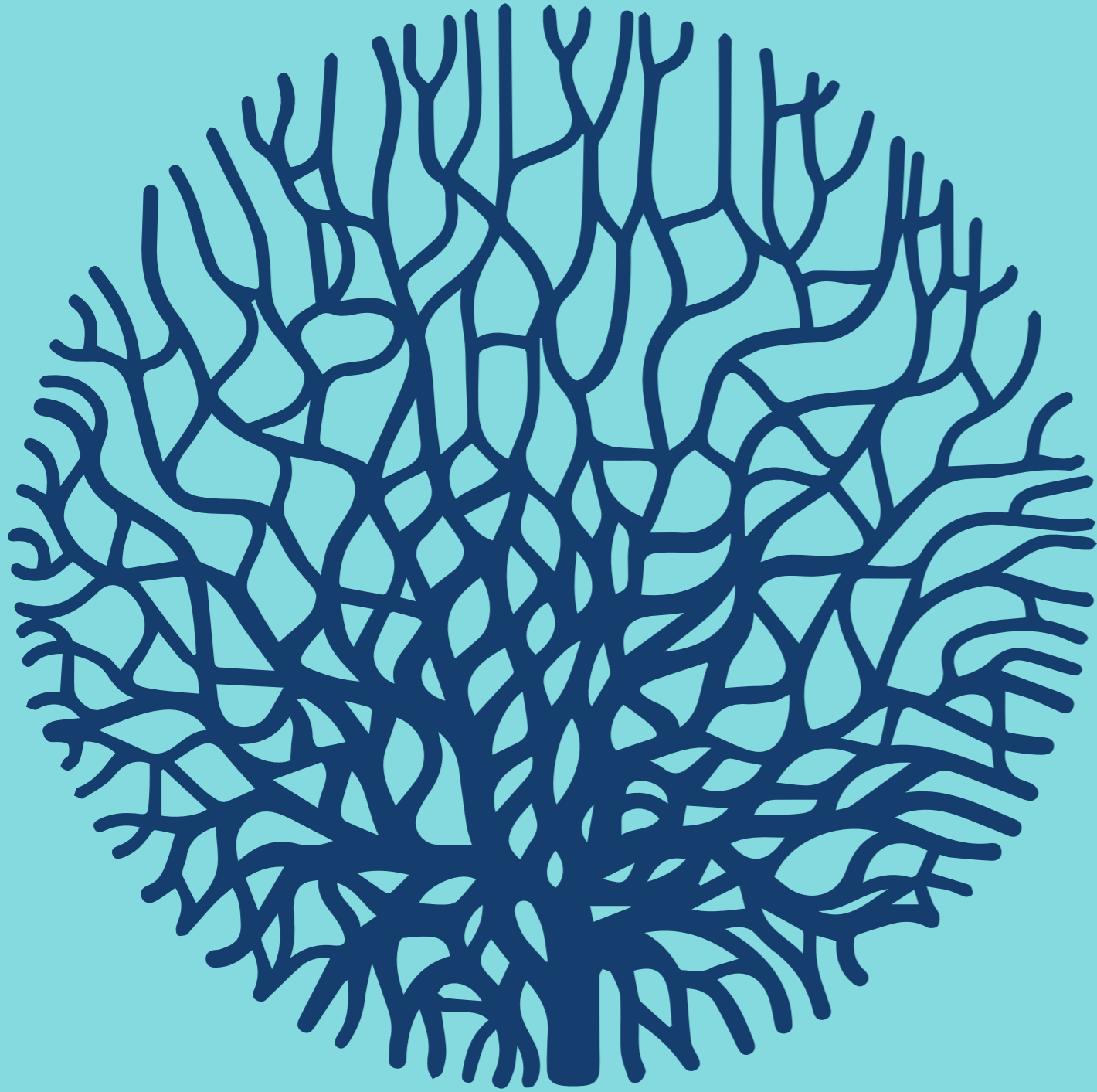
MacDiarmid Institute PhD and MSc students visited Greenmeadows Intermediate in South Auckland and Christchurch's Casebrook Intermediate School in May. The science teaching workshops involved hands-on sessions with the children, as well as teacher development (photos below). Each of the 24 sessions were 90 minutes long and included demonstrations of liquid nitrogen and dry ice as well as hands on activities.



“Overall a very positive couple of weeks with lots of follow ups both with Greenmeadows, Casebrook and the visiting teachers.”

UNIVERSITY OF OTAGO'S CHEMISTRY OUTREACH
COORDINATOR DR DAVE WARREN ON THE OUTREACH
WEEKS

MSc student Sam McIntyre running outreach at Greenmeadows Intermediate



Into the future

All the work we do towards creating a highly trained technically capable workforce comes to fruition in this section, as we see our highly tech savvy graduates take their first steps towards the workplace. The outreach we do and support others to do inspires kids to keep on with science. The wrap-around soft-skill and industry training for our PhD students prepares them for life outside of a PhD. And our internships and introductions to employers open doors for our graduates who, with their deep-tech PhDs, are then poised to begin their careers in academia, government, existing industry or the start-up ecosystem; a high-earning NZ science-trained workforce who are actively improving NZ living standards.

Into the future

This year we continued our internship placement programme across government sectors, the social enterprise sector, and industry. This year was no different from previous years with our interns repeatedly telling us that these internships are a fantastic means to provide a smooth transition from an academic research setting to a professional setting without losing the skills they learnt as a PhD candidate. We have also received feedback on how interns have really benefited from learning communication skills and understanding various organisational structures across the different sectors we place interns into.

This year we had a total of 15 interns, with two still in progress. Six interns were in ministries and the Office of the Prime Minister's Chief Science Advisor (OPMSCA). Government internships have especially been reported as intern destinations great for developing varied writing skills and styles outside the academic context, as well as a great way to learn how to ask questions of a varied audience. Our own affiliated spinout company, Allegro Energy, also hosted an intern, which is something we would like to work more toward with our other affiliated spinout companies. Another new style of internship was having a placement of our own in collaboration with New Zealand Product Accelerator (NZPA).

In the Research and Development (R&D) commercial environments, we had new placements at Tectonus, Hydroxsys and Cirrus Materials Science Ltd, and an intern at social enterprise Creative HQ, which was particularly useful for our interns to understand how start-ups work and the benefit of working in a small team with big impact. We placed an intern at UniServices and then the intern managed to secure a fulltime position there, a great outcome and highly desired for our PhD candidates where possible. Ending 2021 with new networks and new types of internships makes us very excited about the potential for 2022 internships.

Once our people leave the Institute, we stay in close touch through our alumni LinkedIn page, our alumni networking events and – new in 2021 – our quarterly alumni newsletters, as well as through Facebook and meetups for our DiscoveryCamp and Discovery Scholarship recipients. We also offer further commercialisation training through our Alumni Business Scholarships and co-funding mentorships.

Internships 2021



Matthew Ting interned at start-up Hydroxsys, a clean-tech company using new technology for water extraction in the mining and dairy industries. Matthew's research project looked at nitrate rejection in ultrafiltration membranes. Following his internship Matthew has continued in a research position with Hydroxsys for a few months, and intends to develop a career in consulting.



Stephen Lo took up an internship at Auckland UniServices as a Commercialisation Analyst in the Engineering and Digital Technologies team. Following his internship he was offered a permanent position as Commercialisation Manager at UniServices.



Déanna Shea interned in MBIE's Contestable Investments Team, working on applications and contracts for Endeavor and Smart Ideas grants, learning from the inside how government contributes to the science scene. Following her internship she's returned to a research career, taking up a postdoc position at the University of Otago.



Fraser Hughson interned at Victoria University of Wellington working on the commercialisation of supercapacitor electrolytes. During the course of his internship, Fraser co-founded new start-up company Allegro Energy where he currently serves as CTO. The team has just completed their first round of capital raising which will allow them to begin supercapacitor production early next year.



Anindita Sen took up an internship at Creative HQ, designing secondary education programmes for Vanuatu and has now returned to Victoria University of Wellington as a Research Assistant.



Vipin Kumar interned at Callaghan Innovation's Advanced Materials Group, looking at Laser surface texturing market insights. After his internship, Vipin was offered a position in global chemical manufacturing company Hexion Inc. based in Mt. Maunganui, where he has been working since May 2021 as a Chemist, creating new materials for the wood industry and regularly engaging in other areas such as manufacturing support and customer support activities.



Roan Vasdev took an intern position at University of Auckland spinout company Tectonus, researching new materials for seismic friction dampers. Since his internship Roan has been working as an Audit Technician/Scientist for Dunedin biotech company Oritain Global.



Caixia Hou interned at Cirrus Materials Science Ltd, a niche eco-science spinout from the University of Auckland that provides patented technology to the global aerospace and electronics industry. She's applying her research knowledge in a commercial R&D environment, working on the influence of Cirrus Dopant™ on Performance of Electrodeposited Metal Coatings.



Sandhya Singh also worked in the MBIE - Contestable Investments Team, gaining understanding of how the government science system and funding policies fund various science and innovation-based projects. She is next heading to Europe in January 2022 to begin a postdoc position at the Technical University of Denmark working on enzyme-mediated dynamical combinatorial chemistry.



Edoardo Galli interned at the Ministry for the Environment, working with the Joint Evidence, Data & Insights team as an intern analyst. The project focuses on the Long-term Insights Briefing and the Environmental Reporting 2022. After the internship Edoardo hopes to find a job in R&D or the government sector.

Women in the MacDiarmid Institute

Our Women in MacDiarmid Institute Network was quietly supporting our women researchers this year. In August at the start of lockdown, we held an online meeting to share worries, offer each other support, strategies, and different perspectives. Associate Investigator Dr Emilia Nowak also continued her individual coaching to develop individual talent, skills and knowledge to bring depth and insight to a person's strengths profile, enabling them to get the best out of their work, professional development and improving their work/life balance. These sessions are particularly useful as they are targeted to the individual and allow for multiple sessions as needed.

“I'd been feeling overwhelmed and distracted by other people's demands. This strengths workshop made me realize how these (strengths) can enhance my work and overall life”

“I often think back to the sessions, and it has helped me understand how I work/think and approach my days”

WORKSHOP PARTICIPANTS

Alumni newsletters launched

We launched our Alumni Newsletters this year as a means of providing a targeted quarterly update of what has happened in the MacDiarmid Institute, as well as a way for us to share with our alumni jobs and events, and opportunities to stay connected with the MacDiarmid Institute. The term alumni is broad within the MacDiarmid Institute, and includes former students, postdoctoral researchers, research assistants, and even investigators that have since left the Institute. With over 300 alumni receiving this newsletter, we have been able to celebrate together alumni stories, achievements and awards, and strengthen the relationship with old and new MacDiarmid Institute whānau.

MacDiarmid Emerging Scientists Association (MESA)

2021 has been another great year for MESA with a large number of fantastic, well-attended events being held across the country. As always, we kicked off the year by holding welcome events in each of our centres. This is always a super fun way to make connections with other MacDiarmid Institute students and this year was no exception! MESA was able to run its famous “Python Workshop” in both the North and South Island this year, which are always incredibly popular! Other MESA organised events included an AFM workshop at the University of Auckland at the start of the year, a presentation workshop at the University of Otago and a writing skills workshop at Te Herenga Waka - Victoria University of Wellington.

After the unwelcome return of COVID-19 in August, some of our key MESA events were unfortunately cancelled or postponed, including our extremely popular MESA Bootcamp, an ImageJ and OpenCV workshop at Massey University and multiple site visits. However, we were able to hold a “Science from the Supermarket” workshop online, which was a great deal of fun, and supply funding to a number of our members to attend online conferences.

This year was the inaugural year for a new position on the MESA committee, the Industry Representative. This role, and the work that has been done so far, is particularly exciting and provides incredible opportunities to MacDiarmid students, well beyond the scope of the formal PhD structure, and should help MacDiarmid Institute graduates stand out among the crowd. MESA is very excited to see how this role develops and the opportunities that arise in the coming years.



Photographs from some of the MESA workshops that took place in 2021



Into the metrics

Financials

	2020	2021 Jan-Jun Old Contract	2021 Jul-Dec New Contract
CoRE funding	6,664,067	3,332,034	3,200,00
Surplus carried forward	1,699,129	425,000	N/A
Other funding (mainly interest income)	70,590	715,656	N/A
Total revenue	8,433,786	4,472,690	3,200,000

Salaries and salary related costs

Director and Principal Investigators	1,216,070	493,443	152,673
Post-Doctoral Fellows	386,683	281,585	-
Research / Technical Assistants	89,802	65,368	71,005
Others	386,617	245,000	219,084
Total salaries and salary related costs	2,079,172	1,085,396	442,762

Other costs

Overheads	1,969,133	564,522	167,934
Project Costs	3,241,519	2,591,459	302,736
Travel	92,158	104,470	3,795
Postgraduate Students	1,051,805	126,843	121,905
Total other costs	6,354,615	3,387,294	596,369
Total expenditure	8,433,786	4,472,690	1,039,131
With late invoices* (full reporting included in 2022)			1,992,650
Net surplus / (Deficit)	-	-	2,160,869
with late invoices* (full reporting included in 2022)			1,207,350

*Due to delays related to the set-up of the new contract with partners, not all invoices were received in time to be included in the 2021 breakdown and will be included in full detail in our 2022 report.

At a glance

Headcounts by category

Emeritus Investigators	23
Principal Investigators	38
Stakeholder Relations Partner Iwi	1
Associate Investigators	47
Postdoctoral Researchers	165
Students	358

Total **632**

Peer reviewed research outputs by type

Journal articles	386
Book chapters	2
Conference papers	15
Books	0

Total **403**

Board, executive, staff and students

Governance Representative Board

Mr Paul Atkins*
Chair of the Board

Professor Richard Blaikie
Deputy Vice-Chancellor, Research & Enterprise
University of Otago

Mr Will Charles
Executive Director, Technology Development,
UniServices
University of Auckland

Professor Ray Geor
Pro Vice-Chancellor College of Sciences
Massey University

Professor Wendy Lawson*
Pro Vice-Chancellor
University of Canterbury

Mr Paul Linton
General Manager Research and Technical
Services, and Commercial Businesses
Callaghan Innovation

Mr Joe Manning
Head of Department – Materials and Air
GNS Science

Professor Ehsan Mesbahi
Pro Vice-Chancellor Wellington Faculties of
Science, Health, Engineering, Architecture and
Design Innovation (SHEAD)
Victoria University of Wellington

Mr Hēmi Rolleston
Chair (November onwards)
General Manager Te Ao Māori and Science
Services
Scion

Prof Ian Wright*
Deputy Vice-Chancellor Research and Innovation,
University of Canterbury

Ex-Officio

Professor Nicola Gaston
Co-Director, MacDiarmid Institute
University of Auckland

Professor Justin Hodgkiss
Co-Director, MacDiarmid Institute
Victoria University of Wellington

Professor Paul Kruger
Deputy Director Stakeholder Engagement,
MacDiarmid Institute
University of Canterbury

Associate Professor Geoff Willmott
Deputy Director Commercialisation and Industry
Engagement, MacDiarmid Institute
University of Auckland

Dr Anna Garden
Science Executive Representative, MacDiarmid
Institute
University of Otago

*Partial year

International Science Advisory Board

Professor Sir Richard Friend
Cavendish Professor of Physics
University of Cambridge, UK
Physics of energy materials, condensed matter

Dr Anita Hill
Chief Research Scientist, Future Industries
CSIRO, Australia
Porous materials

Professor Wilhelm Huck
Professor of Chemistry, Institute for Molecules
and Materials
Radboud University, Netherlands
Artificial cells

Professor Tomonobu Nakayama
Deputy Director, Administrative Director, Group
Leader of WPI-MANA
Deputy Director of ICYS

Professor at the University of Tsukuba
National Institute for Materials Science | NIMS
International Center for Materials
Nanoarchitectonics (MANA)
University of Tsukuba, Japan
Surface physics and chemistry, nanotechnology,
nanobioscience

Professor Daniel Nocera
Patterson Rockwood Professor of Energy
Harvard University, USA
Chemistry of renewal energy

Professor Ivan Parkin
Dean of Mathematical and Physical Sciences
Faculty
University College London, UK
Nanomaterials

Professor Annie Powell
Professor of Inorganic Chemistry, Institute
of Inorganic Chemistry and Institute of
Nanotechnology
Karlsruhe Institute of Technology
Germany
Molecular materials

Dr Charles Royal
Independent researcher and consultant
New Zealand
Mātauranga Māori

Professor Michelle Simmons
Director, Australian Research Council Centre
of Excellence for Quantum Computation and
Communication Technology
Laureate Fellow
Scientia Professor of Physics
University of New South Wales, Australia
Quantum computing, condensed matter physics

Professor Matt Trau
Professor of Chemistry, University of Queensland
Deputy Director and co-founder, Australian
Institute for Bioengineering and Nanotechnology
University of Queensland, Australia
Nanoscience, nanotechnology, and molecular
diagnostics

Dr David Williams
Chief Research Scientist and Laboratory Manager,
Hitachi Cambridge Laboratory
University of Cambridge, UK
Materials for computing

Science Executive

Professor Nicola Gaston
Co-Director, MacDiarmid Institute
University of Auckland

Professor Justin Hodgkiss
Co-Director, MacDiarmid Institute
Victoria University of Wellington

Professor Paul Kruger
Deputy Director Stakeholder Engagement,
MacDiarmid Institute
University of Canterbury

Associate Professor Geoff Willmott
Deputy Director Commercialisation and Industry
Engagement, MacDiarmid Institute
University of Auckland

Sam Brooke
MESA Co-Chair
Massey University

Professor Simon Brown*
Research Programme Leader: Future Computing
University of Canterbury

Dr Jack Chen
Associate Investigator Representative
Auckland University of Technology

Dr Laura Domigan
Principal Investigator Representative
University of Auckland

Dr Anna Garden
Principal Investigator Representative
University of Otago

Dr Pauline Harris
Māori Research Representative/Research
Programme Leader: Mātauranga Māori
Victoria University of Wellington

Stephanie Lambie
MESA Co-Chair
University of Auckland

Dr James Storey*
Science Leader: Tomorrow’s Electronic Devices
Victoria University of Wellington

Professor Shane Telfer*
Research Programme Leader: Catalytic
Architectures
Massey University

Professor Jadranka Travas-Sejdic*
Research Programme Leader: Reconfigurable
Systems
University of Auckland

Associate Professor Geoffrey Waterhouse*
Science Leader: Energy
University of Auckland

Professor Martin (Bill) Williams*
Science Leader: Functional Nanostructures
Massey University

Ex-Officio

Catherine Gibbs*
Centre Manager, MacDiarmid Institute
Victoria University of Wellington

Genevieve Fitzjames
Project Coordinator, MacDiarmid Institute
University of Auckland

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
Office Manager, MacDiarmid Institute
Minute-taker
Victoria University of Wellington

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

*Partial year

MacDiarmid Emerging Scientist Association (MESA) 2021

Sam Brooke
Co-Chair
PhD Student
Massey University

Stephanie Lambie
Co-Chair
PhD Student
University of Auckland

Aljo Anand
Secretary
PhD Student
University of Auckland

Hellen Nalumaga
Co-Treasurer
PhD Student
Victoria University of Wellington

Charlie Ruffman
Co-Treasurer
PhD Student
University of Otago*

Tehreema Nawaz
Social Media Representative
PhD Student
Victoria University of Wellington

Benjamin Westberry
Commercialisation and Industry Representative
PhD Student
Massey University

Kate Andrew
Centre Representative
PhD Student
Massey University

Matt Brett
Centre Representative
PhD Student
Victoria University of Wellington

Calum Gordon
Centre Representative
PhD Student
Victoria University of Wellington

Shikeale Harris
Centre Representative
PhD Student
Massey University

Azy Hashemi
Centre Representative
Postdoctoral Fellow
University of Canterbury

Emeka Itumoh
Centre Representative
PhD Student
University of Auckland

Brianna Nally
Centre Representative
PhD Student
University of Otago

Rosanna Rov
Centre Representative
PhD Student
University of Auckland

Ciaran Ward
Centre Representative
MSc Student
University of Otago

Aran Warren
Centre Representative
PhD Student
University of Canterbury

*Partial year

Principal Investigators (38)

Maan Alkaiasi*
Martin Allen
Sally Brooker
Simon Brown
Chris Bumby
Laura Domigan
Alison Downard*
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
Carla Meledandri
Franck Natali**
Volker Nock
Natalie Plank
Ben Ruck
James Storey
Shane Telfer
Jadranka Travas-Sejdic
Charles Unsworth
Geoff Waterhouse
Catherine Whitby
Grant Williams
Martin (Bill) Williams
Geoff Willmott
Ulrich Zuelicke

* Indicates shift in status from PI to EI

** Indicates temporary shift in status from PI to AI

Stakeholder Relations Partner Iwi (1)

Diane Bradshaw

Associate Investigators (47)

Mathew Anker*
Eva Anton
Baptiste Auguie
Ebubekir (Ebu) Avci
David Barker
Catherine Bishop*
Saurabh Bose**
Margaret Brimble
Philip Brydon
Peng Cao
Jack Chen
Kai Chen*
Shen Chong
Martyn Coles*
Matthew Cowan
James Crowley
Nathaniel Davis
Renwick Dobson
Guy Dubuis**
Christopher Fitchett
Robin Fulton
Petrik Galvosas
Vladimir Golovko
Prasanth Gupta*
Muhammad Hanif*
Shaun Hendy
Patricia Hunt*
Geoff Jameson
Marcus Jones
Vedran Jovic
Jon Kitchen*
Erin Leitao
Jérôme Leveneur
Luke Liu*
Ben Mallett
Steven Matthews*
Kim McKelvey*
Michel Nieuwoudt
Emilia Nowak
Elke Pahl
Viji Sarojini
Tilo Söhnel
Krista Steenbergen

MI Students in 2021 (358)

Mark Waterland
Cameron Weber*
Stuart Wimbush
Ben Yin*

* Indicates appointed as AI
** Indicates resigned as AI

Emeritus Investigators (23)

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

*Indicates shift in status from PI to EI
**Indicates retired as EI

Administrative and Technical Staff

Genevieve Fitzjames
Project Coordinator, MacDiarmid Institute
University of Auckland

David Flynn*
Electron Microscopy Technician
Victoria University of Wellington

Catherine Gibbs*
Centre Manager, 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

David Turner*
Research Engineer
University of Canterbury

Rosie Wayte
Office Manager, MacDiarmid Institute
Victoria University of Wellington

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

*Partial year

PhD (300)

Abudayyeh Abdullah University of Otago
Acheson Chris Victoria University of Wellington
Adams Ryan University of Canterbury
Agneray Heiana University of Auckland
Aguilar CJ University of Auckland
Akogun Fola University of Otago
Allan Claudia University of Canterbury
Altenhuber Nicola University of Canterbury
Ambadiyil Soman Arya Victoria University of Wellington
Anand Aljo University of Auckland
Andrew Phillippa-Kate (Kate) Massey University
Anil Anusree University of Auckland
Ashraf Jesna University of Auckland
Auer Bernhard Massey University
Ayed Zeineb Victoria University of Wellington
Bandara Nisansala Massey University
Bayat Afrooz University of Canterbury
Beikzadeh Ghelejlou Sara University of Auckland
Bell-Tyler Joseph University of Auckland
Bernach Michal University of Canterbury
Bhaskar Subhasree University of Auckland
Bioletti Gabriel Victoria University of Wellington
Bjareborn Oscar Victoria University of Wellington
Board Amanda University of Canterbury
Bondi Luca University of Otago
Booth Tony Robinson Research Institute
Brant Nicola University of Auckland
Brar Navneet Kaur University of Auckland
Brett Matthew Victoria University of Wellington
Brooke Sam Massey University
Brooks Justin (Gus) Victoria University of Wellington
Browne Lara Victoria University of Wellington
Burling Sophie Massey University
Busher Lal University of Auckland
Camacho Luis University of Auckland
Carroll Liam University of Canterbury
Casey-Stevens Caitlin University of Otago
Cassie Erica Victoria University of Wellington
Chahal Harpreet Kaur University of Auckland
Chan Andrew University of Auckland
Cheema Jamal University of Auckland
Chen Xize University of Auckland
Choudhury Minati University of Otago
Christopher Tim University of Auckland
Cleland Josiah Massey University
Clyde Daniel University of Auckland
Coombes David University of Canterbury
Currie Michael University of Canterbury
Davies James University of Canterbury
Deas Robert University of Auckland
Devese Samuel Victoria University of Wellington
Dong Yusong University of Auckland
Doran Conor University of Auckland
Drummond Grace University of Auckland
Earl Andrew University of Auckland
Edens Samuel University of Canterbury
Elahi Asrar University of Otago
Emeny Chrissy University of Canterbury
Evans Matthew Victoria University of Wellington
Fellner Daniel University of Auckland
Ferris Shaun University of Auckland
Ford Kathryn University of Canterbury
Francis Adam Victoria University of Wellington
Franke Christine University of Canterbury
Gaar Jakob University of Auckland
Galli Edoardo University of Canterbury
Gearing Hayden University of Auckland
Geurts Alisha University of Auckland
Ghosh Sunandita University of Auckland
Gilbertson Fletcher University of Canterbury
Glasson Judith University of Auckland
Gonzales Jofferson Victoria University of Wellington
Gordon Calum Victoria University of Wellington

Grant Thomas University of Auckland
Grant-Mackie Emily University of Auckland
Green Lewis University of Auckland
Gunukula Venkata University of Auckland
Guo Lun University of Auckland
Gupta Arka Massey University
Hamonnet Johan University of Canterbury
Happe Erica Victoria University of Wellington
Happe Erica Victoria University of Wellington
Hardy Jake Victoria University of Wellington
Harikrishnan Harry University of Canterbury
Harper Aimee University of Canterbury
Harpreet Chahal University of Auckland
Harris Shikeale Massey University
Harvey-Reid Nathan University of Canterbury
Haverkate Natalie University of Auckland
Hayali Ahmed University of Canterbury
Hedley Gavin University of Canterbury
Heenan Alex University of Canterbury
Hermanspahn Lily University of Canterbury
Hermant Yann University of Canterbury
Heywood Zachary University of Canterbury
Horrocks Matthew University of Auckland
Hosking Peter University of Auckland
Hou Caixia University of Canterbury
Howard Ben University of Canterbury
Howard Georgina University of Auckland
Hughson Fraser Victoria University of Wellington
Hung Jenny University of Auckland
Hunt Liam University of Auckland
Hunter Gray University of Auckland
Ijaz Mohsin University of Otago
Ilina Aleksandra (Sasha) Victoria University of Wellington
Islam Atif Victoria University of Wellington
Itumoh Emeka University of Auckland
Jena Kumar (Debajyoti) University of Auckland
Jia Zong Hao University of Auckland
Kahlon Navjot Kaur University of Auckland
Kan Wen-Fa (Regis) University of Auckland
Kanyan Deepika University of Auckland
Kasim Johanes University of Auckland
Khalil Bushra Anam University of Auckland
Kim Alex University of Auckland
King-Hudson Te-Rina University of Canterbury
Kleinjan (nee Bakker) Carline University of Canterbury
Kollmetz Tarek University of Auckland
Kovalenko Nadiia University of Auckland
Kuang Ze University of Auckland
Kumar Saawan University of Auckland
Kumar Vipin University of Auckland
Lacalendola Nicola (Nick) University of Auckland
Lamba Saurabh University of Auckland
Lambie Stephanie University of Auckland
Latif Qaisar University of Auckland
Lee Subo Massey University
Li Sheung Yin (Tony) University of Auckland
Li Yang Massey University
Lim Keemi University of Auckland
Lin Chao Yang (Sunny) Victoria University of Wellington
Lin Crystal Yongqi University of Auckland
Lin Rolland University of Auckland
Lisboa Lynn University of Otago
Love Michael University of Canterbury
Lucarelli Valentina University of Auckland
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
Makinde Zainab University of Auckland
Malone Niall University of Auckland
Mandal Ramkrishna University of Otago
Mao Yubing University of Auckland
Mapley Joseph University of Otago
Marone-Hitz Ombéline University of Otago
Martin Treceno Samuel University of Canterbury

MI Postdoctoral Researchers and Research Assistants in 2021 (165)

Maslin	Thomas	University of Canterbury
Mataira-Cole	Ratu	Victoria University of Wellington
Matthewman	Emma	University of Auckland
Matthews	Brooke	University of Canterbury
Mautner	Ira	University of Auckland
McArdle	Sophie	University of Canterbury
McKerchar	Hannah	University of Canterbury
Mehdizad	Maral	University of Canterbury/VUW
Miller	Jackson	Victoria University of Wellington
Mirzakhani	Sara	University of Canterbury
Misiuk	Kirill	University of Otago
Mohandas	Nimisha	Massey University
Mohd Darbi	Nur Maizura	University of Auckland
Molloy	Ellen	Victoria University of Wellington
Mooney	Roisin (Rosie)	Auckland University of Technology
Murai	Sai	Victoria University of Wellington
Na	Tae Ung (Tony)	University of Auckland
Naiya	Mohinder	University of Auckland
Nally	Brianna	University of Otago
Nalumaga	Hellen	Victoria University of Wellington
Narasimhan	Badri Narayanan	University of Auckland
Nawaz	Tehreema	Victoria University of Wellington
Neiman	Alex	University of Canterbury
Nesbitt	Sam	University of Canterbury
Newton-Vesty	Michael	University of Canterbury
Nguyen	Hong Phan (Jenna)	Victoria University of Wellington
Nieke	Philipp	University of Auckland
Nott	Thomas	Victoria University of Wellington
Onal	Sevgi	University of Canterbury
O'Neil	Alex	Massey University
Ortega	Kenneth	University of Otago
Palpal-latoc	Dennise	University of Auckland
Pandian	Santhosh Kumar	University of Auckland
Park	Kun Woo	University of Auckland
Patel	Hamesh	University of Auckland
Patel	Sahil Dineshbhai	University of Auckland
Patel	Sneh	University of Auckland
Paulin	Emily	University of Auckland
Pearl	Esperanza (Essie)	University of Auckland
Petters	Ludwig	Massey University
Posa	Luka	University of Auckland
Pot	Catherine	Victoria University of Wellington
Pradhan	Susav	Massey University
Prasad	Shyamal	Victoria University of Wellington
Pu	Yuguang	University of Auckland
Pulickal Joseph	Delsa	University of Auckland
Qicheng	Zhang	University of Auckland
Rajchakit	Urawadee	University of Auckland
Ramamirtham	Sashikumar	Massey University
Randall	George	University of Auckland
Rani	Aakanksha	University of Auckland
Rees	Shaun	University of Auckland
Rehan	Muhammad	Massey University
Reis	Miguel	University of Canterbury
Ren	Zhijun	Auckland University of Technology
Richardson	Georgia	Victoria University of Wellington
Robb	Matthew	University of Otago
Rosli	Zulfitri	University of Auckland
Ross	Daniel	University of Otago
Rov	Rosanna	University of Auckland
Ruffman	Charlie	University of Otago
Sabet	Saman	University of Auckland
Safaei	Sina	University of Auckland
Sale	Sarah	University of Canterbury
Salehitaleghani	Sara	University of Canterbury
Sarkar	Debolina	University of Canterbury
Sarwar	Mian Makhdoom (Mak)	University of Otago
Schuurman	Joel	University of Canterbury
Schweig	Michael	Victoria University of Wellington
Sen	Anindita	Victoria University of Wellington
Sester	Clement	Victoria University of Wellington
Shaib	Ali	Victoria University of Wellington
Sharma	Shailendra	University of Canterbury
Shashidar	Vinay	University of Auckland
Shea (Ayupova)	Deanna	Victoria University of Wellington

Sheikholeslami	Sina	University of Auckland
Shepperson	Oscar	University of Auckland
Shiraz	Fathumma	University of Auckland
Shojaei	Maryam	University of Canterbury
Siamaki	Mohammad	Victoria University of Wellington
Singh	Sandhya	University of Otago
Siu	Christy	University of Auckland
Smith	Alexander	University of Auckland
Smith	Mark	University of Auckland
Solis Muñana	Pablo	Auckland University of Technology
Soman	Arya	Victoria University of Wellington
Song	Xin	University of Auckland
Spasovski	Martin	University of Auckland
Steel	Jamie	University of Canterbury
Steinmetz	Kai	University of Auckland
Stevenson	Sarah	Victoria University of Wellington
Subhasree	Bhaskar	University of Auckland
Sundaresan	Sriram	University of Otago
Tamming	Ronnie	Victoria University of Wellington
Tan	Shi Min	University of Auckland
Tang	Chhayly	Victoria University of Wellington
Tang	Da	University of Auckland
Tang	Ross	Victoria University of Wellington
Taylor	Dion	Victoria University of Wellington
Thomas	Kadin	Victoria University of Wellington
Thompson	Karen	Victoria University of Wellington
Thorn	Bryan Andres (Andres)	University of Auckland
Tiban Anrango	Technology	
Ting	Sheng Hao (Matthew)	University of Auckland
Tong	Juliana	University of Auckland
Treacher	Eddyn (Ned)	Victoria University of Wellington
Truong	Diana	University of Auckland
Twidle	Andrew	University of Auckland
Uhrig	David	Robinson Research Institute
Urbanska	Magda	University of Auckland
Van Hilst	Quinn	University of Otago
Vella	Joe	University of Auckland
Vincent	Emma	University of Auckland
Vyborna	Natalija	University of Auckland
Wagner	Isabella	Victoria University of Wellington
Wan	Ziyao	University of Auckland
Wang	Jie	Victoria University of Wellington
Wang	Qing	University of Auckland
Wang	Tony	University of Auckland
Wang	Yuxin (Sunny)	University of Auckland
Wang	Zifei (Linna)	University of Auckland
Warren	Aran	University of Canterbury
Watkin	Serena	University of Canterbury
Watts	Benjamin	Victoria University of Wellington
Weal	Geoffrey	University of Otago
Westberry	Benjamin	Massey University
Williams	Elyse	University of Auckland
Wislang	Kate	University of Canterbury
Wong	Chi Hung (Andy)	University of Auckland
Wong	Peter	University of Auckland
Wood	David	University of Canterbury
Wu	Jiazun	Victoria University of Wellington
Yang	Mingrui (Ray)	Massey University
Yang	Tingxuan	University of Auckland
Young	Alice	University of Canterbury
Young	Elidh	University of Otago
Yu	Diana	University of Auckland
Yudhipratama	Indra	University of Auckland
Zemke-Smith	Chase	Victoria University of Wellington
Zhang	Aicheng	University of Auckland
Zhang	Ao	Robinson Research Institute
Zhang	Ethan	Victoria University of Wellington
Zhang	Hongzhou	University of Auckland
Zhang	Kelly	University of Auckland
Zhang	Wen	University of Auckland
Zhang	Yao	Victoria University of Wellington
Zhang	Yiming	Massey University
Zhang	Huihua	University of Auckland
Zhou	Yufei	University of Otago

Masters (58)

Abdool Kader	Zain	University of Canterbury/GNS
Brown	Roland	University of Auckland
Bui	Phuong	Victoria University of Wellington
Butler	Tane	Victoria University of Wellington
Buzas Stowers-Hull	André	Massey University
Chan	Sanutep	Victoria University of Wellington
Clague	Lily	University of Otago
Cox	Matthew	University of Otago
Daniels	Ryan	University of Canterbury
Elashkar	Ahmed	University of Canterbury
Ferguson	Alexander	University of Auckland
Fernandez	Irene Marice (Mai)	Victoria University of Wellington
Filatov	Yuri	University of Canterbury
Forbes	Cody	Victoria University of Wellington
Francois	Jack	University of Auckland
Gao	Hetian (Henry)	University of Auckland
Girdwood	Megan	University of Canterbury
Grant	Mason	University of Auckland
Ha	Stephen	University of Auckland
Hamilton-Horne	Angus	Victoria University of Wellington
Harris	Jonathan	University of Otago
He	Jing	Massey University
Ji	Junghun (William)	University of Auckland
Kuang	Ze	University of Auckland
Kumar	Barath	Massey University
Lloyd	Hank	University of Auckland
Lockwood	Stephanie	Victoria University of Wellington
Ly	Panharath (Ricky)	University of Auckland
Markwitz	Martin	Victoria University of Wellington
McIntyre	Finn	University of Canterbury
McIntyre	Sam	University of Otago
Mendoza	Shaira	Victoria University of Wellington
Newport	Rebecca	University of Canterbury
Nielsen	Benjamin	Victoria University of Wellington
Otter	Sam	Massey University
Panjeta	Madhu	Auckland University of Technology
Park	Luke Hyung-Keun	University of Auckland
Payet	Fabien	University of Canterbury
Pearcy	Aston	University of Canterbury
Plummer	Sam	University of Canterbury
Said	Sultan	Auckland University of Technology
Salam	Joanne	Auckland University of Technology
Sansom	Gabriela	Massey University
Scott (Reid)	Victoria-Jayne	Massey University
Sheard	William	University of Auckland
Stephens	Emily	Victoria University of Wellington
Stone	Madeline (Dana)	University of Canterbury
Sullivan	Matthew	University of Canterbury/GNS
Taylor	Marcus	University of Canterbury
Tong	Marco	University of Auckland
Venkatesh	Siddharth (Sid)	Massey University
Peng	Ford	University of Canterbury
Wagner	Rachel	Victoria University of Wellington
Wallace	Ciaran	University of Otago
Ward	Hosea	University of Canterbury
Watson	John	University of Otago
Whiting	Richard	University of Canterbury
Wiley	Zizhong (Victor)	Victoria University of Wellington
Zhang		

PDFs (84)

Abdollahi	Ayoub	University of Auckland
Acharya	Susant	Victoria University of Wellington
Akbarinejad	Alireza	University of Auckland
Al-Ghaus	Zahraa	University of Auckland
Arif	Tanzeel	Victoria University of Wellington
Bhattacharjee	Tanmoy	University of Otago
Bonesi	Marco	University of Auckland
Calvert	Matthew	University of Auckland
Cameron	Alan	University of Auckland
Cavanagh	David	University of Otago
Chalard	Anais	University of Auckland
Chan	Andrew	University of Auckland
Chan	Eddie	University of Auckland
Chan	Jay	Victoria University of Wellington
Chen	Wan-Ting	University of Auckland
Chen	Linda	University of Canterbury
Clarke	Daniel	Victoria University of Wellington
Davison	Emma	University of Auckland
De Zoysa	Gayana Heruka	University of Auckland
Ding	Xiaobo	University of Auckland
Dolamore	Fabian	University of Canterbury
Furkert	Daniel	University of Auckland
Gai	Sinan	University of Otago
Gilkes	Jenna	University of Canterbury
Given	Fiona	University of Canterbury
Harris	Paul	University of Auckland
Hashemi	Azadeh (Azy)	University of Canterbury
Haverkate	Natalie	University of Auckland
Hayat	Muhammed	University of Auckland
Holmes-Hewett	William	Victoria University of Wellington
Holtkamp	Hannah	University of Auckland
Horsfall	Aimee	University of Auckland
Hubert	Jonathan	University of Auckland
Hume	Paul	Victoria University of Wellington
Kammermeier	Michael	Victoria University of Wellington
Kavianinia	Iman	University of Auckland
Kerr-Philips	Thomas	University of Auckland
Kihara	Shinji	University of Auckland
Kolathodi	Muhammed Shareef	University of Auckland
Kowalczyk	Renata	University of Auckland
Li	Fan (Freda)	University of Auckland
Li	Henry	University of Canterbury
Liu	Jinlong	University of Auckland
Lolohea	Taniela	University of Auckland
Lowrey	Sam	University of Otago
Maity	Tanmay	Victoria University of Wellington
Mallinson	Joshua	University of Canterbury
Martinez Gazoni	Rodrigo	University of Canterbury
Minnee	Thomas	University of Auckland
North	Rachel	University of Canterbury
Novikova	Nina	University of Auckland
Ogilvie	Olivia	University of Canterbury
Peng	Lishan	University of Auckland
Prabowo	Sigit	Victoria University of Wellington
Price	Mike	Victoria University of Wellington
Quinsaas	Jose	Massey University
Raj (Patil)	Komal	University of Canterbury
Raudsepp	Allan	Massey University
Rennison	David	University of Auckland
Risos	Alex	University of Auckland
Rossa	Thais	University of Auckland
Ruffman	Charlie	University of Auckland
Sharma	Shailendra	University of Canterbury
Sikorska	Celina	University of Auckland
Somerville	Walter	Victoria University of Wellington
Stubbing	Louise	University of Auckland
Sun	Yiling	University of Canterbury
Sun-Waterhouse (James)	Dongxiao	University of Auckland
Swain	Jonathan (Jon)	University of Auckland
Thorn	Karen	Victoria University of Wellington
Venturumilli	Sriharsha	Victoria University of Wellington

Weissert	Lena	University of Auckland
Wells	Frederick Steven (Steve)	University of Auckland
Williams	Geoffrey	University of Auckland
Wilson	Zoe	University of Auckland
Wright	Joshua	University of Canterbury
Wu	Ting	University of Canterbury
Xu	Sherry	University of Auckland
Xu	Tao	Victoria University of Wellington
Yang	Sunghyun	University of Auckland
Zhang	Ao	Victoria University of Wellington
Zhang	Peikai	University of Auckland
Zhang	Shengping	University of Auckland
Zhu	Bicheng	University of Auckland

RAs (81)

Banks	Sophie	Robinson Research Institute
Bennington	Michael	University of Otago
Brannigan	Natalie	University of Canterbury
Browne	Lara	Victoria University of Wellington
Burnett	Brydon	University of Auckland
Butler	Tane	Victoria University of Wellington
Carley	Sarah	University of Auckland
Chambers	Eleanor	Victoria University of Wellington
Chan	Andrew	University of Auckland
Chen	Qun (Queenie)	University of Auckland
Clarke	Jordan	Victoria University of Wellington
Clifford	Max	Victoria University of Wellington
Cordwell	Amelia	University of Auckland
de Clercq	Damon	Victoria University of Wellington
Dissanayake	Shama	University of Auckland
Dixon	Alex	University of Auckland
Durrant	Matthew	University of Canterbury
Fan	Flora	University of Auckland
Fraser	Handayani (Putri)	Victoria University of Wellington
Gallaher	Joe	Victoria University of Wellington
Gilmour	James (Tom)	Victoria University of Wellington
Goddard-Winchester	Max	Robinson Research Institute
Hamilton-Horne	Angus	Victoria University of Wellington
Howard	Ben	University of Canterbury
Islam	Atif	Victoria University of Wellington
Kaltenberg	Szymon	Victoria University of Wellington
Kerr-Philips	Thomas	University of Auckland
Khalil	Bushra Anam	University of Canterbury
Kumar	Vishal Vijaya Kumar	University of Auckland
Lacalendola	Nicola	University of Auckland
Laufersky	Geoffry	Victoria University of Wellington
Lee	Subo	Massey University
Li	Si	University of Auckland
Lo	Stephen	Auckland University of Technology/Massey University
Maity	Tanmay	Victoria University of Wellington
Majic	Matt	Victoria University of Wellington
Makinde	Zainab	University of Auckland
Manners	Sarah	University of Canterbury
Matthews	Hannah	University of Auckland
McCone	Jordan	Victoria University of Wellington
McConnell	Fraser	Victoria University of Wellington
McLeod	Oliver	GNS/Victoria University of Wellington
Monteiro	Jaimy	Victoria University of Wellington
Mungalpara	Maulik	Massey University
Nair	Mohinder	Auckland University of Technology
Najafabadi	Atefeh Fazel	Victoria University of Wellington
Narasimhan	Badri Narayanan	University of Auckland
Park	Luke	University of Auckland
Patel	Sahil Dineshbhai	University of Auckland
Pradhan	Susav	Massey University
Prahash	Laura	University of Auckland
Rani	Aakanksha	University of Auckland
Reid	Oscar	University of Canterbury
Ridings	Kannan	University of Auckland
Ross	Daniel	University of Otago

Safaei	Sina	University of Auckland
Sampath	Gayan	University of Canterbury
Schuyt	Joe	Victoria University of Wellington
Scott (Reid)	Victoria-Jayne	Massey University
Shea (Ayupova)	Deanna	Victoria University of Wellington
Siesicki	Jessica	Victoria University of Wellington
Singh	Varinder	University of Otago
Siow	Andrew	University of Auckland
Smith	Jordan	University of Otago
Sprengers-Sanson	Juniper	Victoria University of Wellington
Stanley	Blake	Victoria University of Wellington
Sun	Zhiyuan	Robinson Research Institute
Sutton	Joshua	Victoria University of Wellington
Tamming	Ronnie	Victoria University of Wellington
Tang	Chhayly	Victoria University of Wellington
Tayagui	Ayelen	University of Canterbury
Ting	Sheng Hao	University of Auckland
Trewick	Edward	Victoria University of Wellington
Vartha	Callum	Victoria University of Wellington
Wagner	Isabella	Victoria University of Wellington
Waitaiki	Hemi	Victoria University of Wellington
Wang	Qing	University of Auckland
Watt	Charlie	University of Auckland
Woolly	Ethan	Victoria University of Wellington
Xu	Buzhe	University of Auckland
Zhang	Yao	Victoria University of Wellington

Journal covers



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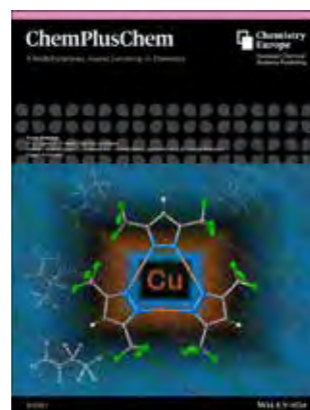
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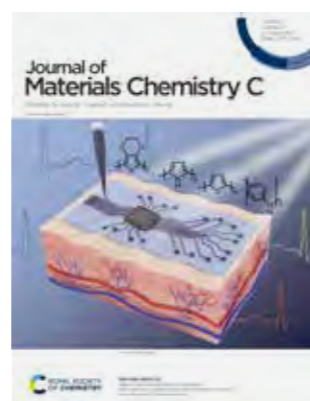
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AUTHORS	TITLE	JOURNAL
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Book chapters

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Bissember, A. C., Hyland, C. J. T., Wales, S. M., Hawkins, B. C., Chen, J. , Fleming, C. L., Cording, A. P., Henneveld, J. S., Lo, S. & Zarfos, S. D.	Seven-membered rings	<i>Progress in Heterocyclic Chemistry</i>	Elsevier Ltd

Technical reports

RESEARCH OUTPUT TYPE	AUTHORS	DETAILS
GNS Science report 2021/22	Rogers, K.M., Thomson, J., Campbell, H.J., Mahara, B., McLeod, O. & Bradshaw, D.	Geochemical characterisation of Māori artefacts from Kawhia museum, New Zealand using pXRF
GNS Science miscellaneous series	Bradshaw, D. , Rogers, K. M. & McLeod, O.	Understanding the unique environmental attributes and biological materials of Kāwhia – Aotea South. Lower Hutt (NZ)

Conference papers

AUTHORS	TITLE OF CONFERENCE PAPER	TITLE OF PROCEEDINGS
Ainslie, M., Grilli, F., Quéval, L., Pardo, E., Perez-Mendez, F., Mataira, R., Morandi, A., Ghabeli, A., Bumby, C. W. & Brambilla, R.	A New Benchmark Numerical Model: The High-Tc Superconducting Dynamo	<i>7th International Workshop on Numerical Modelling of High Temperature Superconductors (2021)</i>
Zhang, P., Travas-Sejdic, J. , O'Grady, G. & Du, P.	Comparison of gold and PEDOT:PSS contacts for high-resolution gastric electrical mapping using flexible printed circuit arrays	<i>2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)</i>
Natali, F. , Warbrick, J., Harris, P. , Huata, R., Kennedy, J. , Bradshaw, D. , Markwitz, A. , Miller, J., Paasi, K., Millar, B., Hodgkiss, J. M. & Gaston, N.	Exploring Synergies Between Māori Knowledge and Western Science on the Formation of Natural Colors - Ko te Whai Hua ki te Rangahau, ki te Pūtaiao, o Ngā tae I te Nuku o te Whenua	<i>Proceedings World Geothermal Congress 2020+1, USA Reykjavik, Iceland (2021)</i>
Novikova, N. I., Matthews, H., Williams, I., Sewell, M. A., Nieuwoudt, M. , Simpson, M. C. S. & Broderick, N. G. R.	Identifying phytoplankton using raman spectroscopy	<i>Optics InfoBase Conference Papers (2021)</i>
Holtkamp, H. U., Marini, F., Quinn, L., Agueraray, C., Nieuwoudt, M. , Grey, G., Jarrett, P. & Simpson, C.	Investigating changes in skin biochemistry due to Discoid Lupus Erythematosus using Raman spectroscopy and mass spectrometry	<i>Optics InfoBase Conference Papers (2021)</i>
Rogers K.M., Bradshaw, D. , Thomson J., McLeod, O. & Campbell, H.J.	Investigating the Kawhia Museum geological taonga collection using non-destructive pXRF fingerprinting	<i>New Zealand Archaerological Association Annual Conference, July 4-7, Taupo, New Zealand (2021)</i>
Bradshaw, D.	Kei Hawaiki-Iti Ko Te Maara Kai Teena, oo Whakaotirangi: Preserving Hawaiki-iti: a site of cultural significance	<i>New Zealand Archaerological Association Annual Conference, July 4-7, Taupo, New Zealand (2021)</i>
Yeo, A., Muhammad, R. & Avci, E.	Mechanical Characterisation of Robotic Capsule Anchoring Mechanism for Gastrointestinal Tract	<i>The 7th International Conference on Advanced Mechatronics (ICAM) (2021)</i>
Taylor, R., Ainslie, M.D., Bumby, C.W. & Weijers, H.	Modelling Interactions Between HTS Tapes and Permanent Magnet Fields in an HTS Dynamo	<i>7th International Workshop on Numerical Modelling of High Temperature Superconductors (2021)</i>
Venuturumilli, S., Geng, J., Leuw, B., Bumby, C.W. & Badcock, R.A.	Modelling of various rectifier flux pump topologies enabled by JcB switches	<i>7th International Workshop on Numerical Modelling of High Temperature Superconductors (2021)</i>
Robinson, D., Chen, Q., Xue, B., Wagner, I., Price, M., Hume, P. , Chen, K. , Hodgkiss, J. M. & Zhang M.	Particle Swarm Optimisation for Analysing Time-Dependent Photoluminescence Data.	<i>2021 IEEE Congress on Evolutionary Computation (CEC) 2021 Jun 28 IEEE.</i>
Mehdizad, M., Fullard, L., Galvosas, P. & Holland, D.	Quantitative measurement of hopper flow using MRI	<i>Powders & Grains 2021 – 9th International Conference on Micromechanics on Granular Media</i>
Meffan, C., Menges, J., Dolamore, F., Fee, C., Dobson, R. & Nock, V.	Transistor off-Valve Based Feedback, Metering and Logic Operations in Capillary Microfluidics	<i>2021 IEEE 34th International Conference on Micro Electro Mechanical Systems (MEMS)</i>
Harris, P. , Gaston, N. , Huata, R., Millar, B., Bradshaw, D. , Markwitz, A. , Natali, F. & Hodgkiss, J.M.	Whakarewarewa Thermal Village as a Living Laboratory for Indigenous Materials Science Outreach and Education	<i>Proceedings World Geothermal Congress 2020+1, USA Reykjavik, Iceland (2021)</i>

Keynote & invited speaker addresses

NAME	DETAILS
Ebu Avci	"Microrobotics for Biomedical Applications" at Return on Science. February 2021, Auckland, New Zealand
Catherine Bishop	"Phase Transformation in Pb-free Ferroelectrics" at MacDiarmid Institute Annual Symposium. 9-12 February 2021, Rotorua New Zealand
Sally Brooker	"Interesting correlations in spin crossover" at 1st Symposium on Spin State Switching (2B-Switch). 30 August - 3 September 2021, Universities of Bordeaux (France) and Bayreuth (Germany)
Peng Cao	"Advanced Battery Technologies" at NZCA-GREEN: Resolving global challenges of sustainability. 12 July 2021, Christchurch, New Zealand
Martyn Coles	"Developing the chemistry of the alumanyl anion, [Al(NONDipp)]" at Dalton Joint Interest Group Conference. 29 June - 1 July 2021 (online)
Laura Domigan	"Cultured meat in an Aotearoa New Zealand context" at Food Science and Technology Global. 27-28 April 2021, Singapore
Shaun Hendy	"Mathematical Models for COVID-19 in Aotearoa New Zealand" at Public Health Summer School Symposium. 1 February 2021, Wellington, New Zealand
	"The science behind the COVID-19 response" at eResearch 2021. 11-12 February 2021, Wellington, New Zealand
	"New Zealand's COVID-19 Experience: The Role of Digital Tools" at Digital Tools for Addressing Infectious Diseases in the Asia-Pacific Region: Challenges and Opportunities. 25-26 August 2021 (online)
	"COVID-19 and M. bovis : Modelling" at M. bovis Science Conference. 23-24 November 2021, Wellington, New Zealand
Steven Matthews	"Plasma Spraying of CaCO3 Coatings from Oyster and Mussel Shell" at 1st NZ-China Forum on Advanced Materials and Processing Technologies (AMPT2021). 28 May 2021, Jiangsu University of Science and Technology, China
Carla Meledandri	"Tuning metal-organic framework nanocrystals using microemulsions" at World Nano Congress on Advanced Science and Technology (WNCST 2021). 8-13 March 2021, Tamil Nadu, India
Shane Telfer	"CO2 capture using a deceptively simple metal-organic framework" at 2021 NZCA-GREEN Symposium. 12-13 July 2021, Christchurch, New Zealand
Geoff Waterhouse	"Nanotechnology-based systems for delivery, separation and sensing" (Plenary) at Academicians Forum of Interdisciplinary Biology and Inaugural Ceremony of Exploration. 14-16 January 2021, Kaifeng, China
	"Smart nanotechnology-based systems for food, agricultural and medical applications" (Plenary) at International Forum on Agricultural Products Intensive Processing and Development of Functional Food Resources. 8 May 2021, Ningxia, China
Catherine Whitby	"Yielding to Stress: the effect of interparticle interactions on how Pickering emulsions flow" at 72nd Divisional Meeting of Division of Colloid and Surface Chemistry of the Chemical Society of Japan. 21 September 2021, Japan
Martin (Bill) Williams	"Studying Polysaccharides in Solution with SAXS and Molecular Dynamics" at ANSTO User Meeting 2021. 24-26 November 2021, Melbourne, Australia
	"Polysaccharide Structures in the Outer Mucilage of Arabidopsis Seeds Visualized by AFM" at Pacificchem 2021: A Creative Vision for the Future. 16-21 December 2021, Hawaii, USA

