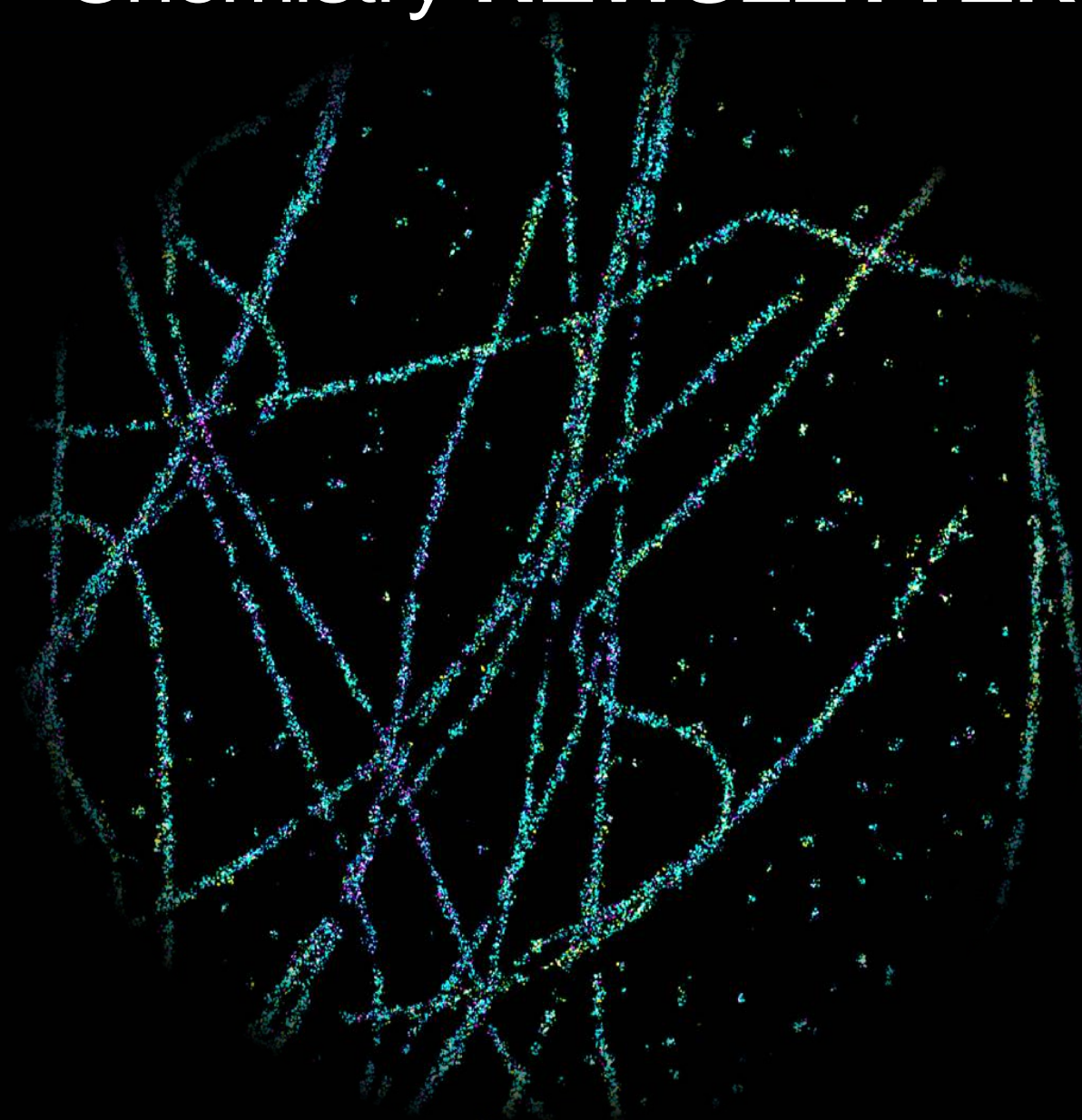




UCL

Chemistry NEWSLETTER



Sustainability

Shaping the Future

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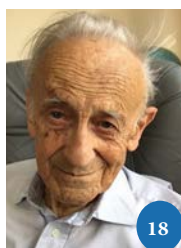
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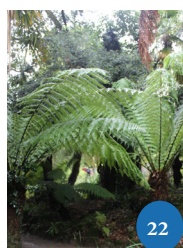
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UCL Chemistry NEWSLETTER

Cover Graphic: Dr Sabrina Simoncelli

Microtubules observed as never before: Dr. Simoncelli and collaborators developed a method capable of imaging the three-dimensional organization of biological structures down to the size of their structural proteins, ~4–10 nm (colour in the image represents axial-position). This new development, published in Nature Communications (vol 12, 517, 2021) opens up exciting opportunities in different fields ranging from life to material sciences.

Editors: Prof. Claire Carmalt, Dr Rebecca Ingle

Contributors: Prof. Claire Carmalt, Dr Roopender Kumar, Dr Michael Booth, Dr Daniele Castagnolo, Dr Neha Arora, Dr Peter Bolgar, Dr Samson Khene, Dr David Rowley, Dr Krešo Bučar, Dr JL Kiappes, Dr Harsh Bhatia, Lulu Kwan, Aisha Mumtaz, Alberto Ristache, Louise McSeveny

Special thanks: Prof. Alwyn Davies, Prof. Helen Hailles, Dr Daniele Castagnolo, Prof. Furio Cora, Dr Helena Wong, Dr Yang Xu, Dr Sabrina Simoncelli, Dr Ajay Piriya, Charlie Nason, Darren Byford

Layout: Louise McSeveny

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Page 23, 25, 29 Louise McSeveny

Page 25 Lulu Kwan

Page 29 Photos by Mae Mu, Pablo Pacheco, Babak Habibi & Alexandr Hovhannisyan on Unsplash

Welcome



It is towards the end of the summer break as I write the welcome to this year's newsletter and this summer we have all had to cope with record temperatures. While the Department has always been keen to embrace sustainability and find ways to reduce energy usage it is clear that this really must be a priority moving forwards. Thanks to Professor Andrea Sella we are in the process of analysing the effects and safety aspects of turning off fumehoods overnight and during weekends and have now tested a number of areas. This makes complete sense given the huge amount of energy required to run our fumehoods and we hope to implement this over the next few months. Our Departmental Safety Officer, Dr Rob Wilson, has also encouraged groups to take part in UCL's LEAF (Laboratory Efficiency Assessment Framework) and so far 5 research laboratories have gained Bronze awards, 1 a silver award and the Graham Teaching laboratory a Gold Award. It is clear that we must all embrace sustainability and make every effort to reduce energy usage.

This year we received the Research Excellence Framework (REF2021) results and I'm delighted to say that Chemistry at UCL had amazing results. For those not familiar with REF in REF2021 outputs (publications) (60%), impact (25%) and research environment (15%) combine to give an overall grading for each unit of assessment (UoA). In each category, there is a 4*, 3*, 2*, 1* and UC (unclassified) rating. 4* is the highest rating and means world-leading research, 3* is internationally excellent, 2* is recognised internationally, 1* recognised nationally. Highlights from the REF2021 results for UCL Chemistry showed that (i) we came 3rd nationally on GPA and 4*; (ii) we came joint 1st nationally on combined 4*/3*; (iii) 4* outputs showed a rise in rankings for UCL Chemistry from 16th to 4th and (iv) Chemistry was the only UoA at UCL to score 100% for 4*/3*. We also showed one of the biggest improvements in 4* outputs in the UoA for Chemistry since the previous REF in 2014. I am hugely proud of everyone in the Department and our achievements.

We had a number of leavers and retirements this year. Professor Steve Price took early retirement and is now busy cycling, climbing and continuing as a First Responder. Professor Charles Marson will be retiring in September and Professor Beppe Battaglia moved to a new position as an ICREA Research Professor at the Institute of Bioengineering of Catalunya. Nicola Philips (Senior HR Staffing Officer), Angelo Delbusso (workshop technician), Enrico Buonauro (Research Administrator) and Holly Ambrose-Wilson (Teaching & Learning Administrator)

left the Department to take up new positions. We welcomed Dr Michael Booth (Royal Society URF and pro-leptic Lecturer), Dr Roopender Kumar (Lecturer) and Dr Daniele Castagnolo (Associate Professor) into the Organic Section. Rezwana Akhtar (Senior HR Staffing Officer), Rhianna Betts (Assistant Teaching & Learning), Lillian Anyadi (Education Administrator) and Jose Prego (Senior Education Administrator) joined the professional services team along with Jesel Gohil into the Teaching Laboratory Technical team and Dr Andrew Stewart as our new TEM Facility Manager. This academic year we were pleased to welcome three new Associate Lecturers (Teaching) to the department - Dr Neha Arora, Dr Peter Bolgar and Dr Samson Khene to provide teaching across the 3 sections of inorganic, organic and physical as we cope with our large student intakes.

Dr Andy Beale was awarded the Royal Society of Chemistry Peter Day Award and Dr Adam Clancy has been awarded a Royal Society University Research Fellowship. In the UCL Education Awards the Departmental Bootcamp Team (Liz Munday, Tamara Alhilfi, J.L. Kiappes, Martyn Towner, Claire Gacki, Crosby Medley, Alan Philcox, Dave Webb, Luka Nunar, Helena Wong, Hannah Shalloe, Katherine Holt, Gopinathan Sankar, Yang Xu) received the Award for Innovation and Transformation with a focus on building learning communities. Professor David Scanlon received the Student Choice Award for Excellence in Personal tutoring. Congratulations also goes to those who were promoted in the Senior Promotions this year: Dr Dewi Lewis to Professor of Physical Chemistry, Dr Giorgio Volpe to Professor of Soft Matter, Dr Dejan-Kresimir (Kreso) Bucar to Associate Professor, Dr Caroline Knapp to Associate Professor and Dr Anna Roffey to Associate Professor (Teaching).

Following last years record intake of undergraduate students, we had another large intake of 220 students at the start of the 2021/22 academic year and this looks set to continue this coming academic year. I am grateful to all the staff and also the excellent PGTA support that ensured our undergraduate laboratories could run effectively.

I look forward to embracing more in person teaching and events as we move into the new academic year. I wish you all the best for 2022/23 academic year.

Professor Claire Carmalt
Head of Department

Staff Update

New Staff

Dr Roopender Kumar was born and raised in a farm-village in Northern India. He received a master's degree in organic chemistry from the University of Delhi and worked on his master's thesis with Professor Hans-Ulrich Reissig at the Free University Berlin on a multicomponent reaction to access new heterocyclic compounds.

After that, Roopender joined Professor Cristina Nevado's lab at the University of Zürich, where he earned his PhD in September 2017. During his dissertation study, Roopender designed and developed a novel class of pincer-ligands to stabilise metastable gold intermediates, allowing hitherto difficult mechanistic investigations and the production of new gold-based OLED materials. He began his postdoctoral studies as an SNSF (Swiss National Science Foundation) postdoctoral scholar with Professor Matthew Gaunt at the University of Cambridge in January 2018. At Cambridge, Roopender led a team that developed a practical and general approach for synthesising alkyl amines.

He joined the Department of Chemistry at University College London as an Organic Chemistry and Chemical Biology lecturer in January 2022. His main interest is in the design and development of new ligands, catalysts, and sustainable technologies to access functionally rich small organic molecules and materials employing feedstock chemicals or biomass.



Q&A with Roopender

What is one lesson you learned early on in your life?

Actually, I learned two – that is what happens when one is as ignorant as I was or am – fundamental lessons. In some ways, I was very fortunate to spend most of my adolescence working on the farm, where I learned first-hand that “if you want to harvest, then plant” and that “efforts do not go un-rewarded.” It simplified my life and helped me to an unbelievable degree over the years.

What other subjects do you enjoy besides chemistry (assuming you enjoy chemistry)?

Neuroscience, history, and philosophy, or should I say, the history of philosophy. It provides one with a much broader perspective and enables one to contemplate the otherwise untemplated.



Dr Michael Booth is a Royal Society University Research Fellow and Lecturer in Organic Chemistry and Chemical Biology. His research focuses on the synthesis and application of controllable nucleic acids and synthetic cells for biology and medicine.

Michael studied for an MChem degree at the University of Southampton, which included research projects in the groups of Professor Martin Grossel, Professor Ali Tavassoli, and Professor George Attard. As part of his undergraduate degree, he also undertook a placement at the Université de Montréal, Canada, under the supervision of Professor Stephen Michnick. Michael then carried out his PhD at the University of Cambridge under the supervision of Professor Sir Shankar Balasubramanian, developing sequencing techniques for modified cytosine bases. This work was patented and spun out into a company, Cambridge Epigenetix. Michael then moved to the University of Oxford to work in the group of Professor Hagan Bayley as a postdoctoral researcher and Junior Research Fellow at Merton College, Oxford. At Oxford, he developed light-activated DNA technology to control cell-free protein expression within synthetic cells. Michael then started his independent research career in 2018 with a Royal Society University Research Fellowship in the Department of Chemistry at the University of Oxford. In March 2022, Michael started his position at UCL Chemistry.

Michael has won several awards and prizes, including the 2015 Scopus UK Award in Biochemistry, Genetics and Molecular Biology, the 2019 Biochemical Society Award in Biotechnology, and an EPSRC New Investigator Award.

Inside Michael's Lab

Synthetic cells; giant unilamellar vesicles ~20 micrometers in diameter that have expressed a fluorescent protein inside, based on an encoded DNA sequence.

Middle: A light-activated concentric circle pattern of synthetic cells

Bottom right: Polyacrylamide gel electrophoresis analysis of photocage reactions with DNA

Bottom left: Silica gel purification of a light-activated photocage to control DNA



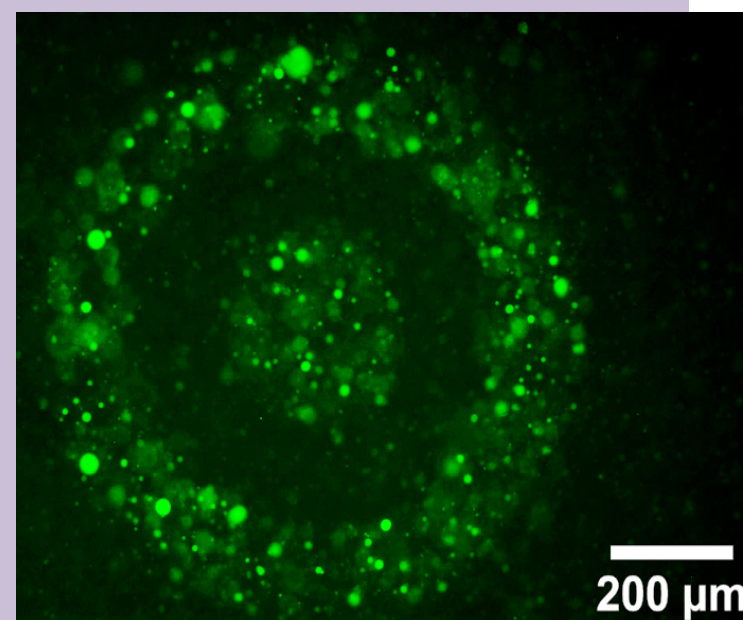
Dr Daniele Castagnolo obtained his PhD in Medicinal Chemistry and Pharmaceutical Sciences at the University of Siena (Italy) in 2006 working with Professor Maurizio Botta on the synthesis of antimycobacterial agents and on the development of microwave assisted metathesis reactions. During his doctoral studies he also joined the research group of Professor Johann Mulzer at the University of Vienna (Austria) as a visiting PhD student, working on the total synthesis of the Branimycin side chain.

After completing his Ph.D., Daniele was appointed as postdoctoral research associate at the Helsinki University of Technology (Finland) in the group of Professor Petri Pihko, where he worked on the development of Brønsted acid catalytic reactions for the synthesis of non-anomeric [6.5]-spiroketals. In 2008 Daniele moved back to the University of Siena as a Research Fellow, working on the development of new metal-catalyzed alkyne reactions for the synthesis of drug-like compounds and on the identification of novel antifungal and antiviral agents.

Finally, he completed his postdoctoral studies at the University of Manchester (UK) working in the research group of Professor Jonathan Clayden on the synthesis of tertiary thiols. In 2012, Daniele started his independent research at Northumbria University and later, in September 2015, he moved to King's College London.

Since January 2022, Daniele is an Associate Professor in Chemical Sustainability at the Department of Chemistry at UCL.

Read more about Daniele on Page 28-29



New Staff



Dr Peter Bolgar is an organic chemist with a special interest in physical organic chemistry and supramolecular chemistry. He joined UCL in March 2022 as an Associate Lecturer (Teaching).

Peter was born in Hungary, where he attended the local primary and secondary state schools. He came to the UK in 2013 to pursue his undergraduate studies in Natural Sciences at St Catharine's College at the University of Cambridge. Thereafter, he continued with his PhD studies at Cambridge in the field of supramolecular chemistry, under the supervision of Professor Christopher Hunter.

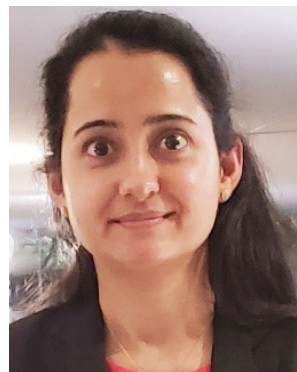
After graduating, he joined our department at UCL. Peter is a member of the UK Chemistry Olympiad Working Group (which you can read about on the next page), and in his free time he enjoys studying meteorology and looking after his plants at his allotment.



Dr Samson Khene is an Associate Lecturer (Teaching) in physical chemistry with interest in improving student engagement in chemistry tutorials by working on developing an inclusive and evidence based pedagogical approach for designing highly engaged chemistry tutorial sessions.

Before joining UCL he taught physical chemistry at Rhodes University (South Africa) and Nottingham Trent University. He obtained his BSc (in physics and chemistry), BSc(hons), MSc and PhD degrees as well as a Postgraduate Diploma in Higher Education (PDGHE) at Rhodes University. His MSc and PhD research were supervised by the Distinguished Professor Tebello Nyokong.

Samson has expertise in the synthesis, spectroscopy and electrochemical characterisation of metallophthalocyanine complexes for their possible application as photosensitisers in photodynamic therapy (PDT), electrocatalysts for the detection of pollutants in water and as nonlinear optical (NLO) material. His recent research has focused on understanding the effect of symmetry on nonlinear optical properties of phthalocyanine complexes using the Z-scan technique and DFT calculations.



Dr Neha Arora is an Associate Lecturer (Teaching) in Inorganic and Materials Chemistry at UCL. Prior to this, she was a Research Associate with Prof. Sir Richard Friend in the Cavendish Laboratory, University of Cambridge (2018–2021), where she focused on investigating the structural, compositional, and optoelectronic properties of next-generation solid-state materials for their application in solar cells and light-emitting devices.

After gaining her PhD in Inorganic Nanomaterials from IISc, she joined EPFL, Switzerland, as a postdoctoral researcher funded by a Swiss Government Excellence Scholarship. She was nominated by Siemens AG to attend the 63rd Lindau Nobel Laureate Meeting on Chemistry during her PhD. From 2016-2018, she worked as a Postdoctoral Scientist with Prof. Michael Grätzel at EPFL, where her research focused on the fabrication and understanding of perovskite solar cells yielding high efficiencies and remarkable photovoltages.

In addition to research, she has been involved in teaching solid-state chemistry and emerging photovoltaic technologies and is committed to enhancing student engagement and learning.



Chemistry staff at this year's Graduation Ceremony 31 August 2022

Awards

MAPS Faculty Education Awards

Each year the Faculty of Mathematical & Physical Sciences recognises excellence in teaching from staff through the Faculty Education Awards. We are delighted to be able to announce the Chemistry winners of the 2022 MAPS Faculty Education Awards.

Claire Gacki Individual Excellence: Claire is an integral member of the technical team, and provides outstanding support in the undergraduate teaching lab, working hard to improve the student experience and support her colleagues.

Seán Kavanagh Individual Excellence: for his devotion to teaching excellence through his direct supervision of masters and PhD students.

Jude Ayogu Highly commended: for his significant contribution to PhD students' wellbeing.

Chemistry Connected Learning Team: Dr Anna Roffey, Dr Stephen Potts, Prof. Katherine Holt, Dr Liz Munday, Dr J.L. Kiappes Jr, Dr River Riley, Dr Tamara Alhilfi, Dr Vicky Hilborne, Dr Miguel Rivera: Team Award for Innovation and Transformation, with a focus building learning communities. This team have laid the foundation for how the department will ensure that our teaching is pedagogy-led, expert-led, student informed and delivered of high quality across all our programmes.

Also the **Chemistry Bootcamp Team** won a Team Excellence award from MAPS as well as the UCL Education Award (see next page for details).

RSC Awards

Prof. Andrew M. Beale has been awarded the Royal Society of Chemistry's 2022 Materials Chemistry Division Mid-Career Award: Peter Day Award.



Andrew Beale is a Professor of Inorganic Chemistry, Group leader at the Research Complex at Harwell, Chief Scientific Officer & co-owner of Finden Ltd and a management group member of the EPSRC-sponsored UK Catalysis Hub.

His interests lie in establishing structure-function relationships in materials, including catalytic solids and energy storage materials as a function of both time and space using X-ray & optical spectroscopic and scattering methods applied under *in situ* and operando conditions. Specific areas of interest include the development of novel imaging techniques ('multimodal' & 5D), particularly X-ray Diffraction Computed Tomography (XRD-CT) for the study of single catalyst bodies/grains/batteries under real reaction conditions (i.e. temperatures > 1273 K and pressures up to 50 bar, real-time charge-discharge), determining the nature of the active site and reaction mechanism in catalysts for NO_x abatement, methane activation/upgrading, unravelling the self-assembly mechanism of microporous materials and the characterisation of catalytically active supported nanoparticles

In 2012 he co-founded Finden Ltd providing high-end characterisation of solid-state functional materials spanning the fields of catalysis, energy, automotive parts and pharmaceuticals, typically at the critical juncture of scale-up to pilot plant.

Promotions



Dr Dewi Lewis to Professor of Physical Chemistry



Dr Giorgio Volpe to Professor of Soft Matter



Dr Dejan-Krešimir (Krešo) Bučar to Associate Professor



Dr Caroline Knapp to Associate Professor



Dr Anna Roffey to Associate Professor (Teaching)

UCL Education Awards

Chemistry Boot Camp Team

Innovation and Transformation, with a focus on building learning communities

Due to the COVID-19 pandemic, Undergraduate students at UCL who were going into the 2nd, 3rd and 4th years of their degree had missed out on their laboratory work, skills which are crucial to a chemistry degree. The boot camp concept, a one- to three-week period of carefully designed labs, was used to provide students with a formative learning environment to gain these skills in advance of summative lab courses or their MSci research projects.

Chemistry degrees fundamentally have laboratory practical work integrated throughout, and our graduates can expect to emerge with a solid grounding in experimental work. The pandemic created a major challenge to this, as we had a year when our students were unable to achieve the learning objectives of their practical courses.

This team of Academics and Technical staff did an absolutely phenomenal job of

designing, planning and running Year 2, Year 3 and Year 4 'Boot-Camps' to cover the major technical skills. These have been a huge success, with student feedback clearly valuing the importance of these laboratories.

Head of Department, Prof Claire Carmalt commented "The students responded wonderfully to these Boot camps and hugely enjoyed being back in the lab, back in the department and back on campus after many had endured a rather isolating previous academic year due to Covid. It was the perfect way to ensure that our students received the necessary training in the skills they had missed while not having to get stressed about grades. The support and interaction that the students received from this brilliant team was outstanding,

all of whom went above and beyond to guarantee that all went smoothly. An excellent student experience resulted, with students informing me that they enjoyed the labs, that they were great, and they were chill and fun! I am fully supportive of this award - the outstanding contributions of this team make them very worthy recipients of this award".

These highly innovative bootcamps have absolutely transformed our students learning experiences and communities this year, and the philosophies developed will be integrated and transform our future laboratory courses.

Meet the Team

Dr Liz Munday: Lecturer (Teaching)
Dr Tamara Alhilfi: Lecturer (Teaching)
Dr J.K Kiappes: Lecturer (Teaching)
Crosby Medley: Teaching Laboratory Operations Manager/
Technical Safety Officer
Claire Gacki: Chemistry Laboratory Technician
Hannah Shalloe: Chemistry Laboratory Technician
Martyn Towner: Natural Sciences Laboratory Technician
Alan Philcox: Chemistry Teaching Laboratories Manager
Co-ordinator
Dave Webb: Turner Laboratory Senior Technician
Luka Nunar: Chemistry Laboratory Technician
Dr Helena Wong: Graham Laboratory Senior Technician
Prof Katherine Holt: Professor of Physical Chemistry
Prof Gopinathan Sankar: Professor of Solid State Chemistry
Dr Yang Xu: Lecturer in Chemical Energy



Ultra-Fast Laser Facility Opening

A live event was held on May 4th, 2022, to celebrate the opening of a new ultrafast laser facility in the Department of Chemistry and to advertise the facility to potential future users of the femtosecond transient absorption and photoelectron spectroscopy end-stations. It was attended by 112 people.

The proceedings included a welcome speech by Prof Helen Fielding (PI),

an opening seminar by Prof Eleanor Campbell FRS (University of Edinburgh), a keynote lecture by Prof Steve Bradforth (USC, USA), and closing speeches from Prof Ivan Parkin (Head of MAPS) and Dr Michael Spence AC (President & Provost).

The President/Provost was invited to cut the ribbon to officially open the facility and this ceremony was broadcast live to the lecture theatre to rapturous applause. All attendees were invited on laboratory tours led by Dr Julia Davies, the facility manager, and the event culminated in a poster session and drinks reception.

If you're interested in accessing the facility, then please email Julia Davies and/or Helen Fielding. For further information, see <http://helenfieldinggroup.co.uk/ultrafast-laser-facility/>

From left to right: Prof. Claire Carmalt, Prof. Helen Fielding, Dr Michael Spence, President & Provost UCL, Prof. Geraint Rees Vice Provost of Research, Innovation & Global Engagement, Prof. Ivan Parkin, Dean MAPS Faculty



EDI Committee Update

As life began to return to some degree of normality over the previous academic year more in person events were possible. The EDI committee started to tentatively re-initiate events and an excellent attendance at postdoc coffee mornings showed that there was definitely an appetite for more in person events. Dr Rebecca Ingle, our postdoc working group (WG) lead organised a fellowship workshop in the Department along with the London Postdoc Summer Symposium. Since the new mentoring scheme had received positive feedback we also arranged further mentor and mentee training using Teams as the online platform. We also used the staff meetings to raise awareness and signpost wellbeing support available at UCL.

Dr Yang Xu, lead of the Postgraduate Research (PGR) Working Group analysed our PGR admissions data for the past 3 years. It was pleasing to see that the data showed a significant increase in female application, offer and acceptance numbers. This follows changes to our recruitment policy for PhD students which now ensures that all studentships are open to the most talented internal and external candidates, and are advertised on our webpage and all final year

undergraduates are informed by email. A PhD thesis writing workshop was also organised which is described below.

PhD Thesis Writing Workshop

In June PhD Dr Yang Xu, PGR WG lead ran the annual PhD Thesis Writing Workshop. This workshop aims to help our students enhance their understanding of the structure and illustration of a PhD thesis, prepare for a viva and help direct students to academic writing support. It is also an opportunity for students to hear personal experience of thesis writing from a panel of experts.

This year panellist included PhD student Viliyana Lewis who spoke about how to get started, followed by Ramsay Fellow Dr Adam Clancy who returned this year to present on thesis structure. PDRA Dr Kylie Yang spoke about how to create scientific illustrations and figures. Prof. Katherine Holt shared a supervisor's perspective on both thesis preparation and viva. Daphne Thomas, Head of UCL Academic Communication Centre gave an overview of writing a thesis, self-plagiarism, and academic writing support provision within College. Senior teaching & learning postgraduate administrator Dr Jadranka Butorac was on hand to answer any queries on final year PhD progression.

The event, held via Teams, was well attended with up to 45 students. These

workshops provide practical and useful advice covering all stages of thesis preparation, just one way the EDI PGR Working Group's fulfils its aim to build an inclusive environment to support our students to achieve their goals. Most of all, it gives students an opportunity to discover that some of the problems and pitfalls they face are universal and that they are not alone.

Events



After 3 attempts all cancelled due to Covid, a retirement party finally went ahead to wish Prof. Steve Price a happy retirement after 28 years at UCL. Steve is pictured above with his wife Kath & Claire.

Student Update

Prizes

Second year PhD Poster Prizes

Rothwell prize for best synthetic work

Phyllida Britton

Supervisor: Kreso Bucar

Organic Chemistry

Ioanna Thanasi

Supervisor: Vijay Chudasama

Inorganic Chemistry

Zuharia Arshad

Supervisor: Jawwad Darr

Physical Chemistry

Sebastian Stockenhuber

Supervisor: Andrew Beale

Computational Chemistry

Lavan Ganeshkumar

Supervisor: David Scanlon

PhD Prize Winners

Clarke Prize

Xinyue Zhang

Supervisor: Chris Blackman

Best student presentation in Inorganic Chemistry for her presentation:

Synthesis and Photoelectrochemical Performance of Delafossite CuFeO_2 Thin Film via Aerosol-assisted Chemical Vapor Deposition

Catlow Prize

Seán Kavanagh

Supervisor: David Scanlon

Best student presentation in Computational Chemistry for his presentation titled:

Cation Disorder and Solar Cell Performance in ABZ_2 Materials

Davies Prize

Benjamin Thoma

Supervisor: Matthew Powner

Best student presentation in Organic Chemistry for his presentation titled: Lysine as a privileged structure in prebiotic peptide synthesis

Ewing Prize

Alessia Gentili

Supervisor: Giorgio Volpe

Best student presentation in Physical Chemistry for her presentation titled:

Characterisation and implementation of optimal search strategies

Undergraduate Prize Winners

Lauren Cook

Neil Sharp prize for excellence in Theoretical (including Computational) Chemistry

Kristina Kostadinova

Parke Davis prize for excellence in Medicinal Chemistry

Edoardo Simonetti

Harry Poole prize for excellence in Physical Chemistry

Tereza Kacerova

Charles Vernon Prize Charles Vernon prize for excellence in Biological Chemistry

Jirí Doležal

Franz Sondheimer prize for excellence in Organic Chemistry

Alissa Sadikovic: Ronald Gillespie Prize for best student in Inorganic/Materials Chemistry proceeding to PhD at UCL

Lauren Cook & Jessie Liu were awarded the Tuffnell Prize for the best student commencing a PhD in the department.

The CK Ingold Prizes for excellence in undergraduate performance were awarded to:

Kevin Ma

Alexandra Dubinskaya

Jed Hutchings

Yijia Li

Luca Petrini

Krzysztof Habdas

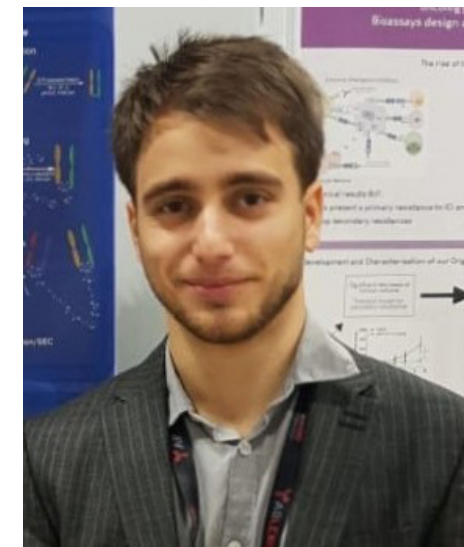
Peter Szijj

I graduated from UCL in 2017 with an MSci degree in Natural Sciences. I carried out my PhD at UCL in the labs of Professor Vijay Chudasama (UCL Chemistry) and Professor Lucy S. K. Walker (UCL Institute of Immunity and Transplantation).

My project focused on the modular chemical generation of bispecific antibodies and their conjugates for the treatment of autoimmune diseases and cancer. The PhD consisted of three main projects; 1) preparing a bispecific antibody-drug conjugate to selectively destroy an immune cell subset implicated in the development of autoimmune diseases, 2) preparing three-protein immunomodulatory complexes as a

cancer therapeutic in collaboration with the Bertozzi group at Stanford University, and 3) the re-construction of IgG-like bispecific antibodies using chemistry. I have presented my work at various international conferences, including the Festival of Biologics Basel and San Diego, won the prize for best presentation at the 2021 ISMB retreat, the Davies Prize and the Ramsay Medal.

I finished my PhD in June 2022, and I am currently carrying out a post-doctoral fellowship to continue project 1 with Prof. Walker at UCL, while we are in the process of preparing manuscripts for projects 2 and 3. Regarding longer term plans; I would like to stay in academia and start my own research group one day.



Ramsay Medalist

UK Chemistry Olympiad

Four A-level students from the United Kingdom won silver medals at the 54th International Chemistry Olympiad competition following training by UCL Chemistry Lectures (Teaching).

The annual International Chemistry Olympiad (ICHO) is a competition for talented secondary school chemistry students. Nankai University in Tianjin, China hosted the virtual Olympiad, during which the A-level students, together with 322 other students from 82 different countries, completed a five-hour theory exam spanning a wide variety of chemistry.

For the first time, the team's training week was held at UCL in Department of Chemistry. The students had training sessions led by the RSC Olympiad Working Group including Lecturers (Teaching) Peter Bolgar and J.L. Kiappes.

The UK Team earned four silver medals at the 54th International Chemistry Olympiad. The team was comprised of Ben Gilpin from West Bridgford School, New Jantarakulchai and Nat Juntarawatt from the National Mathematics and Science College, and Leo Reddy from Woking College.

You can learn more about the team's experience and the UK Chemistry Olympiad on the RSC website (<https://edu.rsc.org/rsc-education-news/uk-students-shine-at-international-chemistry-olympiad/4015970.article>).

Pictured are New, Ben, Leo, and Nat in the Christopher Ingold Building together with the portrait of Sir William Ramsay and team mascot, Paddington.



Student Choice Awards

These awards are a way for students to thank amazing members of staff, and let them know that their hard work makes a difference.

The UCL Student Choice Award for Excellent Personal Tutoring this year was awarded to Prof. David Scanlon for always being there to provide students with pastoral support and academic guidance.



Graduating Students

PhD

Safa Almadhi
Supervisor: Giuseppe Battaglia

Riccardo Argurio
Supervisor: Gopinathan Sankar

Malavika Bhide
Supervisor: Caroline Knapp

Emma Campbell
Supervisor: Andrew Beale

John Chapman-Fortune
Supervisor: Gopinathan Sankar

Gemma Davison
Supervisor: Chun Tung Lee

Cesare De Pace
Supervisor: Giuseppe Battaglia

Haobo Dong
Supervisor: Ivan Parkin

Maud Einhorn
Supervisor: David Scanlon

Rhys Evans
Supervisor: Francesco Gervasio

Katie Hobson
Supervisor: Claire Carmalt

Runjia Lin
Supervisor: Ivan Parkin

Richard Lunn
Supervisor: Claire Carmalt

Roshni Malde
Supervisor: Jamie Baker

Gabriele Marchello
Supervisor: Giuseppe Battaglia

Liam Martin
Supervisor: Alethea Tabor

Kudakwashe Nyandoro
Supervisor: Derek Macmillan

Zhiyong Pan
Supervisor: Ivan Parkin

Helena Philpott
Supervisor: Helen Hailes

Mikhail Pumpianskii
Supervisor: James Anderson

Chengwu Qiu
Supervisor: Andrew Beale

Abdul Rashidi
Supervisor: Richard Catlow

Antonio Ruiz Gonzalez
Supervisor: Kwang Leong Choy

Mustafa Sener
Supervisor: Daren Caruana

Maria Belen Sola Barrado
Supervisor: Giuseppe Battaglia

Peter Aron Szijj
Supervisor: Vijay Chudasama

Rachel Szpara
Supervisor: Thomas Sheppard

Sukhi Talewar
Supervisor: Christoph Salzmänn

Alex Tanner
Supervisor: Geoff Thornton

Harry Tinker
Supervisor: Caroline Knapp

Thierry Tran
Supervisor: Graham Worth

Alice Van Haeften
Supervisor: Graham Worth

Oliver Walker
Supervisor: Kwang Leong Choy

Guanyu Wang
Supervisor: Kwang Leong Choy

William Whitehouse
Supervisor: Stefan Howorka

Isobel Wilson
Supervisor: Michael Porter

Xueming Xia
Supervisor: Christopher Blackman

Siyu Xiong
Supervisor: Kwang Leong Choy

Yijie Xu
Supervisor: Jawwad Darr

Arthur Youd
Supervisor: David Scanlon

Siyu Zhao
Supervisor: Ivan Parkin

Lei Zhu
Supervisor: Richard Catlow

Yiyun Zhu
Supervisor: Christopher Blackman

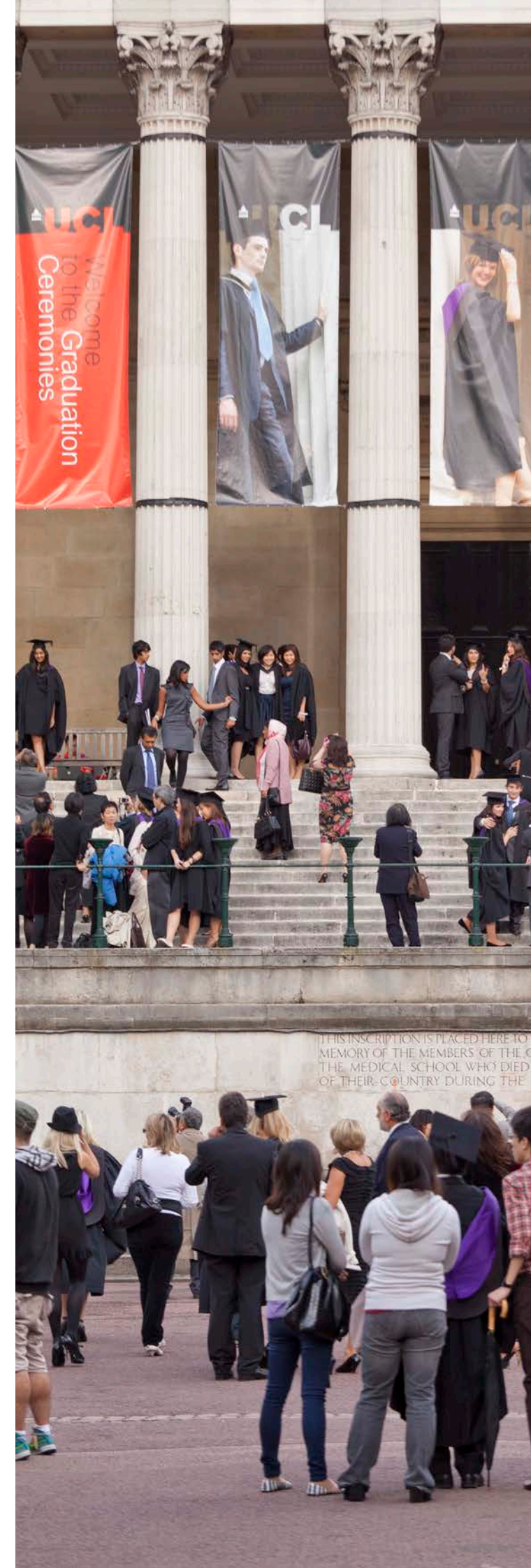
EngD

Filip Ambroz
Supervisor: Ivan Parkin

Simon Austin
Supervisor: Robert Bell

Archana Bhartiya
Supervisor: Ian Robinson

Yiana Shakespeare
Supervisor: Jawwad Darr



Chemical & Physical Society

In the time of COVID-19

Krešo Bučar President 2021 - 2022

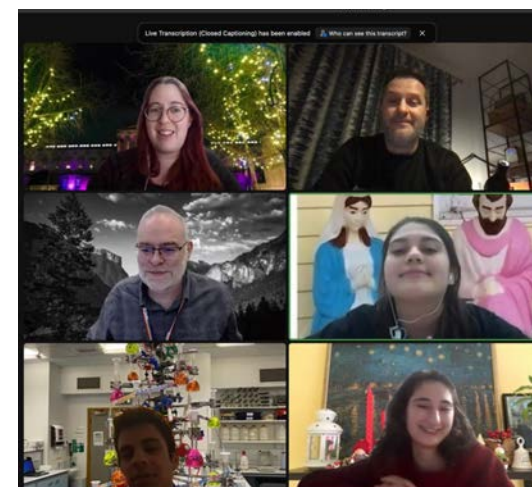
Hopefully, most readers of this *Newsletter* have heard of the *Chemical and Physical Society* (CPS), know something about its long and illustrious history, and have even attended a CPS event (or two). What many of you may not realise, however, is the fact that every CPS event is brought to fruition by a dedicated committee of UCL Chemistry students. As the vice-president of the Society from 2020-2021, and then president from 2021-2022, I have been privileged to observe the Committee in action during one of the tougher periods in recent history, and what I observed was inspiring. The success of the CPS during the pandemic years was purely the result of the enthusiasm, diligence, and sheer creativity of the Committee members, working together as only the best scientific teams can.

It is thanks to the Committee that we were able to hear talks from more than fifty distinguished scientists throughout the pandemic, when so many of us were missing out on interactions with the broader community. Much thought and effort were put into lining up exciting speakers from many different and exciting fields, with a healthy mix of early career researchers and leading authorities. The Committee were also keen to make the talks more accessible to a broader audience by hosting speakers at lunchtime, allowing those with caring or other responsibilities to attend. The social hours following each talk brought together students and staff in a way that only a post-seminar coffee or happy hour can, and perhaps introduced some to the idea that some of the best and most productive scientific conversations happen outside of the classroom, or the laboratory.

I won't recap all the scientific talks here, as you can find recordings of every one of them on the slick CPS YouTube video

channel (have a look – it's great! <https://www.youtube.com/channel/UCp1-femwNp49BDc3g2IYkbQ>). There are also a couple of CPS events that you won't find a record of online, but are particularly worth highlighting though, as examples of the CPS' commitment to the health, well-being, and the professional development of their fellow-students. These include a Mental Health Workshop led by Dr Zoe Ayres and our own Chiara Pillen, who did an outstanding job here. Dr Ayres discussed mental health issues in the scientific community, and about coping strategies that actually work. Chiara then followed this by sharing specific tools and resources (these are now listed on the CPS Moodle page) and made this content also further accessible through widely distributed pocket-sized leaflets. The International Women's Day was celebrated with an eye-opening talk by Dr Jessica Wade, who highlighted inequalities within the scientific community and showing us how we can be more inclusive as colleagues and mentors. The CPS has also organised a Careers Evening and invited a panel of former UCL Chemistry students to discuss their career progression after graduation. This event was extremely well-attended (around 150 people in all!), and the panel discussion was followed by drinks and much lively conversation with the panel members.

It is also thanks to the Committee members that we are now developing a comprehensive CPS Handbook, that will help future CPS Committee members understand their own roles and that of the Society itself. Again, the pandemic both highlighted a problem and allowed the problem-solving skills of our students to shine: the need for a Handbook had not been felt throughout the Society's history until the pandemic disrupted the continuity of the Committee's activities, stripping away the know-how and networks



Pictured here top: the CPS Committee at the first hybrid talk event in November 2021.

Bottom: we're making sure we're in sync and ready for the 'Christmas' Quiz in February 2022.



Top Left: The CPS Committee all dressed up for the CPS Boat Party in May 2022.

Bottom Left: Taking a break from all those busy meetings (November 2021)

Right: The survivors of the CPS Boat party in May 2022.

acquired over the years and passed down from student to student. While the Handbook will ensure continuity in the future, Chiara Pillen's and Miranda Molloy's continuing efforts with archiving past materials will ensure preservation of the Society's long and storied past.

Finally, it would be remiss of me to forget the role of the CPS in organising many memorable and enjoyable social events during my tenure. It is easy to ignore the importance of such social activities in forming a cohesive community here at the UCL Department of Chemistry, and I want to make sure we acknowledge

the Committee's efforts in driving events such as the picnic in Gordon Square, one of the first post-lockdown in-person events, which had a great turnout (especially from the first-years), or the online Christmas quiz, which was delayed due to the emergence of Delta variant, but brought much needed cheer to all of those who participated (well done Team 'Bismuth or Pleasure!').

And of course, I can't conclude without mentioning the CPS Boat Party, where I was outnumbered by a hundred-odd thirsty chemistry students in the middle of the Thames. As you can imagine, this

is one of the more popular efforts of the CPS each year, but perhaps not a very healthy one for attending Presidents and other members of academic staff with more delicate metabolisms.

In closing then: I am very grateful to all the CPS Committee members I've worked with over the past two years: Chiara Pillen, Miranda Molloy, Tina-Maria Burova, Deepali Desai, Hannah Thatcher, Krzysztof Habdas, Lauryna Soblyte, Blake Parker, Jakub Chomiuk, Luca Petrini, Sofia Rogers Ruiz, Lauren Cook, Andrey Ten, Sarah Wills, Krisi Kostadinova, Harry Li, Rachael Doherty, Wendy Wu,

Tamara Alhafi, Cally Haynes and J.L. Kiappes Jr. You have all been incredibly hard-working, collaborative and, above all, kind. Your activities have enriched the UCL Chemistry community. I'd also like to wish all the best to our new CPS President, Cally Haynes, and welcome vice-president J.L. Kiappes Jr to the Committee: I hope you enjoy your roles as much as I did!

Professor Alwyn Davies

Emeritus Professor Alwyn Davies, FRS, has been a pillar of the Chemistry Department for the last 70 years. Recognised for his scientific contributions to the fields of organic and organometallic chemistry, Alwyn has been a teacher and mentor for a generation of UCL Chemistry students.

PhD Student Aisha Mumtaz met with Alwyn earlier this year to talk about chemistry, the department and its history.



How do you feel the department has changed over the years? What do you think are the most positive changes and which do you think may have been better left unchanged?

The most obvious difference is that of size. After things had settled down after the war, we had three professors and an intake of about 50 students a year. The chemists were all in one building (now called the Kathleen Lonsdale Building), with three lecture theatres, and three teaching labs: organic, inorganic, and physical. To give an organic lecture, I had to walk just thirty yards through the organic lab. You knew all the chemists and most of the people in the Staff Common Room at lunch time. There was one departmental colloquium at 4 p.m. on a Wednesday and all the staff and research students attended.

The difference between the small department then and the much bigger department now is like that living in a village or in a large block of flats. You have, or at least have the potential, of a larger group of friends and acquaintances, with wider interests, but you lose something of the camaraderie of a smaller and more tightly knit group.

Also, life has become much more bureaucratic. I must have been on the staff for 10 years before I attended a committee meeting, except to set and mark examination papers. Appointment to lectureships involved only a tap on the shoulder by Ingold with no advertisement or interview. Promotions were equally painless: "Give me an updated copy of your C.V. Alwyn, we want to put you up for a Readership" (Ted Hughes);

“The research interest has been greatly broadened. The department is now run as a democracy rather than a benign autocracy”

“Let me have two or three names of people who would support your promotion to a Chair” (Ron Nyholm).

The result of this was that in Ingold’s day, all the younger staff were his Ph.D. graduates, and nearly all were working on some aspect of his mechanistic organic chemistry. This perhaps could be justified in a small department as it was then as only a concerted effort could make any international impression, and indeed it was successful. In the present much bigger department, open advertisement and competition is the only way.

You say that your research involved organic peroxides and free radicals as well as organometallic chemistry - what were some of your most memorable moments/highlights as a researcher within the department?

Three experiments stand out. In 1956, Mike Abraham showed that the organoboranes R²B-R reacted with oxygen to form peroxides R²BOOR, just as hydrocarbons HR react with oxygen (but much more slowly) to give the hydroperoxides HOOR.

Ten years later, using an optically active borane, R^{*}B(OH)₂ and some radical inhibitors which had

been newly developed, Brian Roberts showed that mechanistically this autoxidation was a radical chain reaction, just like the hydrocarbon reaction. In parallel, John Bloodworth showed that organotin compounds reacted heterolytically with isocyanates to give stannyl urethanes in the same way, but much more rapidly, that alcohols react with isocyanates to give the protic equivalents.

This suggested first that there was a wide unexplored field of radical reactions of organometallic compounds to be investigated. Secondly, it implied that hydrogen could be regarded as just another metal and that any reaction which could be carried out with a protic reagent H-X could be carried out with the metal equivalent M-X.

These were the key findings which guided most of our subsequent work. We used ESR spectroscopy to establish and study the kinetics of radical reactions of organometallic compounds and identified many new radicals, radical anions, and radical cations. Similarly, the reaction of the organotin compound with an isocyanate provided the prototype for heterolytic addition, elimination, and ene reactions of tin and a

variety of other metals. The Periodic Table is full of metals and you can change the other groups about the polyvalent metal to tailor the reactivity in such a way that is not possible with the monovalent hydrogen.

What made you want to remain at the department for so many years? Was there something in particular that made you want to stay?

It was an excellent department, I got on well with the various Heads of Department (Ingold, Ted Hughes, Ron Nyholm) and I had an unbroken supply of research grants and very good students. I was proud of the pioneering and nonconformist ethos of the College. Further to that, London has a metropolitan advantage, with the Chemical Society (now the RSC), the Society of Chemical Industry, the Royal Society, the British Library, the museums, many publishing houses, and the embassies all within easy reach. It is also a great communications hub. It provided a stream of chemical visitors from overseas and I could get to any university in Britain (except Aberystwyth), to give a lecture or hold a Ph.D. examination, and get back in one day. UCL provided advantages which few other universities could meet.

What or who inspired you to pursue a career in Science?

The “who” is difficult. It was not a chemistry teacher as I was at school during the war, with frequently changing chemistry teachers or none at all. If anyone, it was a physics teacher who stayed longer, and my elder brother John (who became an engineer) who was doing chemistry experiments at home. I would have been equally happy doing physics at college, but not biology. At the beginning of the war our biology teacher left and could not be replaced and I never had a biology lesson. It was the experimental side, and scientific principle of not accepting at face value what you read or are told, but questioning the basic evidence, which attracted me to science. Nulius in verba (Not by word alone) as the Royal Society has it.

Tell us about your role as the archivist for the department.

In 1957, Ingold asked me to take over the archives from Bert Allen who was leaving for Canada. I was happy to do that as the appointment came with a filing cabinet, though the only item it had in it was Ramsay’s Nobel certificate. Since then we have built up a remarkable collection of artifacts, and we have unearthed history which had been forgotten. For example, the fact that Professor Williamson was a key figure in the transformation of Japan from a feudal country into a parliamentary democracy in the 1860s is not mentioned in the college’s official book on its centenary in 1926, though he is venerated in Japan.¹ I hope that

the college does better on the bicentenary in 2026.

Our remarkable history, together with objects which can be displayed, for example the silver lion incense burner which Princess Ito gave to Mrs Williamson, Collie’s X-ray image of a needle in a thumb, and a set of Ramsay’s five noble gas tubes which still light up, provide excellent material for a lecture, and I think this should be given to each crop of first year students. Of all that I have written I am most proud of the book on the history of the Department that Peter Garratt and I wrote in 2013.²

How do you feel that Chemistry has evolved within the department? What do you think have been the biggest developments in the field - and what do you think the future of Chemistry will be?

The technique of chemistry has of course changed greatly since I was a student. Interchangeable ground glass joints were not known and apparatus was assembled with cords or rubber bungs. I doubt whether present students would recognise a cork roller, or cork borers, or a bat’s wing burner. Students were expected to do their own simple glassblowing, but we had three full time professionals whereas we now have one, parttime. The first experiment that new students met in the lab was to make their own wash bottles.

None of the now familiar instrumental techniques such as NMR, IR, Raman, or mass spectroscopy, or chromatography, which have now taken a lot of the labour out of research, were available. My PhD project involved the reaction of a number of enantiomeric aliphatic alcohols and halides. It was difficult in those pre-chromatographic days to purify liquids on a small scale, and they were characterised only by density and refractive index. I hate to think how my samples would now stand up to investigation by GLC and NMR techniques.

Another improvement that I am very conscious of is that of safety. In my early years here, the topic was never mentioned. I remember that one student lost two fingers (azide), and two both lost an eye (concentrated sulphuric acid; peroxidised ether). I don’t remember any accident of that severity since we moved into the “new” building in 1989. It is one example where bureaucracy (the Control of Substances Hazard to Health, COSHH) has had a good effect.

The research interest has been greatly broadened. The department is now run as a democracy rather than a benign autocracy. The teaching is now much more user-friendly.

The determination of the structure of DNA must rank as one of the most important discoveries in chemistry in my lifetime, in view of the developments which continue to spring from it.

Any prediction of where chemistry goes from here is much more hazardous. Years ago I was on the IUPAC committee which organised the Congress which was held in the Department. A session on carbon had been put on the lecture programme, but then we could not find anyone who could talk on developments in carbon chemistry: there were none, and it was regarded as a dead subject. Now we have buckyballs and graphene and all the related fascinating chemistry. This illustrates the danger of trying to predict the future of chemistry. The most that I would venture is to suggest that the major developments will come where chemistry overlaps with other sciences such as physics, biology, or cosmology.

What advice would you give to scientists just starting their research careers and what has helped keep you so enthusiastic about chemistry for all this time?

First, don’t work in departmental isolation. Put yourself about. Publish your work as soon as it is ready. Take every opportunity you can to give outside lectures (and make sure that they are good lectures!); attend relevant conferences, and get to know the other groups worldwide, who have similar interests. I have only gained by being open in discussion with other people of similar interests.

Second, take time, regularly, to evaluate your research and see where it is taking you. This may cause you to change direction or emphasis and open up new lines of enquiry. Research in chemistry is like a never-ending game of search and discovery, played out according to complicated chemical rules. I still find it fascinating.

References

1 A translation of a Japanese biography of Williamson is available for free from UCLPress (uclpress.co.uk): Alexander Williamson, A Victorian chemist and the making of modern Japan, by Takaaki Inuzuka and translated by Haruko Laurie. UCLPress, 2021. ISBN: 9781787359314

2 UCL Chemistry Department, 1828-1974, by Alwyn Davies and Peter Garratt. Science Reviews 2000 Ltd., 2013. ISBN 9781900814461. All copies of the book have been sold but Alwyn would be pleased to email anyone who is interested a pdf copy of the proof. (a.g.davies@ucl.ac.uk)



Aisha Mumtaz is a PhD student in Dr Bob Schroeder & Dr Rebecca Ingle’s groups working on the synthesis of chiral, organic semiconductors and the investigation of their photoinduced behaviour with ultrafast spectroscopy techniques, for photocatalysis and photothermal therapy applications.

Sustainability



the theory & the practice

Enjoying our standard of living whilst minimising our adverse impact on the environment lies at the heart of sustainability. Chemistry as a subject tends to have a pretty bad reputation when it comes to environmental issues and there are huge pressures to clean up our act. Here in UCL Chemistry we are taking on this challenge from the viewpoints of environmental mitigation, new technologies and a fundamental knowledge of how chemistry operates in or interacts with the environment. The research themes of “Chemical Sustainability” and “Chemistry of the Environment” overarch our efforts, some of which are highlighted in the student articles and interviews of staff involved in sustainability, in this newsletter.

From a mitigation aspect, we are looking to understand what happens to pollution of any form, to land, oceans or the atmosphere. The well-publicised problems of plastic degradation and the pervasiveness of microplastics throughout the environment are ones of organic mechanisms, the combination of chemistry with metabolism and even phase separation. Similarly, the issues of atmospheric pollution, poor air quality, ozone depletion (or formation) and the budget of greenhouse gases rely upon solar interactions with molecules – photolysis, free radical chemistry and kinetics. We can only understand and act on environmental problems if we truly understand their provenance. This requires fundamental studies back in the laboratory, but also field observations of chemical change in the real world, requiring sensor technology and careful analytical measurements.

Humankind’s constant quest for energy is

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another key driving force. There’s a lot of energy in chemical bonds and realizing this through the development of new battery chemistry and technology, highlighted here, is essential. Other sustainable energy sources such as Solar require fundamental understanding of energy states of excited molecules and the very nature of known and new materials designed to optimize the collection of solar energy, using computational and experimental methods. Even the basic thermodynamics of phase change can also be exploited to our benefit, if we know what is happening on a molecular level. Aside from our fundamental research we are also examining our own impact. But for all our good, long-term intentions, we need to look hard in the mirror and think about the energy and resource intensity of our activities. If there is one thing that we have learned this summer, is that climate change is become an ever more potent threat here in the UK. Our emissions should therefore be considered as being a health and safety issue, even if not on the usual chemistry laboratory timescale. Chemistry is a power and resource intensive activity, but these requirements can be reduced by working smarter without compromising safety. In the UCL Chemistry ‘living lab’ project we are looking at safely reducing the energy consumption from fume hoods, solvent usage and even water consumption, all of which reduce our environmental impact. The LEAF project, highlighted here, aims to make all of our laboratories more sustainable.

We are also committed to embedding sustainable and environmental principles throughout our taught and laboratory courses at undergraduate and postgraduate (taught) level: from our first year air pollution monitoring in schools project through to final year optional modules including atmospheric chemistry, green chemistry and CO₂ capture. Finally, getting the message across – communication is vital and we disseminate to schools, science societies and the wider media.

Today’s world
is manifestly
different,
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compromised

Last century saw chemists (and others!) promise a utopian future, embodied in the slogan “Better Living Through Chemistry”, an abundance of fossil fuels and little regard of the eventual consequences of polluting our planet. Today’s world is manifestly different, our environment is already compromised and on a path to more change. Chemistry now has the task of rising to this challenge, through fundamental and applied research and equipping the next generations with the knowledge to understand and react to the future, whatever that might bring. Enjoy these highlights of some of our current sustainability research activities.

Dr David Rowley, Senior Lecturer in Physical Chemistry



Recycling with Nature

I had the pleasure of speaking to one of the academics in the Chemistry Department, Professor Helen Hailes (pictured below right), who has been with us for nearly 28 years. Helen has a very busy summer schedule so many thanks Helen for setting aside two mornings to speak with me!



Helen was interviewed by 3rd year Chemistry student Lulu Kwan, who is currently on her year abroad, studying at Caltech.

Helen's journey to becoming an academic at UCL began during her PhD at Cambridge and postdoctoral position at Imperial College London. Specialising in biosynthesis, which is the understanding of how organisms make molecules, she spent a lot of her early research career carrying out experiments in the laboratory, as well as doing small group teaching and laboratory demonstrating. Her subsequent enjoyment of teaching during her PhD and applying synthetic skills to biosynthetic problems led her to look for jobs in academia and to her arrival at UCL some 28 years ago!

The pragmatic and investigative approach from her earlier biosynthetic work led to her interest in biocatalysis, and Helen has worked in this area of chemistry for several years. She has also focused on designing lipids for delivery applications, particularly for gene delivery. Her research on the use of biocatalytic enzymes as a sustainable method in synthesis has included work on transketolases, transaminases, decarboxylases and norcoclaurine synthases. She has more recently extended the use of enzymes for breaking bonds, as well as making them.

The field of biocatalysis lends itself well to collaborating with others to work towards a larger problem, which is more achievable with a larger skillset. In particular, Helen is working closely with the Plastic Waste Innovation Hub, which has "a multidisciplinary team of researchers, including scientists, engineers, designers, and social scientists, taking a design-led approach to the issue of plastic waste."^[1] The Plastic Waste Innovation Hub was established about 5 years ago to investigate approaches to degrade or recycle plastic waste, with initial research grant funding. Helen and the team were able to work on the multi-disciplinary task of designing and optimising plastic degrading enzymes, including PETases which can breakdown PET plastic for molecular recycling. Developing new enzymes involves the use of several approaches, but developments in, for example, bioinformatics, metagenomics, and molecular and synthetic biology mean the process is now much more rapid. In recent work, the team have generated very cool enzyme mutants, and are exploring the mechanism of action as well as capabilities.

Helen was very excited to share her recent enzyme discovery project which started at home during Covid lockdown and involved feeding a hot bin with compostable plastics such as PLA, PBAT, and biodegradable teabags which contain PLA. She explains that the teabags broke down over time, and they have now discovered microbes which can break down PLA. The microbes have now been successfully transferred into vials in the lab in order to carry out further research and identify the enzymes involved. Helen has been supervising PhD students on projects relating to this area.

As the new enzyme degradation systems can be quite innovative at times, Helen stresses that one important task is to also engage with the public and one example of this is the 'Big Compost Experiment'^[2] set up by the Hub. The Hub has also been focusing on ways to advise the public on how to deal with plastic waste, by creating relevant content broadcasted in the media, and by publishing books.

How to recycle waste textiles is a challenging problem of increasing concern as most ends up in landfill. Helen is also looking at microbial and enzymatic solutions to tackle this. Another exciting project she is involved in is the use of machine learning and cameras to enable the separation of plastic waste streams in the waste depot.

Students can look forward to the opening of the UCL East campus this year, which is a significant investment from UCL to build a new campus on the Queen Elizabeth Olympic Park, together with £100 million of funding from the government. Helen has been particularly involved in both proposing and developing the Chemistry Department activities in the Manufacturing Futures Lab -MFL- in the new Marshgate building on the campus. MFL is an interdisciplinary laboratory, which includes mechanical engineering, chemical engineering, biochemical engineering, and chemistry. The interdisciplinary nature of the laboratory will be essential when working on new challenging strategic projects where chemistry is one component of a sustainable manufacturing future. Helen has been leading the design of the new MSc in Chemical Sustainability starting in 2023, which will provide

exceptional training in chemical and biological molecular assembly using methods that have a low environmental impact.

The research quality in the chemistry department at UCL has been recently acknowledged by the Research Excellent Framework 2021 assessment. UCL Chemistry was ranked 3rd nationally for their 4* research submissions and joint 1st for 4* and 3* submissions. As Director of Research during this period, Helen has been significantly involved over the past couple of years in the selection of work for submission, together with colleagues. The results are important as they are used by the UK higher education funding bodies for the allocation of funding for research.

Collaboration with others to achieve a bigger goal is something that Helen thoroughly enjoys, and she encourages chemists who are looking to go into chemical sustainability to take on interdisciplinary projects, as chemistry alone as a discipline cannot solve everything. Continuing to share some of her thoughts on doing research, she reminds us to do things we really enjoy, to not be afraid to take on big challenges, and that although many things won't work how we may want them to, there will often be some nuggets amongst them that do! She ends with the reminder that early career researchers should look at balancing both big and challenging projects as well as smaller more tractable endeavours when starting their research careers.



LEAF

Laboratories working for a sustainable future

It's estimated that laboratories are responsible for around 2% of global plastic waste and use 3-10 times more energy per meter squared than a typical office. The LEAF (Laboratory Efficiency Assessment Framework) programme is a certification scheme that encourages labs to take action to save plastics, water, energy and other resources. Developed by Sustainability UCL, LEAF is now helping to advance sustainability in labs across the world, with more than 70 global research institutions now taking part. Labs are awarded either bronze, silver or gold depending on the number of sustainable actions have been achieved.

Fourteen labs in Chemistry have applied for LEAF accreditation and to date 5 labs have been awarded bronze, with one silver and one gold achieved.

Dr Helena Wong, Senior Technician, and Hannah Shalloe Chemistry Laboratory Technician achieved gold for the undergraduate physical chemistry Graham Lab. Helena and Hannah had to achieve a maximum number of sustainability actions in areas of Waste, People, Sample and Chemical Management, Equipment and Ventilation. Some examples of this include the lab switching from single use plastic pipettes to glass pastuer pipettes, glass weighing funnels and reuse of disposable cuvettes which has resulted in massive reductions in waste. An in-person induction on sustainable practices is now a prerequisite to working in the Graham Lab. All chemicals are catalogued, redundant chemicals are offered to the rest of the department and a practice of repurposing excess solutions has been implemented. Equipment is always turned off immediately when not in use, the fume cupboard is serviced annually, and when not in use the sashes are always closed.

Dr Kris Page Laboratory Manager in the Materials Chemistry Research Centre achieved a silver award for the 3rd floor inorganic labs. Kris has found that engaging with LEAF has had a positive impact within the research labs, and said that this has been 'an opportunity to step back and look at how things are done in the lab and see how you can improve both energy efficiency as well as improving the working environment for researchers.

The hope is that the LEAF programme will encourage labs to engage with sustainable practices and make their contribution towards a greener environment.

References

[1] Plastic Waste Innovation Hub, <https://www.plasticwastehub.org.uk>, (accessed 9 August 2022).

[2] Big Compost Experiment, <https://www.bigcompostexperiment.org.uk>, (accessed 17 August 2022)

Sustainable Battery Research for the Future

Sustainable chemistry is all about finding less toxic and environmentally benign chemicals to meet our needs. At UCL Chemistry, several research groups are working on ways to help us achieve Net Zero carbon emissions, including developing new materials for sustainable energy, better ways of making chemicals and recycling plastics. Dr Harsh Bhatia talks to the people behind this cutting-edge research.

Nowadays, we are always surrounded by umpteen electronic devices like smartphones, earphones, smart watches, laptops and motor vehicles. All of these sophisticated 21st century devices require energy to perform the required tasks. This energy is stored in the form of electricity in the small rechargeable batteries. Since their discovery more than 200 years ago, batteries have travelled a long path in terms of their size and efficiency. However, the essential components in a battery are still similar: an anode, a cathode, and an electrolyte. However, each component suffers from its own issues which affects the performance and sustainability of a battery cell as a whole. We see how UCL researchers are working together to revolutionise battery materials and cell design.

Lithium Alternatives

The group of Dr Yang Xu, who works in the field of fundamental materials chemistry, has received two EPSRC grants to develop new battery chemistries based on potassium ions. One of the grants investigates new intercalation anode materials for potassium-ion batteries (PIBs) through utilising materials with attractive crystal structures and designing structural defects. The other grant looks at a whole new way of making batteries – ‘anode-free’ PIBs. The cathode material in this new class of batteries will be made from sulfur - a cheap, earth-abundant element and the byproduct of industrial processes. He envisages that the success of this project would reduce the involvement of toxic and expensive transition elements (these include cobalt, manganese, nickel, copper) from the batteries thus making them cheaper and greener. His group members are working on changing each of the major components of the battery. Charlie Nason, a PhD student in the group, very eagerly describes his work which involves the investigation of novel materials for the anode. He mentions that the PIBs are far from commercialization due to issues around the battery stability, capacity and performance. To overcome these issues, his research is based on the study of potassiated titanium-niobium oxide (KTiNbO_5) as a new anode material. He expects that the sluggish performance of the PIBs can be improved with this material, while giving the batteries high power outputs. He further adds that both titanium and niobium are inexpensive and abundant metals and would be a better alternative than lithium and other current choices.

At the same time, a PDRA Dr Ajay Priya works to improve the diffusion of K-ions in new electrode materials. She creates defects

in the anode to boost the storage capacity of the battery and enhance the movement of the K-ion, in order to overcome the diffusion difficulty caused by the large size of K in comparison to Li. Additionally, she utilizes a number of spectroscopic characterization tools, including both *in situ* and *ex situ* tools, to understand the storage mechanism of K-ion in transition metal oxide and sulfide based electrode materials. Perhaps soon, thanks to the work of this team, it will be K-ion, rather than Li-ion, running inside our devices.

Sustainable Development

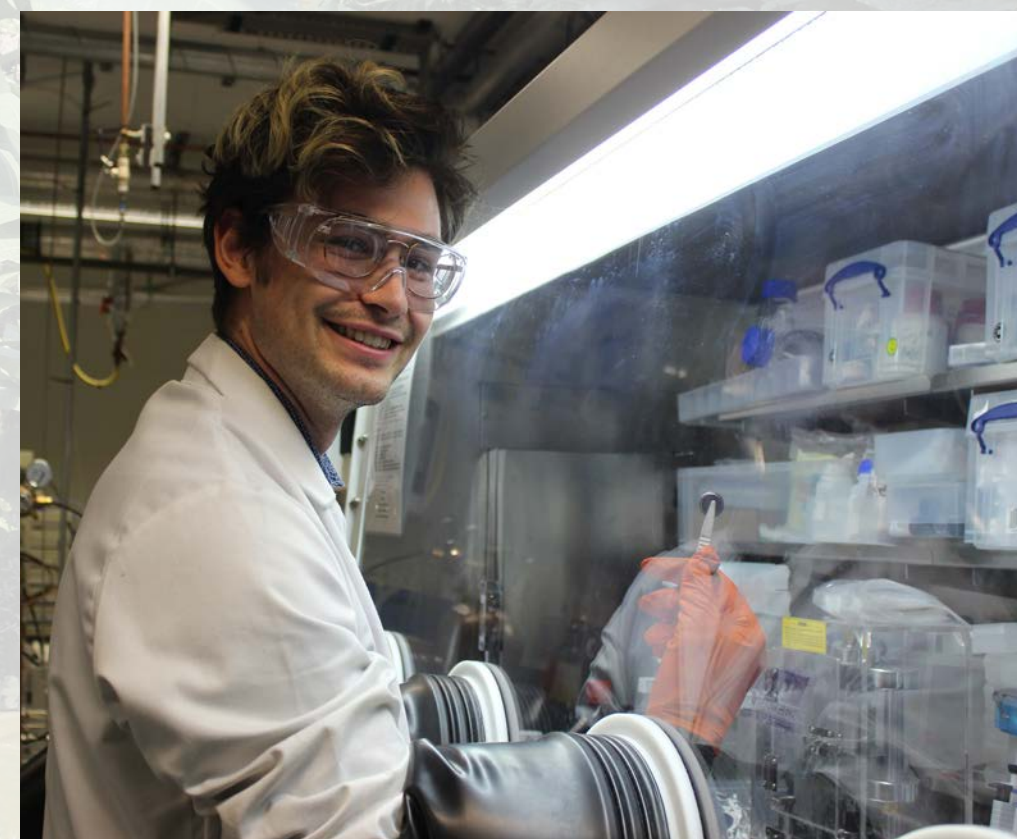
A key part of improving how batteries work is to understand how charges move through a battery cell. Professor Katherine Holt studies this fundamental electrochemistry feature at the interface of electrolytes and electrodes using infrared spectroscopy. Being a spectroelectrochemist in the department, she investigates the materials synthesized

in the labs of Dr Yang Xu and Prof. Jawwad Darr with the spectrophotometers available in her lab. While sharing her recent results, she describes how the concentration of ions in an electrolyte plays an important role to get the best output from the batteries, as exemplified by her investigation on the fundamental properties of water-in-salt electrolytes and their interfaces with solid electrodes. Apart from Professor Holt's work on finding green electrolytes, Prof. Jawwad Darr and Prof. Ivan Parkin are working on find green and sustainable electrode materials.

Exploring a different front of electrolyte research, Dr Avishek Dey in the group of Prof. Robert Palgrave has been designing novel ionic liquids as a new type of electrolyte, as they have higher conductivity and wider electrochemically stable voltage window than conventional electrolytes. In addition, he utilizes his expertise of *in situ* electrochemical photoelectron spectroscopy to understand the behaviour of these liquids interacting with the surface of solid electrode materials, opening up an important avenue to investigate ionic liquids for which much knowledge is lacking in current research.

The discovery of new battery materials and the acquisition of the understanding of battery chemistries are being greatly accelerated by computational chemistry in an unprecedented speed. Prof. Furio Cora and Prof. David Scanlon are the key enablers for such kind of work, contributing significantly to the field. What is even more fascinating is that their works reveal the electronic and

Meet Post doc Dr Ajay Piriya (Top right) and PhD student Charlie Nason (bottom) from Dr Yang Xu's lab. Ajay is photographed here attaching PIB coin cell batteries to battery cycler, which measures battery response/performance over the time and gathers different battery parameters like storage capacity, cycle life during charge/discharge cycles. The real-time monitoring of the battery performance can be visualized using the computer interfaced with the battery cycler. Charlie is busy creating coin cell PIB batteries, which are produced within a glove box for safety.



structural properties of batteries materials, as well as the structure-performance relationship, at the depth that effectively directs experimental chemistry for new battery materials discovery and optimisation. These studies of sustainable battery materials

from the points of view of material chemists, spectroscopists and computational chemists are just among many ways that UCL Chemistry is working to develop novel energy technologies to contribute achieving the Net Zero emission target.

Meet Dr Daniele Castagnolo

Daniele Castagnolo joined the department in January 2022 as Associate Professor in Chemical Sustainability. Once settled, Daniele quickly set to work on furnishing Chemistry's new premises at UCL East as well as developing the new masters programme in Chemical Sustainability ready for 2023. PhD student Alberto Ristache fought his way through 100s of stacked boxes of unpacked new equipment to meet with Daniele for an informal chat and to find out exactly how Italian our new academic staff member really is.



Daniele was interviewed by Alberto Ristache, 4th year Chemistry MSci student whose research focus for his MSci year is self-healing organic semiconductors in Dr Schroeder's group

Any culture shock on arrival at UCL?

Before moving to UCL, I was working at KCL and, in terms of organization, UCL and KCL are very similar. The main difference for me is that at KCL I was working in the Institute of Pharmaceutical Science as part of the division of Pharmacy while at UCL I am in the Chemistry Department. Being an organic/synthetic chemist, I find this environment more suitable for the research I am doing.

How heartbroken will you be to leave old Christopher Ingold Building for flash new shiny freshly painted brand new offices/labs at UCL east.

The new building at UCL East is amazing, the labs are new and spacious. At the moment we are in the process of buying a lot of new equipment and we are looking forward to working in the new labs. One of the most exciting things about moving in the new building for me, is that also PIs and researchers from biochemical engineering and other non-chemistry disciplines will have their labs established there, creating an interdisciplinary and stimulating research environment that may lead to new exciting research ideas

What are the goals of the new master's program you are designing?

The new master's program will be in sustainable chemistry. Sustainability is the key word of this historical time as, today, we need to think a different way to live in our world and in the society. This is also about chemistry as we need to do chemistry in a way that is more sustainable than before, minimizing or avoiding chemical pollution and excessive chemical waste. This is what we want to teach in the Master's degree and we aim to train the next generation of students in doing chemistry in a more environmentally friendly way. As an example, we will teach them how to carry out chemical reactions using "green" catalysts, like enzymes, or benign solvents like water, minimizing the use of other petroleum-based solvents. Also we want the student to understand that the concept of sustainability is not referred only to the environment but it takes into account also economic and social aspects which are

crucial in the development of chemical processes, especially the industrial ones

Any anecdotal moments in the lab, or silly mistakes that a student has done?

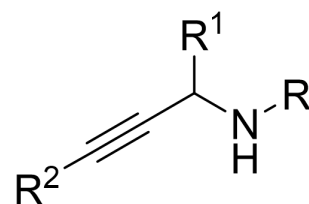
"Normal" things such as some fires in the lab, but since I was a student there has been an enormous improvement in lab safety and these incidents are less frequent nowadays (fortunately).

One of the most memorable excellent moments in your career?

For sure one of the moments that most influenced my life was to move to UK and join and work with Jonathan Clayden, who I suppose every chemistry undergraduate has heard of, and who has been inspirational for me.

Do you have a favorite molecule?

Propargylamines. It is the first class of compounds I worked on when I was an undergraduate student and you can still do nice chemistry with them!



What is a chemical tool that you wish that chemist used more?

I think biocatalysis should be used more often in chemical synthesis.

What is the most important question in (organic) chemistry today?

Can we do the same chemistry we used to do 40 years ago in a more environmentally friendly way? Instead of developing new reactions, why not to focus on the optimization/modernization of some of the existing chemical reactions and try to make them more sustainable?



Left: Daniele's Group photographed in the UCL Quad
Bottom: Daniele at UCL East
Middle: Daniele and family



How Italian is Daniele?

Pizza or pasta?
Both

Rome or Milan?
Born in Rome, but I'd prefer to live in Milan

Napoli or AC Milan?
Juventus!

Mountain or sea?
I'm more a sea person, but I love both.

Rosso or Bianco?
Rosso, Bianco and Verde (red, white and green the Italian flag)



Obituary

Paul Francis McMillan 1956 - 2022



Paul was an outstanding scientist, colleague, and teacher who joined UCL and the Royal Institution as Professor of Solid State Sciences in 2000 and has held the Sir William Ramsay Chair of Chemistry since 2008. Scottish by birth, he was an undergraduate at the University of Edinburgh where he supplemented his grant by playing in a band; he retained a love of music throughout his life. He did his PhD at Arizona State University. His brilliance was such that he was hired onto the academic staff shortly after gaining his degree. His primary interest was in the study of matter under extremes of temperature and pressure for which purpose he used diamond anvil cells and multianvil presses. His work was extraordinarily broad taking in fundamentals of geochemistry, the study of pressure-induced amorphisation and the quest for liquid-liquid phase transitions, Raman and optical studies of materials under high pressure and, in recent years, electrochemistry, energy conversion materials, the study of proteins, bacteria and small invertebrates at high pressure.

Paul was involved in a huge range of collaborations which took in computational chemists, chemical engineers, battery scientists, physicists of the

nanoscale, cell biologists and veterinarians. Over his career he contributed to almost 500 research articles including some which are landmarks. He was also an enthusiastic teacher and mentor who thought deeply about how to convey complex ideas to students. He also had strong views about what and how we should teach chemistry and science more widely. Paul loved football, playing for an hour one evening a week with colleagues until just before the pandemic struck. Paul had a great love of France having spent time as a visiting professor in Nantes and Rennes, and enjoying summers walking in the mountains around his beloved Grächen with his wife Mary-Claude to whom we wish to express our deep sadness and condolences at his passing.

On Friday 10 June 2022, the department celebrated Prof Paul McMillan legacy and scientific contribution by holding a one-day symposium that presented new developments in some of the many disciplines that reflect Paul's diverse interests.

A group of Paul's friends, collaborators and former students presented a series of short presentations that showcased new developments in several different fields. Paul's PhD supervisor and colleague Prof. Alexandra Navrotsky from Arizona State University spoke on New Worlds, New Chemistry. Prof. Navrotsky also gave a

seminar to the department the evening before on Organics Matter: Common Features in Energetics of Polymer Derived Ceramics, Metal Organic Frameworks, and Other Hybrid Materials.

The day was organized by Dr Fabrizia Foglia, EPSRC Fellow and was well attended by ~60 with many more joining in online. Fabrizia is pictured here at the end of her presentation on Disentangling water, ion and polymer dynamics. Afterwards participants gathered in celebration in the Nyholm Room and were treated to Fabrizia's home made Cantucci.

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Grants

Investigators: Dr Tim Hele & Dr James Attwater
Title: University Research Fellowship Enhanced Research Expenses 2021
Sponsor: Royal Society
Value: £121,988.32 & £168,969.00 respectively
Period: 2021-2023

Investigator: Professor Peter Coveney
Title: Virtual Human Cardiovascular Modelling & Simulation
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Investigator: Professor Peter Coveney
Title: Software Environment for Actionable & VVUQ-evaluated Exascale Applications
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Title: Development Of XRF-CT/Fluorescence Microscopy 3D Correlative Imaging to Study Zeolite Structure
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Investigator: Professor Gopinathan Sankar
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Investigator: Professor Jawwad Darr
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Investigator: Professor Steve Price
Title: Heterogeneous Radical Chemistry
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Period: 1 Oct 2021 to 30 Nov 2022

Investigator: Dr Rebecca Ingle
Title: Wellcome Trust - Wellcome Institutional Strategic Support Fund (ISSF3) – Restarting Research Award
Sponsor: Wellcome Trust
Value: £15,000.00
Period: 1 Nov 2021 – 31 May 2022

Investigator: Dr Yang Xu
Title: Probing the Mechanism of Electrochemically Storing Ca-ions In Materials with Disordered Structures
Sponsor: The Royal Society
Value: £19,913.60
Period: 15 Nov 2021 - 14 Nov 2022

Investigator: Professor Scott Woodley
Title: Particles At eXascale on HPC (PAX-HPC)
Sponsor: EPSRC
Value: £3,041,190.55
Period: 1 Dec 2021 - 30 Nov 2024

Investigator: Dr Giorgio Volpe
Title: Contactless Droplet Manipulation for Highly Aligned Organic Semiconductors
Sponsor: EPSRC
Value: £941,347.68
Period: 1 Jan 2022 – 31 Dec 2024

Investigator: Professor Helen Hailes
Title: Novel Sustainable Manufacturing Technologies for Efficient Utilisation Of Agricultural Waste Streams In A Circular Economy
Sponsor: ESPRC Lead: Professor Gary Lye F47 Biochemical Engineering
Value: £241,302.20
Period: 1 Jan 2022 - 31 Dec 2024

Investigator: Dr Fabrizia Foglia
Title: Advanced neutron scattering techniques to understand and improve performance in membrane nanotechnology
Sponsor: EPSRC Early Career fellowship
Value: £1,233,592.20
Period: 1 Jan 2022 - 26 Dec 2026

Investigator: Dr Gi-Byoung Hwang
Title: Wellcome Trust – Institutional Strategic Support Fund (ISSF3) – Restarting Research Award
Sponsor: Wellcome Trust
Value: £19,999.77
Period: 1 Jan 2022 – 30 Sep September

Investigator: Dr Rebecca Isaksson
Title: Wellcome Trust – Institutional Strategic Support Fund (ISSF3) – Restarting Research Award
Sponsor: Wellcome Trust
Value: £19,538.47
Period: 1 Jan 2022 – 15 May 2022

Investigator: Professor Ivan Parkin & Professor Claire Carmalt
Title: A Durable and Scalable Anti-soiling Coating for Solar Modules
Sponsor: EPSRC
Value: £453,318.01
Period: 26 Jan 2022 – 25 Jan 2025

Investigator: Dr Rebecca Ingle
Title: Ultrafast Electronic Spectroscopy as A Process Analytical Technology
Sponsor: Analytical Chemistry Trust Fund
Value: £30,000
Period: 1 Feb 2022 - 1 Jul 2023

Investigator: Dr Gemma-Louise Davies
Title: Targeted Multifunctional Nanocarriers for the Treatment and Diagnosis of Hepatocellular Carcinoma
Sponsor: Royal Society of Chemistry

Value: £9908.42
Period: 1 Feb 2022 – 31 Jan 2023

Investigator: Professor Peter Coveney
Title: An Open Competition of Generative Methods for AI-guided Drug Discovery
Sponsor: EPSRC
Value: £35,604.00
Period: 21 Feb 2022 – 30 Jun 2022

Investigator: Dr Yang Xu
Title: Developing High-capacity Composites as Na-ion Battery Anodes
Sponsor: The Royal Society
Value: £24,422.62
Period: 1 Mar 2022 - 28 Feb 2023

Investigator: Dr Daniele Castagnolo
Title: Evolving cyclopropane fatty acid synthase enzymes into biocatalysts for the synthesis of cyclopropane containing drugs and chemicals
Sponsor: Glaxosmithkline Research and Development Ltd
Value: £30,750.00
Period: 1 Mar 2022 - 30 Sep 2025

Investigator: Dr Fabrizia Foglia
Title: Advanced Metrology for Polymer Electrolyzers - AMPERE
Sponsor: EPSRC
Value: £252,571.01 (£0.00 to Chem)
Period: 1 Apr 2022 – 30 Sep 2023

Investigator: Professor Alethea Tabor
Title: Interrogating the nisin:lipid II interaction: a chemical biology approach
Sponsor: EPSRC
Value: £759,212.97
Period: 1 Apr 2022 - 31 Mar 2025

Investigator: Professor Richard Catlow
Title: Predictive multiscale free energy simulations of hybrid transition metal catalysts
Sponsor: EPSRC
Value: £834,868.92
Period: 1 May 2022 - 30 Apr 2026

Investigator: Professor Jawwad Darr
Title: Scale-up Manufacturing of Next Generation Ultra-High Power Li-ion Cathodes
Sponsor: Faraday Institution
Value: £128,328.42
Period: 1 Jun 2022 - 30 Jun 2023

Investigator: Professor Helen Hailes
Title: Lipid and Peptide Synthesis for the Delivery of Therapeutics
Sponsor: 4basebio UK Societas
Value: £120,000.00
Period: 1 Sep 2022 - 31 Aug 2026

Investigator: Dr Yang Xu
Title: “Free-from”: transition metal-free and anode-free potassium batteries
Sponsor: EPSRC
Value: £255,475.15
Period: 1 Oct 2022 – 30 Sep 2024

Investigator: Professor Sally Price
Title: Kinetically accessible CSP landscapes for pharmaceuticals
Sponsor: Pfizer Limited
Value: £40,909.09
Period: 1 Oct 2022 – 30 Sep 2025

Investigator: Dr Giorgio Volpe
Title: Fluid Antenna Systems For 6G
Wireless Communications: Implementation, System Optimisation and Theoretical Analysis
Sponsor: EPSRC
Value: £89,497.58
Period: 1 Oct 2022 - 30 Sep 2026

Investigator: Dr Adam Clancy
Title: Understanding Charged Interfaces at The Nanoscale with Designer Nanomaterials
Sponsor: The Royal Society
Value: £627,216.36
Period: 1 Oct 2022 - 30 Sep 2027



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A big thank you to all the kind people who have supported the department directly to help us to build on our international reputation for teaching, research, and to make a range of exciting activities possible. Your kind contributions have a direct impact upon our students and staff, and we are very grateful for it. We continue to provide an excellent education and training environment for undergraduate and postgraduate students in Chemistry and all staff are developing innovative methods to inspire and instruct. It is great to know that we have your support and assistance as we work to do this.



If you have an item for next year's newsletter we would love to hear from you. Are you a UCL Chemistry student and interested in writing for the annual news? Please email l.mcseveny@ucl.ac.uk