THE WINTON PROGRAMME FOR THE
Physics of Sustainability

WINTON-KAVLI
WORKSHOP
2023

Winton-Kavli Workshop

Cambridge and Rutland Water, UK
10 to 14 July 2023

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Welcome to the Winton-Kavli Workshop

Hi! I'm Lata, Programme Manager for the Winton Programme here at Cambridge. I'm really excited to see you all at the Winton-Kavli Workshop in July. Please contact me with any questions relating to this event. If it's an emergency, it's faster to call or Whatsapp me on the number below. For USA students, my Berkeley Programme Manager colleague, Negest Williams, will also be at the workshop, so please don't hesitate to ask her anything. Wishing you all a really productive workshop!

Main Organiser:

Dr Lata Sahonta (Winton Programme Manager)
She/they
Email/Teams sls55@cam.ac.uk
Phone/Whatsapp +445780002531

Berkeley Organiser:

Negest Williams (KavliENSI Programme Manager)
She/her
kavli-ensi@berkeley.edu

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Aims of the Winton-Kavli Workshop

This joint Cambridge-Berkeley Workshop aims to:

- Develop collaborative links between students at the Berkeley Kavli Energy Nanoscience Institute and students studying topics under *Physics of Sustainability* at the University of Cambridge
- Offer training in a wide variety of research skills e.g. journal paper writing, grant proposal writing, fellowship applications, presentation of work to different audiences e.g. industry, investors, government.
- Get an insight into careers in academia, industrial R&D, spin-outs and science policy

Cambridge Faculty Organising Team
Professor Siân Dutton
Professor Akshay Rao
Dr Helena Knowles
Dr Chiara Ciccarelli
Dr Bartomeu Monserrat
Dr Robert-Jan Slager

Berkeley Faculty Attendees
Peidong Yang – symposium only
Naomi Ginsberg – symposium only
Jeffrey Neaton – symposium only
Joel Moore – symposium only
Felix Fischer – workshop and symposium

Workshop Fellows
Rakesh Arul (Cambridge)
Arjun Ashoka (Cambridge)
Ahyoung Kim (Berkeley)
Katherinne Requejo Roque (Berkeley)
Anthony Poggioli (Berkeley)

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Workshop Programme at a Glance

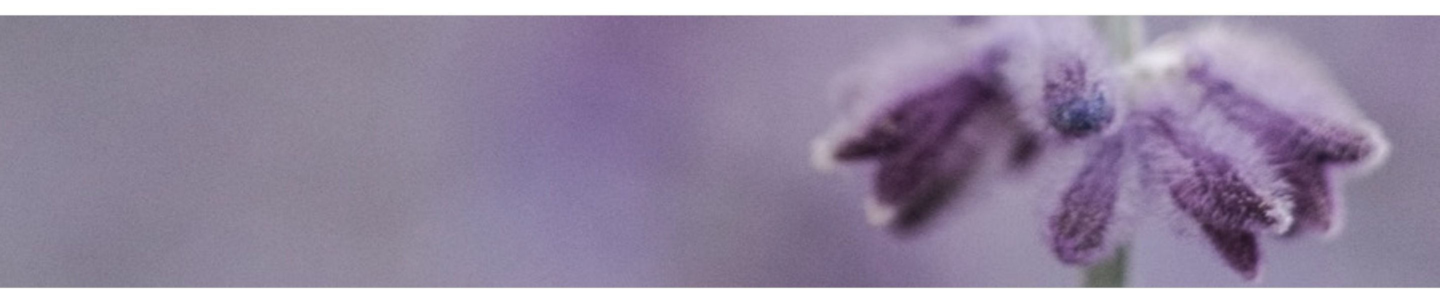
Sunday 9 July
- USA visitors arrive in UK, coach travel for all to Barnsdale Lodge, Rutland

Monday 10 July - Wednesday 12 July
- Workshop Days 1 to 3 (research skills and career development training centred around a USA-UK research collaboration proposal writing competition with travel/research funding for winning project proposers).

Thursday 13 July
- (am) Workshop Day 4 – project judging and prize-giving
- (pm) Coach travel from Rutland to Cambridge, optional lab tours, dinner
- College accommodation for UCB visitors (students in college, Faculty in hotels)

Friday 14 July
- Winton-Kavli Workshop Symposium and poster presentations from all students, followed by dinner in College
- College accommodation for UCB visitors (students/postdocs in college, Faculty in hotels)

Saturday 15 July
(morning) Coach travel to airport for USA students



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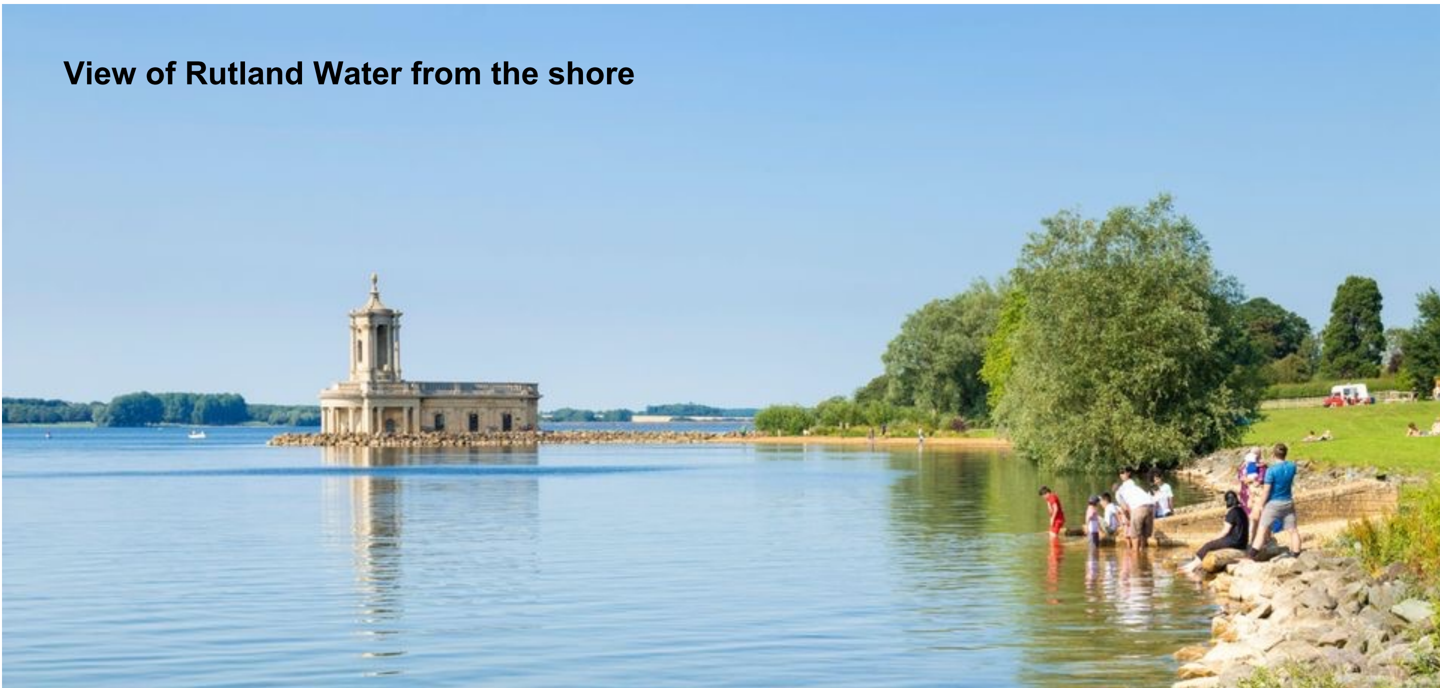
Preparation for the Workshop

Before Arrival:

- All students must prepare a poster pdf to send to Lata Sahonta (sls55@cam.ac.uk) by Monday 12th June for printing. The posters will already be mounted when you arrive for the session will be held at the Symposium on Friday 14 July. (Workshop Fellows: you are very welcome to present three slides if you wish; it's optional for you)

- All delegates must bring with them three slides about their research interests to present to the other workshop delegates. (Workshop Fellows: you are very welcome to present three slides if you wish; it's optional for you)

- I am setting up a WhatsApp students group for this workshop so that Negest Williams and I can communicate with you all easily. Please (after downloading WhatsApp to your phone), add me as a contact on **+447580002531** and send me your phone number so that I can add you to the group. Do this well before the workshop!



View of Rutland Water from the shore

Berkeley Visitors Preparation and Arrival

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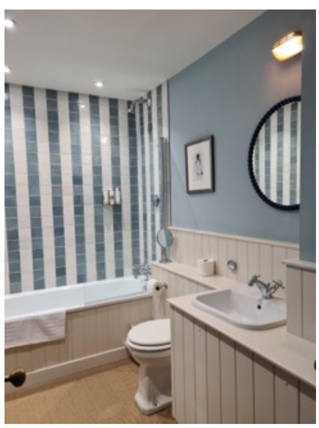
Your accommodation from Sunday 9 July to Thursday 13 July will be at [Barnsdale Lodge], a relaxed boutique hotel near the shore of [Rutland Water], a reservoir around an hour's drive north of Cambridge. Everyone will have individual rooms, each with a double or queen bed. Below are some photos I took when I went there to explore.



During the day there will be workshop activities with working lunches and tea/coffee breaks. Dinners in the evenings will be served in the hotel's restaurant.

Pease let me know if you have any dietary requirements (the food during the day at the workshop will be vegetarian/vegan as standard, due to the Winton Programme's sustainability mission).

Berkeley Visitors Preparation and Arrival

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Travel Details

- For those arriving at Heathrow on Sunday 9 July, Lata Sahonta (sls55@cam.ac.uk) to collect visitors and take them to coach waiting in the Terminal 2 Coach Park.

- For those already in UK, please meet at either Heathrow Airport Terminal 2 Coach Park at 1430, or at Cambridge Cavendish Laboratory reception at 1800. Please let me know your plans so that I can ask the coach driver to wait for you.

TRAVEL FROM AIRPORT TO WORKSHOP (arrival)
Date: Sunday 09 July 2023
Coaches: 1 x 49-seat coach
Pick up Time: Flight UA930 arrives 14:10
Pick-up point(s): London Heathrow Terminal 2 Arrivals gate. **Lata Sahonta to collect group and walk to Coach Park at Heathrow Terminal 2.**
Stop at: Department of Physics, Cavendish Laboratory to collect Cambridge delegates.
CAMBRIDGE DELEGATES: Please be at Cavendish Lab reception at 5pm for coach pickup. I will contact you by Whatsapp to let you know ETA of the coach from Heathrow.
Destination: Barnsdale Lodge, Rutland Water, The Avenue, Oakham LE15 8AH

TRAVEL FROM WORKSHOP TO CAMBRIDGE (end of workshop only)
Date: Thursday 13 July 2023
Coaches: 1 x 49-seat coach
Pick up Time: 14:00
Pick-up point(s): Barnsdale Lodge, Rutland Water, The Avenue, Oakham LE15 8AH
Destination: Round Church Street, Cambridge (the coach cannot park at the accommodation since the lane is too narrow. **Arjun and Rakesh to walk USA delegates from the round church to Wyng Gardens, Thompson's Lane. Lata to walk Negest to Hilton City Hotel.**

TRAVEL FROM CAMBRIDGE TO AIRPORT (end of workshop and symposium)
Date: Saturday 15 July 2023
Coaches: 1 x 33-seat coach
Pick up Time: 05:30 (to arrive for 07:25) **Please note the very early start. Negest to meet students at Round Church 0530am.**
Pick-up point(s): Round Church Street, Cambridge (delegates to walk from Wyng Gardens, Thompson's Lane, Cambridge, CB5 8AQ to the round church to board the coach at 0530)
Destination: London Heathrow, Terminal 2 Flight UA900 departs 10:25

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Workshop and Symposium Full Schedule

Monday 10 July: Workshop Day 1 - Barnsdale Lodge Hotel, Rutland Water

0930 to 1000 Welcome and introduction (Siân, Lata):
- Introduction to the Winton Programme and the aims of the workshop
- Slido poll beforehand to see which careers all delegates are most interested in
- Activity leaders will remind delegates to think about what you want to get out of each activity: training in writing skills, speaking skills, and listening to other researchers

1000 to 1030 Ice-breaker activity (Felix Fischer, postdoc fellows):
students walk around the room completing a fun survey by asking each other questions

1030 to 1100 Pair-Up activity (Felix Fischer, postdoc fellows):
- Everyone is paired up with a student from the other University.
- Task #1: In 3 min the first partner explains their research project to the second partner (i.e. what is the science you are working on and why is it important).
- Task #2: In 3 min the second partner explains back to the first what they understood.
- Repeat Task #1 and #2 with inverted roles.
- Group Discussion: Report on challenges and tricks that you recognized during this exercise. What was good / bad / too complicated / too trivial.

1100 to 1115 Coffee break

1115 to 1200: Pair-Up activity (Felix Fischer, postdoc fellows):
Each pair will have already prepared a 3-min talk about their research. Their partner will present this work to the audience (paired preparation time 10 min, followed by a selection of 3-min talks chosen at random)

1200 to 1300 LUNCH

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Monday 10 July – Workshop Day 1 (afternoon)

1300 to 1530 Collaborative Proposal Prize Launch (Lata):

- Competition: students from both Universities are paired up and develop a collaborative grant proposal based on their combined research interests and expertise, with £1000 travel/software prize for each student in the winning team
- Students discuss each other's research from the researcher profiles, ice breaker activity, and paired activity, to discuss possible collaborative ideas in small groups
- Faculty members act as mentors to teams, and form the judging panel on the final day
- Teams brainstorm project ideas and then report back to the other teams

1530 to 1545: coffee break

1545 to 1645: Talk and Q&A – Dr Helena Knowles, Cambridge

- Research Skills talk

1645 to 1900 downtime, social/outdoor activity

1900 DINNER in hotel

Tuesday 11 July
Workshop Day 2 - Barnsdale Lodge Hotel, Rutland Water

0930 to 1045: Group Discussion (Siân, Lata):
- What is research impact? How to measure your impact besides h-index?
- Breakout groups report back after half an hour of discussion

1045 to 1100: Coffee Break (can be working coffee break)

1100 to 1200: Collaborative Proposal (Lata, with Faculty mentors):
Students start to prepare a 2-page proposal and a 10-minute pitch with Powerpoint, for presentation on the final day (Thursday morning).

1200 to 1300: LUNCH

1300 to 1500: Presentation Skills Activity (postdoc fellows):
- We are all good at explaining our research to other scientists, but what about to other important groups?
- Project pairs verbally pitch (i.e. 5 min with no slides!) their research project idea to policy makers in (1) Congress/Parliament, (2) funders in an NSF/UKRI interview, (3) investors, (4) public e.g. school.
- Encourage the audience to ask questions typical of these groups.
- Final hour is dedicated to presenting pitches

1500 to 1515: Coffee break

1515 to 1615: Careers Talk (Hannah Stern): How to get a Research Fellowship (and what reviewers are looking for in your proposal)

1655 to 1900: downtime, proposal writing, social/outdoor activity

1900: DINNER in hotel

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Wednesday 12 July - Workshop Day 3

0930 to 1030: Collaboration Proposal (Lata)
Students continue to work on joint research proposal, with faculty members as mentors.

1030 to 1045: Coffee Break

1045 to 1200: Fellows' "Ask me Anything" session
This is your chance to ask Anthony, Katy, Ahyoung, Rakesh and Arjun anything you like about their research work, their career aspirations, what they found tough about their fellowship applications, and what science communication tips they recommend!

1200 to 1300: LUNCH

1300 to 1400: Talk (Christoph Schnedermann, Illumion)
A talk from founder of a Cambridge spin-out about Patents, spin outs, and the dos and don'ts of commercialising your research

1400 to 1500: Careers Panel Q&A with panellists (fifteen minutes, a few slides on their career journey)
- Sustainability R&D / Consultancy – Dan
- Policy and Regulation – Bluebell Drummond (UK government)
- Entrepreneurship – Christoph Schnedermann (Illumion)
- Academic research – Siân Dutton, Felix Fischer (UoC, UCB)

1500 to 1515: Coffee Break

1515 to 1615: Careers Panel Q&A
All panellists answer questions about their careers journeys. Fellows and Faculty members can join in with their experiences.

1615 to 1900: downtime, collaborative proposal writing, outdoor activity

1900: DINNER in hotel

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Thursday 13th July – Workshop Day 4

0900 to 0930: Check-out and store luggage/bring to workshop

0930 to 1000: Pitching the Collaborative Proposals (Faculty and Fellows)
- All student teams pitch their 10-min proposal with powerpoint. Q&A from panel. Research proposals handed in.

1100 to 1115: Coffee Break

1115 to 1230: Pitching (contd) followed by Judging (Faculty and Fellows)
- The judging panel will review the 2-page proposals and pitches
- Prize is awarded by panel members to the winning team

1230 to 1330: LUNCH

1400 to 1500: coach travel to Cambridge

1500 to 1600: Check-in (Arjun, Lata)
Students check into Trinity Hall College Accommodation, Wyng Gardens, Thompson's Lane, Cambridge (Berkeley Faculty Members stay at Hilton Cambridge or other local hotel)

1600 to 1700: Optional lab tours

1800: Informal dinner, location TBC

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Friday 14 July 2023

Winton-Kavli Symposium, TRINITY HALL WYNG GARDENS, Thompson's Lane, Cambridge

0930 to 0940
Welcome from Director of Winton Programme, Professor Siân Dutton, University of Cambridge

SESSION I CHAIR: Tijmen Euser, Department of Physics

0940 to 1000
Professor Laura Diaz Anadon, University of Cambridge
"The Role of Policy for Accelerating Energy Innovation towards Net Zero"

1000 to 1040
Professor Peidong Yang, UC Berkeley
"Liquid Sunlight"

1040 to 1110
Dr Alex Forse, University of Cambridge
"Using electrochemistry to capture carbon dioxide"

1110 to 1130
Coffee

SESSION II CHAIR: Sam Stranks, Department of Chemical Engineering

1130 to 1200
Professor Naomi Ginsberg, UC Berkeley
How do energy materials form, transform, and transport energy?

1200 to 1230
Professor Felix Fischer, UC Berkeley
"The Road from Semiconductors to Metals: Engineering Topological States in Nanographenes"

1230 to 1330
Lunch, posters

SESSION III CHAIR: Stephan Hofmann, Department of Engineering

1330 to 1410
Professor Jeffrey Neaton, UC Berkeley
"Nature and fate of photoexcitations in energy materials"

1410 to 1450
Professor Erwin Reisner, University of Cambridge
“Solar Panels for Solar-to-chemical Conversion”

1450 to 1520
Coffee

SESSION IV CHAIR: Robert-Jan Slager, Department of Physics

1520 to 1550
Professor Joel Moore, UC Berkeley
“Quantum Transport: from Theory to Applications”

1550 to 1620
Dr Helena Knowles, University of Cambridge
Talk Title TBC

1620 to 1630
Final remarks from Director of Winton Programme, Professor Siân Dutton, University of Cambridge

1630 to 1830
Drinks, Poster Session for Berkeley and Cambridge participants

1830
Walk to Trinity Hall for dinner at 1900

Useful Information and Phone Numbers

If you get lost:

- Call me, or text the Whatsapp group!
- Please leave your phone GPS location switched on so if you get lost, we can track you with Whatsapp Live location. To share your live location on an Android using WhatsApp, just (1) open our Winton-Kavli Whatsapp chat group (2) select “Share live location” or “Send your current location”, depending on your preference. If you select Share Live Location, you can choose the duration of your location sharing.

UK Emergency Services

- Dial 999 from your phone (this works even if you have a USA phone)
- If you have low/no signal, text 999 (Texts need very little signal and a text will give your location to the nearest emergency services. They will call you and find out what the problem is).

UK train tickets

https://www.thetrainline.com/

UK coach tickets

https://www.nationalexpress.com/en

Cambridge City Taxi Numbers

It is difficult to get an Uber in Cambridge quickly, so if you want an Uber, plan ahead. Uber doesn’t have a monopoly on taxi services in Cambridge city, and the cheapest (and in my experience fastest) is Panther Taxis.

- Panther Taxis 01223 715715
- CamCabs 01223 704704
- Cambridge Airport Taxis 01223 398868

Rutland Water Taxi Numbers

- Berridges 01572 756 088 (accept card payments)
- Meadows Taxi 01572 722 270 (accept card payments)
- Rutland Cabs 01572 757 891

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Appendix:
Delegates research biographies

ALFREDO FLOREZ

Structural characterization of biomolecules, Molecular modeling, single particle cryo-EM, single molecule optical tweezers, biochemical assays.

Alfredo Florez is from Peru and received his B.S. in Chemistry at the National University of Engineering (Lima, Peru), and his M.S. in biophysics at the University of Sao Paulo (Sao Paulo, Brazil). Currently, he is a Ph.D. candidate in Biophysics at the University of California, Berkeley and he is a member of Prof. Carlos Bustamante and Prof. Eva Nogales laboratories. Alfredo's Research is focused on the structural and biophysical characterization of DNA-protein complexes involved in different biological processes such as DNA transcription and mRNA translation involved in gene expression regulation. To perform his research projects he mainly uses single-particle cryogenic Electron Microscopy (cryo-EM) and single molecule Optical Tweezers.

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SHIUN-JR YANG

Ultrafast multidimensional spectroscopy, quantum dynamic simulations, global analysis, lifetime density analysis

Shiun-Jr Yang is currently a 4th year PhD student in chemistry in the Fleming group, where he studies energy transfer dynamics in natural photosynthetic systems. He grew up in Taiwan and received a B.S. and a M.S. in chemistry from National Taiwan University before coming to UC Berkeley. Photosystem II (PSII) is the only natural system that can perform water-splitting. Unlike other photosynthetic systems, photoprotection from excessive excitation is crucial for its strongly oxidizing reaction center components. Yet, PSII must work well under low light conditions to avoid sacrificing energy conversion efficiency for effective photoprotection. To understand how it is able to maintain balance between these two contradictory needs, we study the energy transfer network of this complex system using ultrafast spectroscopy and theoretical simulations. By revealing the design principle of the photosynthetic system, we hope to inspire the development of efficient and durable solar devices.

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AHYOUNG KIM

Characterization, fabrication, Cathodoluminescence, electron microscopy, photoluminescence

Ahyoung Kim is a postdoctoral researcher in UC Berkeley's Chemistry department, specializing in materials science and chemistry. Her postdoctoral work focuses on examining nanoscale luminescent properties of perovskites and other semiconducting materials using cathodoluminescence electron microscopy. In her Ph.D. research at the University of Illinois, Urbana-Champaign, she developed "patchy nanoparticles" and studied their self-assembly dynamics at the nanoscale through liquid-phase TEM. Ahyoung's research has been recognized with several awards, including the Materials Research Society Gold Student Award (2021) and Rising Stars in Soft and Biological Materials (2020). Perovskites hold great potential for enhancing light-to-electricity conversion efficiency and reducing the cost of solar energy technologies, contributing to a sustainable energy system. However, their low stability and limited understanding of local heterogeneities hinder their practical application. To fill this knowledge gap, my research focuses on investigating nanoscale, dynamic luminescent phenomena of hybrid perovskites in presence of heat and light, using in situ cathodoluminescence electron microscopy imaging. By linking chemical structure, morphology, and light emission properties at the fundamental nanoscale, we aim to aid next-generation perovskites with high performance, stability, and reproducibility, accelerating progress towards net zero goals.

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LIWEN KO

Quantum optics, open quantum systems, nonlinear spectroscopy

Liwen grew up in Taiwan and obtained his B.S. in chemistry in 2018 at UC Berkeley. He is currently a PhD student in the Whaley group at UC Berkeley. Liwen's research focuses on the theoretical and numerical studies of light absorption and energy transfer dynamics in natural photosynthesis. Natural photosynthesis operates at a very high quantum efficiency in converting absorbed photons into electron-hole pairs. Therefore a detailed understanding of the energy transfer mechanism in photosynthesis will provide important design principles for artificial photosynthetic systems. We use theoretical tools of quantum optics and open quantum systems to model photosynthetic systems under natural and laboratory conditions. In particular, our studies are coupled to the quantum light spectroscopy experiments performed in the Fleming group at Berkeley, and we are interested in different ways to exploit non-classical properties of light to gain information about the energy transfer dynamics.

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ALEXANDRA GRIGOROPOULOS

Small angle x-ray scattering (SAXS), transmission electron microscopy (TEM), confocal microscopy, dynamic light scattering (DLS), circular dichroism (CD), computational sequence analysis, and molecular dynamics.

Alexandra is from the Bay Area, California. She received her B.S. in Materials Science and Engineering from the University of California, Berkeley, where she is currently pursuing a PhD in the Ting Xu Group. The topic of Alexandra's current work is the self-assembly of random heteropolymers in aqueous environments and at interfaces with biomacromolecules. She aims to use the design rules embedded in natural proteins as a guide to design and optimize bioactive materials, including biodegradable plastics.

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KATHERINNE REQUEJO ROQUE

Colloidal synthesis, Nanofabrication, Surface Modification, Atomic Force Microscopy, High-resolution TEM, SEM, E-beam evaporator, Polymer grafting

Katherinne Requejo Roque received a Ph.D. in Chemistry from Rice University with experience in colloidal synthesis, characterization, and functionalization of nanomaterials. Early as an undergraduate student at PUCP, Katherinne started to developed skills for performing research in the field of material science. Her recent postdoctoral training as a joint postdoc (Alivisatos and Bustamante lab) studying active colloids allowed her to gain experience to develop nanofabrication skills using state-of-the-art equipment at the Molecular Foundry (Berkeley Lab). Currently, as part of the Bustamante research group, which is a leading laboratory in single-molecule biophysics, she has gained important molecular biology skills needed to perform transcription experiments using novel optical probes and nanofabricated devices. As a Peruvian scientist, in addition to the scientific papers she has been able to contribute, she has also been involved in scientific magazines written in her native language Spanish to promote science in young Peruvians. Also, as a PUCP alumni, she has been in contact with several students from Peru who have organized virtual seminars and symposiums in which she has participated to promote chemistry and science. There has been a great interest in developing self-propelled nano/micromotors that can mimic biological motion to answer fundamental questions and target biomedical/environmental applications. Light-powered micromotors are Janus particles that convert chemical energy into motion through mechanisms that need in-depth investigations. Katherinne fabricated Janus particles (Au-TiO_2) using an e-beam evaporator to deposit Au layer on titania cores to evaluate the effect of particle size, metal layer thickness and fuel concentration on the propulsion dynamics. To directly measure the propulsion forces, she synthesized core-shell particles (Au-PS@TiO_2) which can be stably trapped and exhibit the catalytic surface reaction to trigger fuel decomposition.

AIDAN DELGADO

Scanning Probe Microscopy (SPM), Scanning Probe Spectroscopy (SPS), Non,-Contact Atomic Force Microscopy (nc-AFM), On-Surface Synthesis, Matrix Assisted Direct (MAD) Transfer.

Aidan Delgado is a 3rd year Chemistry PhD Candidate in the Fischer group, where he specializes on the applications of Scanning Probe Microscopy (SPM) for electronic and structural characterization of carbon-based nanomaterials. Prior to his time at Berkeley, Aidan received his B.A. in Chemistry from Lawrence University, where he worked with Dr. Graham Sazama synthesizing conductive one-dimensional MOFs. In his free time, he enjoys cycling and running around the Bay Area and hiking with his dog, Charlie. Aidan's research aims at developing a fundamental understanding of the structural and electronic properties of carbon-based nanomaterials. To do so, he utilizes SPM methods (LT UHV SPM/SPS/nc-AFM), allowing him to achieve atomic resolution and explore novel electronic states. Currently, his interests lie in the deterministic control of quantum electronic states in strongly correlated low-dimensional materials. The realization of this disruptive technology will not only reshape the global cycle of energy generation, transport, storage, and conversion, but holds the promise to ring in a new era of low-power high-frequency information processing that scales far beyond the fundamental limits of current semiconductor technology.

BOYU QIE

Wet lab synthesis, On-surface synthesis, Scanning Probe Microscopy, Device Fabrication, Quantum Chemistry Simulation, Periodic System Simulation, Condensed Matter Theory, Machine Learning and AI, Electrochemistry, etc.

Boyu Qie is currently a fourth-year graduate student in Professor Felix Fischer's research group at UC Berkeley, and a graduate student fellow at Kavli Energy NanoScience Institute (ENSI). As a member of the inaugural graduating class in 2015 at the South University of Science and Technology of China (SUSTech), he earned his B.S. in Chemistry with summa cum laude honors. Boyu went on to receive his M.S. in Materials Science and Engineering from Columbia University in 2017. Boyu's current research interests span a range of interdisciplinary fields, combining synthetic and theoretical chemistry, experimental condensed matter physics, and nanofabrication techniques. His work showcases a dedication to integrating diverse scientific disciplines and furthering the understanding of complex materials and their potential applications in clean energy and energy-efficient devices. Boyu Qie is currently a fourth-year graduate student in Professor Felix Fischer's research group at UC Berkeley, and a graduate student fellow at Kavli Energy NanoScience Institute (ENSI). As a member of the inaugural graduating class in 2015 at the South University of Science and Technology of China (SUSTech), he earned his B.S. in Chemistry with summa cum laude honors. Boyu went on to receive his M.S. in Materials Science and Engineering from Columbia University in 2017. Boyu's current research interests span a range of interdisciplinary fields, combining synthetic and theoretical chemistry, experimental condensed matter physics, and nanofabrication techniques. His work showcases a dedication to integrating diverse scientific disciplines and furthering the understanding of complex materials and their potential applications in clean energy and energy-efficient devices.

RAFAELA BRINN

Resonant fluorescence spectroscopy, structural and optical characterization, microscopy (AFM/PFM/TEM), thin film fabrication and growth, nanocrystal synthesis.

Rafaela Brinn is a 4th year Chemistry PhD student at the University of California, Berkeley. She received her B.A. in Chemistry in 2019 from Barnard College where she studied reaction rates of functionalizing graphene using Raman Spectroscopy in the Crowther group. During her PhD, she spent the first few years studying fundamental optical properties of quantum dot thin films in the Alivisatos group and has since shifted to study the emission of rare-earth dopants in ferroelectric oxide thin films as part of the Ramesh group. Rafaela Brinn is a 4th year Chemistry PhD student at the University of California, Berkeley. She received her B.A. in Chemistry in 2019 from Barnard College where she studied reaction rates of functionalizing graphene using Raman Spectroscopy in the Crowther group. During her PhD, she spent the first few years studying fundamental optical properties of quantum dot thin films in the Alivisatos group and has since shifted to study the emission of rare-earth dopants in ferroelectric oxide thin films as part of the Ramesh group.

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ANTHONY POGGIOLI

Molecular dynamics simulation, transport theory, nonequilibrium statistical mechanics, large deviations, hydrodynamics

Anthony earned a BS, MS, and PhD at the University of Washington in environmental engineering with a focus on the theory of stratified, turbulent flows in the coastal ocean. He then completed a master’s and PhD at the Ecole Normale Supérieure in Paris in physics. His PhD research focused on the theory of nonlinear ionic and fluid transport in nanofluidic and angstrofluidic devices. At Berkeley, he works in the Department of Chemistry with David Limmer. His current research is focused on the synthesis of theoretical and simulation techniques to treat problems in nanofluidics and transport in chiral active matter. Anthony earned a BS, MS, and PhD at the University of Washington in environmental engineering with a focus on the theory of stratified, turbulent flows in the coastal ocean. He then completed a master’s and PhD at the Ecole Normale Supérieure in Paris in physics. His PhD research focused on the theory of nonlinear ionic and fluid transport in nanofluidic and angstrofluidic devices. At Berkeley, he works in the Department of Chemistry with David Limmer. His current research is focused on the synthesis of theoretical and simulation techniques to treat problems in nanofluidics and transport in chiral active matter.

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DASOM LEE

Modeling and simulation (simulation tool - sentaurus from synopsys)

Dasom Lee is a 1st year PhD student in EECS, UC Berkeley. She is working with professor Tsu-Jae King Liu. Before she came to this school, she worked in sk hynix for 7 years as a TCAD engineer. She mostly worked on 3D NAND devices. She received her B.S. and M.S. in Materials Science but since she worked on device characteristic analysis, she decided to change her major to Electrical Engineering. She is from Korea and has a husband and 2 year old son. Dasom's research is to study defect-induced noise behavior of advanced MOSFETs, such as FinFETs, at cryogenic temperature to elucidate whether this issue will be mitigated with cryogenic operation of complementary MOS (CMOS) computing integrated circuits (chips) in the future. Noise causes many problems when devices are applied to circuits, which takes a long time to fix the problem. Getting reliable devices is important to elongate the device's lifecycle, thereby not wasting resources. She wants to suggest the best optimized device structure at cryogenic temperature to minimize defect induced noise for a sustainable device.

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2023

EVAN SPOTTE-SMITH

Density functional theory, chemical reaction networks, kinetic Monte Carlo, data science, transition-state theory, Marcus theory

Evan Walter Clark Spotte-Smith (they/them) was born and raised in the suburbs of Baltimore, Maryland. In 2019, they received their B.S. in Materials Science and Engineering from Columbia University, where they performed research on nanoparticle self-assembly dynamics and thermochemical energy storage. Currently, Evan works in the research group of Professor Kristin Persson. They develop methods to interrogate electrochemical reactivity and apply those methods to understand electrolyte degradation and solid electrolyte interphase (SEI) formation in metal-ion batteries. Evan has a passion for mentoring young scientists, and they love cool rocks, smart animals, and tea. Electrolyte decomposition in metal-ion batteries is a major contributor to battery capacity fade and controls the formation of passivating solid electrolyte interphase (SEI) layers. In order to make long-lasting, reliable batteries to replace internal combustion engines in the transportation sector, electrolyte reactivity must be tightly controlled. Evan uses computer simulations - combining quantum chemistry, statistical mechanics, and chemical reaction networks - to predict electrolyte decomposition mechanisms in conventional Li-ion as well as next-generation batteries. From these atomistic insights, they can identify design rules that aid in the development of novel electrolytes and battery charging protocols.

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JINGXU XIE

We mechanically exfoliate flakes on SiO2/Si wafers and use the dry transfer technique to stack the devices. We use photolithography or electron beam lithography to pattern the electrodes. For the electrical measurement, we use both DC or AC methods, with or without magnetic field, and at different temperature from 10mK to 300K. For the optical measurement, we use diode laser to get reflection contrast and photoluminescence spectrum, and we use spatial- and temporal-resolved pump probe circular dichroism spectroscopy to probe the spin-valley information in the sample.

Jingxu Xie is a second-year Ph.D. student working in Prof. Feng Wang's group in the Physics department at UC Berkeley. He received B.S. in physics from Xi'an Jiaotong University in 2021. Jingxu's research is centered around investigating the electronic and optical properties of two-dimensional materials, particularly graphene and transition metal dichalcogenide systems. With a strong focus on developing cost-effective and high-performance devices, his work has potential applications in information processing and optoelectronics, contributing to a sustainable, net-zero future. By utilizing 2D materials and innovative fabrication techniques, Jingxu aims to make these devices accessible to all, thereby accelerating the transition towards a cleaner, more sustainable world.

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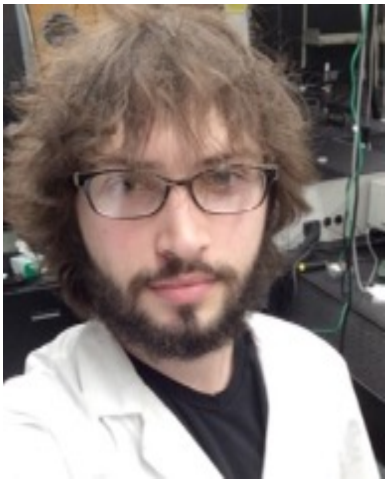

ALEX ODDO

Perovskite, nanocrystal, microscopy, spectroscopy, photophysics, synthesis, NMR

Alex is a 3rd-year graduate student in the group of Peidong Yang at the University of California, Berkeley. He received his Bachelor's and Master's degrees in chemistry from the University of Connecticut in 2020. Alex enjoys research involving materials for energy conversion, and likes to eat, sleep, and relax in his downtime. Perovskite semiconductors are promising candidates for a variety of optoelectronic devices, such as solar cells. Alex's work involves the synthesis and characterization of cesium lead bromide perovskites, with the goal of fundamentally understanding how the semiconductor structure, morphology, and size govern their photophysical properties, such as bandgap, photoluminescence quantum yield, charge carrier lifetime, and the interplay of the phonon coupling. Alex is specifically interested in how these properties present themselves in confined perovskite nanowires as compared to the traditional nanocrystal.

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Lars van Turnhout

My PhD explores the fundamental electronic and spin interactions in hybrid organic – lanthanide-doped nanoparticle systems and aims to deliver a new method for the control of spin-1 triplet excitons, beyond what is possible with current heavy-metal complexing or TADF methods. We aim to establish structure-function relationships and a comprehensive mechanistic understanding of spin-exchange coupling and energy transfer processes in these systems. This we believe has the potential to open new avenues to harness triplet excitons that could be utilised in areas ranging from photocatalysis and optoelectronics to 3D printing and optogenetics.

I mostly use time-resolved spectroscopy – time-resolved photoluminescence and pump-probe spectroscopy – to monitor excited state dynamics in hybrid organic lanthanide systems. Furthermore, I use photothermal deflection spectroscopy to measure direct triplet absorptions (S0 to T1) in these systems. I prepare the lanthanide-doped NPs myself and characterise them using TEM (in combination with EDX for shelled structures). The organic ligands we use are either commercially available or made by collaborators from the Bronstein group.

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Jonah Messinger

Radioisotope power systems harvest nuclear energy from radioactive isotopes in the form of ionizing radiation by radiovoltaics or heat by radioactive thermoelectric generators. Historically, such devices have low efficiency (<7%) and low power density (< 100 W/kg). Gammavoltaics have largely been ignored because γ radiation penetration depth exceeds minority carrier diffusion lengths by orders of magnitude, preventing carrier extraction. The proposed gammavoltaic instead absorbs γ radiation with a novel, thick, single-crystal, and high-yield lanthanide-doped perovskite scintillator, coupled to a spectrally-tuned photovoltaic, allowing high power density γ sources (Co60 and Cs137) to be efficiently harvested.

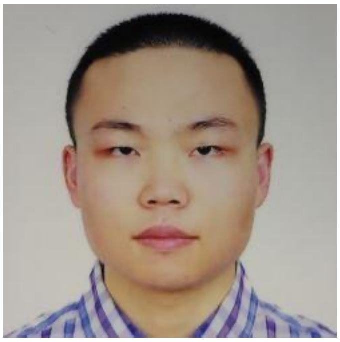
Techniques:

1 - Solution-phase single-crystal growth of ultra-wide bandgap lanthanide- doped perovskite single-crystal (never been done before), which could achieve exceptionally high light yield and be relatively low-cost. Characterized by radioluminescence (also time-resolved single photon counting for lifetime measurement and python fitting), high-activity (~25 TBq) gamma irradiation luminescence, light-yield measurement by integrating sphere, XRD, UV-Vis, and UPS. Collaborating to model in DFT.
2 - Wide bandgap solution-phase photovoltaic with optimized carrier transport layers and metal contacts. Characterized by PL, PLE, TRPL, JV measurement, EQE, UV-Vis, XRD, UPS, SEM, and profilometry. Collaborating to do evaporated perovskite cells. I may also fabricate quasi- 2D perovskite solar cells.

Megan Groom

Performance, real-time state-of-health monitoring, and lifetime prediction are key factors limiting our transition from conventional to electric vehicles. It remains challenging to look inside a battery as it is operated under 'real-world' conditions and unpick factors affecting performance. I am working to integrate hollow-core optical fibres with a micro-objective lens, to locally deliver and collect light from inside the battery, which conventional microscopes cannot access. This enables Raman spectroscopy, an established technique that can assess the state of health of various battery components, to be used to for operando monitoring inside the battery.

As an experimentalist, I predominately use optical characterisation techniques and spectroscopy methods to investigate and develop my fibre-Raman probe.



Zhengkang Qu

The charge transport mechanism in organic conjugated polymer systems has been exciting but difficult due to the complexity brought by the semi-crystalline properties of conjugated polymer film and the soft nature of lattice that allows electron-phonon interaction and thermal fluctuation to play an active role in the charge transport. My PhD is based on FTIR spectroscopy and charge-modulation microscopy to address the issues through optical modelling and reconstructing the dielectric constant spatially at different energy. The dielectric functions will directly depict the charge transfer process in the systems. The findings will contribute to building efficient organic electronic and thermoelectric devices.

Techniques: FTIR spectroscopy, charge-modulation microscopy, differential reflection spectroscopy, Matrix method, Kubo theory.

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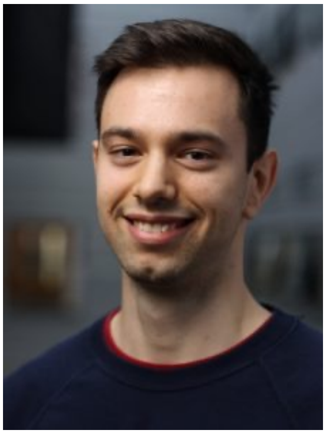


Aleksandar Radic

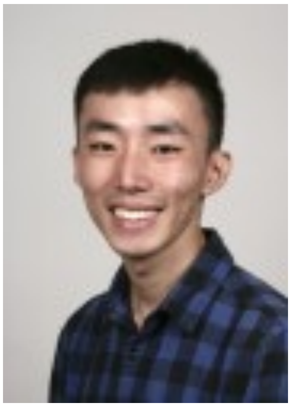
My project aims to build upon work by Merryweather, Schnedermann and Rao to extend operando imaging of energy storage materials to a third spatial dimension so that ion dynamics and phase changes may be tracked, in real-time, throughout battery materials during cycling. With the ultimate aim being to further develop a method which allows for cheap and rapid battery material characterisation and optimisation. My work approaches the problem from joint instrumentation and data analysis/modelling perspectives. I have been working on building a new optical microscope which can achieve 3(+1)D imaging, alongside development of automated software to extract quantitative metrics (relating to ion/phase dynamics) from large optical datasets.

My PhD involves a range of practical methodologies such as synthesis and fabrication of electrodes and battery cells, the development of a new characterisation technique in operando scattering microscopy and various standard characterisation techniques like ellipsometry and SEM. The computational/numerical aspect of the work is focused on applying mathematical methods to optical and electrochemical data analysis, and implementing these methods into new, automated software to process future data which would otherwise not be feasible to analyse manually.

Sophia Belser

Optically accessible colour centres in diamond have a unique electronic structure that can be employed for quantum sensing at the nanoscale. Diamond probes are especially interesting for in vitro and in vivo biosensing of temperature and viscosity. We employ nanodiamond sensors to investigate RNA granules, non-membrane compartments in which cells organise biochemical reactions. Liquid-liquid demixing can cause the formation of pathological aggregates, like amyloid structures associated with Alzheimer's disease or synuclein plaques related to Parkinson's disease. A better understanding of the formation and characteristics of RNA-granules will aid the development of targeted, more economical, and ecological treatments to named diseases.

Nanodiamond functionalisation and characterisation (DLS, Zeta, UV Vis), C.elegans related work, cell culture, soldering/bonding, confocal imaging (home-built setup and commercial), building and maintaining optical systems, Arduino, Python/Matlab/ImageJ for data analysis, hardware control and simulation of interacting spin systems



Jien Hwee Tan

Batteries play an important role in the electrification of the transportation sector and as energy storage systems for renewable energy, both of which are an important step towards a greener future. However, batteries suffer from degradation, meaning that the energy that batteries can store reduces overtime. For my PhD I am studying the impact of a uniform electrode structure on long-term battery performance. The understanding developed will help to inform future materials and electrode design. Furthermore, a more durable battery technology can help to alleviate “range anxiety” in electric vehicle drivers, and hence encourage the faster uptake of electric vehicles.

Synthesis: co-precipitation, calcination. Fabrication: electrode slurry preparation and casting, coin cell fabrication for electrochemical testing. Characterisation: electrochemical testing using potentiostat, synchrotron operando diffraction experiment. Modelling: COMSOL multiphysics simulation. Software: python programming for data analysis

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Andrea Rogolino

Limiting the mounting concentration of greenhouse gases in the atmosphere is one of the most urgent challenges that scientists are called to tackle. Photoelectrochemical (PEC) cells combine the practicality of a device for simultaneous synthesis in separate compartments with the direct conversion of solar energy into chemical bonds. Several approaches to design “artificial leaves” have been investigated in the past decades. The overall goal of my PhD will be to design and develop an integrated system consisting of an inexpensive, dye- sensitised carbon nitride (organic semiconductor) photoanode and a dark cathode for selective CO2 reduction to C2 products (ethylene/ethanol).

Carbon nitrides with covalently-bonded molecular dyes are synthesized through established wet chemistry methods and characterized using a range of spectroscopic (UV-Vis, FT-IR, XPS) and electrochemical (LSV, CV, EIS) methods. TEM images of particles are also taken. Dynamics of photogenerated carriers in carbon nitrides is also investigated through transient absorption spectroscopy and 2D photoluminescence mapping via one-photon and two-photon confocal microscopy. Photoelectrochemical cells are fabricated by drop-casting or spin-coating the photocatalyst with electron/hole transport layers. Finally, products of CO2 reduction obtained upon solar illumination of the PEC device are detected using GC- MS and NMR spectroscopy.

Timothy Lambden

Advances in electron microscopy have provided new means by which we can investigate the nanoscale structure of a vast range of beam-sensitive ‘soft’ materials previously impossible to examine at such length scales. This has been largely driven by development in detector technology, computational power and ease with which we can interface with a microscope. The PhD builds on these advances to optimise acquisition strategies to maximise data quality without significant damage to the sample, including development of ice free cryo holders and optimisation of smart scanning and in-painting. Such materials investigated include perovskites as next generation materials for photovoltaics, and cellulose nanofibers as biodegradable photonic pigments.

I’m based in the electron microscopy group in material sciences at Cambridge, which uses a wide range of advanced electron microscopy techniques, specimen preparation techniques and image processing and modelling software

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Celine Wing See Yeung

Organic photovoltaics (OPVs) is one of the cornerstones of my PhD project. The aim is to incorporate them into photoelectrodes that are coupled with suitable catalysts to drive a wide range of interesting chemical reactions (e.g. water splitting to produce hydrogen as a green fuel or the oxidation of waste plastics). In the literature, there are many types of photoelectrodes focusing on water splitting such as silicon, CIGS and perovskites. However, most of them contain rare, expensive and toxic metals (e.g. indium and lead). Hence, it will be ideal to develop an alternative polymer-based system with improved stability in aqueous solution.

The key research methodologies are: (1) Fabrication of OPVs with carefully chosen layers (via spin coating and metal evaporation) (2) Incorporating OPVs into photoelectrodes with proper encapsulation and wiring (3) Photoelectrochemical analysis (e.g. Cyclic voltammetry, chronoamperometry for stability studies) (4) Other techniques (e.g. SEM/EDX, UV-vis spectroscopy, NMR/HPLC quantification of products formed, IR spectroscopy). (5) Software: Mainly Excel, MATLAB, Origin for data analysis.

Arvind Pujari

My PhD involves the fabrication of dye-sensitized 'photobatteries' systems which can simultaneously harvest and store light in a compact device architecture. The main application for these devices is for powering internet of things (IoT) and other space-constrained devices. Combining energy harvesting and charge storage can help overcome the intermittency of indoor light for their continued operation.

I use a variety of thin film devices to fabricate these devices and use spectroscopic techniques to understand the fundamental physics underpinning them. In the long term, these devices may find applications in low-cost solutions for harvesting and storing energy for off-grid communities, which is important to fight energy poverty in developing countries. My PhD involves the fabrication of solar cells and batteries and their integration, requiring knowledge of both electrochemical and semiconductor physics techniques. I work on the fabrication of batteries (coin cells) and their electrochemical characterization (cyclic voltammetry, impedance studies, EQCM etc.). I also fabricate thin film batteries using pulsed laser deposition (PLD) and sputtering (of solid electrolytes). To make solar cells I use techniques such as atomic layer deposition (ALD) and screen printing. To understand the physics underpinning these devices I use a variety of operando spectroscopic techniques such as reflection microscopy and spectroscopy, time correlated single photon counting and Raman/photoluminescence measurements.

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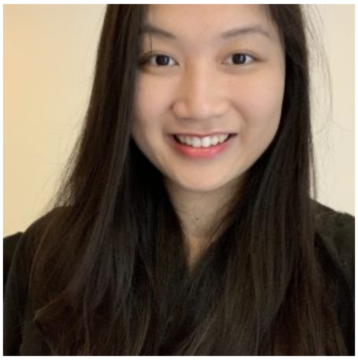

May Ching LAI

Over the past decades, the drive for a high-capacity, long cycle-life and superior safety energy storage systems has led to a rapid advancement of cathode materials for lithium-ion batteries. $Li(Ni_{0.8}Mn_{0.1}Co_{0.1})O_2$ is considered as one of the most promising cathode. However, mechanical integrity issues such as particle cracking are thought to be one of the leading causes of structural deterioration and limited long-term cycle stability. The combination of various electron microscopy techniques help elucidates the properties of the cathode material at the nanoscale, and contribute to the understanding of electrode stability and performance. This is crucial for the advancement of electric vehicles.

Battery cells are synthesised and electrochemically cycled by collaborators. I use focused ion beam-scanning electron microscope (FIB-SEM) to prepare thin lamellae for studies in the transmission electron microscope (TEM). FIB-SEM tomography is then carried out where 3-dimensional models are created using Dragonfly software (a convolutional neural network algorithm was implemented). TEM techniques such as energy dispersive X-ray and electron energy loss spectroscopy analysis evaluate the distribution of transition metal. Diffraction pattern and high-resolution TEM provides information on the crystal structure, strain and cracking. The data from TEM is analysed using Hyperspy (Python library for multidimensional data analysis)

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Oliver Powell

I study the optical coherence properties of defects in hexagonal boron nitride to establish limits of performance for potential applications in quantum photonic devices. Current leading material platforms for solid-state single photon generation, like diamond nitrogen-vacancy centres, require cryogenic cooling for coherent emission to use in quantum devices. When scaled-up for industrial quantum technologies, this would require enormous energy input for maintaining cooling. Hexagonal boron nitride has shown favourable optical and spin qualities up to room temperature, so it is hoped this new material platform can lead to more energy efficient hardware for the upcoming quantum technological revolution.

Techniques

- Use homebuilt confocal microscopes to characterise material defects through photoluminescence and response to optical and microwave pulse sequences or presence of electrical/magnetic fields. Includes optically detected magnetic resonance and operating a cryostat.

- Fabricate devices to control charge environment around defects and deliver microwaves, electrical and magnetic fields to local region efficiently through PCB circuitry and wire bonding.

- Use Python and LabView to operate experiments with homebuilt GUI and to analyse measured data.

- Simulate optical and spin dynamics around material defect using Python to help identify defect identity.

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Jiho Han

The current bottleneck in the global renewable energy transition is the development of cheap, rapid, and high-capacity storage.. Lithium-ion and alternative battery technologies are at the forefront of this challenge, and a deeper understanding of energy materials is essential for the development of future batteries. A realistic understanding of these energy materials can be realised under in-operando conditions, where the material is characterised under realistic electrochemical conditions. My PhD explores the evolution of phase and ion diffusion in battery materials through in-operando optical microscopy. This allows us to gain valuable information on ion diffusion, phase transition mechanisms and particle degradation to aid in the design of next generation battery materials.

Synthesis/fabrication of battery electrode materials and battery electrodes. Design of in-operando electrochemical optical cells (window coin cells). Design of imaging techniques and building optical set-ups. Spectroscopic analysis.

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