

EPSRC CDT in Sustainable Chemistry

Issue 4

Newsletter

University of
Nottingham

Our EPSRC CDT in Sustainable Chemistry is now in its fourth year and has 49 students in Chemistry, Engineering and Biosciences, with a further 14 recruited for Cohort 5. This year is a very important one for us - we recruit our final Cohort as our first Cohort students complete the programme and move into their future careers.

CDT Partner School Representatives:

Chemistry:

Prof Chris Hayes, Prof Neil Champness

Biosciences:

Prof Tim Foster, Dr Ian Fisk

Engineering:

Dr Victor Sans Sangorin

Business School:

Prof Simon Mosey

Engagement with Industry

Over the past four years, we have explored several avenues of engagement between our students and industrial partners. Our industrial partners have, so far contributed over £0.5M towards CDT scholarships (ten partly supported students) with additional support currently being negotiated. Our industrial partners have also contributed a large amount of in-kind support in the form of training, hosting student placements and group site visits, participation in the Centre governance and supporting students at the events such as Induction, Industrial Showcase and Dragons Den.

Our students have had the opportunity to participate in a number of Industrial Challenge Workshops delivered by companies such as GSK, Croda, Unilever, AstraZeneca, Lubrizol, Sygnature, and Buhler. In these workshops, companies present and discuss the main sustainability related challenges that their particular industry faces.

Since summer 2017, the Centre has facilitated a series of industrial site visits, many of which had been open to other PhD students in relevant disciplines.



The visits included companies such as Croda in Goole, GSK site in Stevenage, AstraZeneca labs in Macclesfield and Promethean Particles in Nottingham.

On some visits, the students had the opportunity to visit a number of business areas such as laboratories, product development and marketing, giving them the opportunity to obtain further information about the options for application of their PhD in industry.

Engagement with Industry

Industrial Showcase

27 September 2017

The Centre was pleased to welcome its industrial partners and academic colleagues to its third annual Industrial Showcase. The aim of this annual event is to facilitate further communication between University of Nottingham academics, CDT students and industrial partners. It is also an excellent opportunity for our students to showcase their research including a diverse range of multidisciplinary topics such as: transformation of limonene into a useful monomer; microwave pyrolysis of biomass within a liquid media; exploring the potential of chitosan in the conservation of Viking artefacts and many more.



The event attracted approximately 100 delegates and was also an excellent opportunity for the students to present posters and discuss their research with industrial partners and University of Nottingham academics from a range of disciplines. The event concluded with the announcement of talk and poster prizes, with best talk prizes awarded to Edward Anderson (Cohort 1) and Alexander Kibler (Cohort 2) and prizes for best poster to Mariana Gameiro (Cohort 1) and Rhona Savin (Cohort 3).

Events

Cohort 4 Dragons' Den

12 April 2018



Cohort 4 students (from left to right) James Wilson, Jacob Smith, Catherine Peake, Ekatarina Vorobieva, Michael Green, Aaron Senior, Katie Scott, Oliver Goodrich, Heather Damian, Ben Scrafield, Claire Stringer and Akiharu Kitagawa

Cohort 4 students have successfully presented their research proposals to a panel of academics, industrial partners and their peers from other Cohorts.

The second day of the event involved feedback on the presentations as well as 'Publishing your Literature Review' delivered by Peter Licence and 'Sustainable Chemistry Ingenuity Challenge' delivered by Simon Mosey. The students have now commenced their pilot research project, which they will be working on until the end of September.

Cohort 4 students' projects

Name	Project title
Heather Damian	The late-stage, site-specific functionalisation of polypeptides via polyoxometalate-mediated H-atom abstraction
Oliver Goodrich	Metal-catalysed C-S cross-couplings for the synthesis or modification of sulfoximines
Michael Green	The oxidative activation of H-phosphonates for nucleophilic trapping
Akiharu Kitagawa	Investigation and creation of thermochromic paints for surface thermal analysis
Catherine Peake	Ultra-high energy density redox flow batteries
Katie Scott	Synthesis of spiro- and fused-heterocyclic products via catalytic C-H functionalisation
Aaron Senior	Radical heteroalkylation of complex molecules towards a late stage C-H functionalisation strategy
Jacob Smith	From waste to wealth: recovery and valorisation of heavy metals in abandoned mine wastewater by layered double hydroxides
Benjamin Scrafield	A new, catalytic strategy for piperidine syntheses and a unified approach to the synthesis of sparteine alkaloids
Claire Stringer	Reducing antimicrobial resistance by removing heavy metal ions from dairy farm wastewater
Ekatarina Vorobieva	SCP as a sustainable link between food industry and greenhouse gas remediation
James Wilson	Carboxylic acids as alternative electrophiles in ether synthesis

Events

Green Chemistry Futures

(a joint event with
EPSRC CDT in Chemical Synthesis, Bristol)
8 February 2018

Following the success of our last multi-CDT event, which took place in February 2016, there was a strong drive and motivation to co-organise another event, which would benefit not only the students from the host institutions, but also those from other Universities.

The EPSRC CDT in Sustainable Chemistry and the EPSRC CDT in Chemical Synthesis, University of Bristol came together to co-organise the Green Chemistry Futures Symposium, which took place in Nottingham on 6 February 2018.

The event attracted an audience of over 80 delegates from the host Centres as well as neighbouring Universities including Leicester, Loughborough and Birmingham.

The participants heard four excellent lectures: Designing new strategies for fluorination by Dr Alison Stuart, University of Leicester; Recent advances in medicinal chemistry and asymmetric catalysis by Prof Patrick Guiry, University College Dublin; Electrification of synthesis and other flow chemistries by Prof Thomas Wirth from Cardiff University; and Organic synthesis towards a sustainable society by Prof Shu Kobayashi from the University of Tokyo. Closing remarks were given by the University of Nottingham's Prof Sir Martyn Poliakoff.



Chemical Biology for Sustainable Processes Symposium 25 April 2018

The Centre held its final thematic symposium in academic year 2017/18. Chaired by the CDT student Lidia Delgado, the event featured lectures by Prof Sabine Flitsch, University of Manchester, Dr Cathleen Zeymer, ETH Zurich and Prof John Ward, UCL. The talks were followed by poster session and networking.

Advanced Materials for a Sustainable Future Symposium 6 December 2017

The Symposium included talks on solar driven hydrogen production by Dr Mark Symes, University of Glasgow; Sustainable preparation of functional nanostructured materials using supercritical CO₂ by Dr Albertina Cabanas, Complutense University of Madrid and making organic electronics simpler by Prof Alessandro Troisi, University of Liverpool.



Training

Having completed the intensive year one training and assessment, CDT students start working on their research projects. During the years 2-4 of the PhD programme they also attend a variety of professional skills courses designed to assist them with obtaining additional skills required for a smooth transition into their future careers. Over the past few months, our students have had the opportunity to attend a number of courses such as Communicate your Science in Writing (all Cohorts), Britest Tools (Cohort 3), Career Management (Cohorts 1 & 2), Successful Interviews (Cohort 1), Project Management PRINCE 2 (Cohort 1) and Publishing Workshop (all Cohorts).

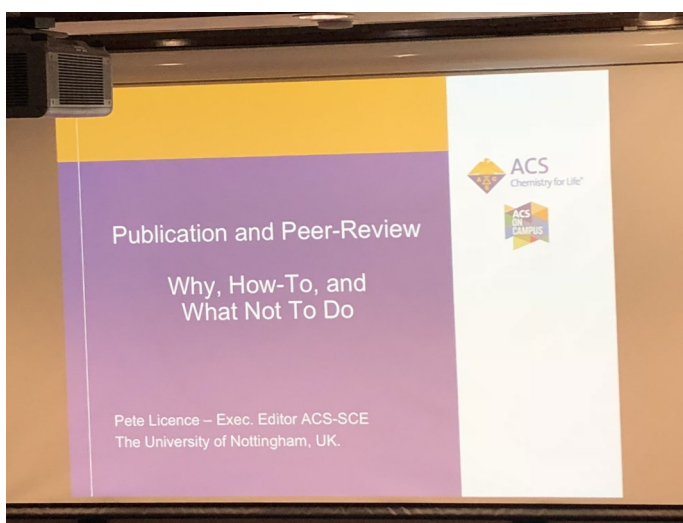
Career Management Workshops 27 & 28 November 2017

The workshop, which took place in November 2017 covered main aspects of career management such as establishing career decision criteria, understanding what employers want, devising CV and application form, utilising digital recruitment and social media, job search strategies, interview skills etc. The workshop was aimed at final year students to support them with smooth transition into employment and penultimate year students to help them explore internship possibilities.



PRINCE 2 Training 8-12 January 2018

Following a conversation with our final year students and assessment of their training needs and future career plans, the Centre made a decision to offer PRINCE 2 training to Cohort 1 students. We would like to take the opportunity to congratulate all participating students on passing their PRINCE 2 exams. We have received excellent feedback about the course from the students and hope to continue offering it to our final year students in future.



Publishing Workshop 17 April 2018

The first Publishing Workshop organised by CDT in Sustainable Chemistry, held in 2016 had been extremely well received by the postgraduate students and early career researchers. Hence the Centre had decided to organise another similar event in April this year.

The event was open to a wider postgraduate community and covered important practical aspects of publishing from publication preparation, submission and review process to issues related to publishing ethics. The workshop was delivered by Peter Licence (Associate Editor of ACS Sustainable Chemistry and Engineering) and Dr Dave Smith (Senior Associate Editor, Chemistry A European Journal).

Cohort building activities

Cryptic Challenge Team Building 30 November 2011

The Centre held its annual cross-cohort team building event facilitated by CCC events. The event took place in the Winter Garden of GSK Centre for Sustainable Chemistry and involved a series of challenges, which needed to be resolved using team work and problem solving skills and presented a good opportunity for the students to network in a fun and informal environment.



Monthly Research Updates and Journal Club

The Centre holds regular monthly Research Update events, which give the students the opportunity to meet, present and discuss their research as well as benefit from hearing presentations from several disciplines such as Chemistry, Engineering, Biosciences and Synthetic Biology.

Journal Club is a monthly event held every second Tuesday of the month 4-5pm, where smaller groups of students meet to discuss a particular recently published journal over coffee and cake. This event has recently opened to the wider PhD community and we would welcome participation from any interested students in other relevant disciplines.

We would ask anybody wishing to attend to email Peri Williams on Perislava.williams@nottingham.ac.uk.

Outreach highlights

CDT students have participated in over 70 outreach events ranging from individual activities such as talks at local events, such as Pint of Science and PubhD to group activities including stand demonstrations at local festivals such as School Science Fair, Wonder, Festival of Science and Curiosity etc. As a part of their mandatory training, students developed and delivered Chemistry Summer School and A Level Masterclass events, aimed at year 12 students.



Outreach highlights

Pint of Science

4-16 May 2018

CDT students Teresa Ambrosio and Paul Henry participated in this years Pint of Science, which took place in Nottingham from 4-16 May.

Pint of Science is an outreach and science communicating event, taking place simultaneously in many UK cities, with the main objective to communicate science to the general public in a more relaxed and informal environment.

As a part of a brewing science event, Paul delivered a talk entitled 'Understanding biotechnology with rapid analysis'- aiming to reveal how the fast analytical techniques have been used to understand the secrets of fermentation bio-processes, giving insight into the behaviour of the modified microorganism.

Teresa made a significant contribution to this years festival as she took a role of the leader of the Sustainability night featuring three University of Nottingham speakers; Dr John Robinson, Chemical and Environmental Engineering, Prof Peter Licence, School of Chemistry and Mr Andy Nolan, Director of Sustainability.



Organising the Festival provided Teresa with a fantastic opportunity to make new contacts, develop new skills and learn more about science. The audience were engaged with all the talks and were appreciative of the quality of the presentations.

CDT students act as judges in The FIRST® LEGO® League competition 19 December 2017

The aim of the competition is to introduce a themed scientific and real-world challenge for teams of school children aged 9-16 to research. Competing teams were tasked with researching a problem around the theme of water, creating a solution and sharing it as widely as possible. The judges saw an array of creative ideas presented by the participants - from installing vacuum toilets in homes in order to save water when flushing, to a social media campaign highlighting water wastage when brushing your teeth.

As well as completing the research project, participants were asked to design, build and program robots as well as to compete head to head in the robot games.



Outreach highlights



CDTs students present at the PubhD event

CDT students Jose Pinto and Teresa Ambrosio presented at Nottingham based PubhD event.

PubhD is an outreach and public engagement event that takes place in various cities in Europe every month.

Jose talked about his research on creating a more sustainable jet fuel that can be used in current day engines, decreasing the dependency on fossil fuels at the Vat and Fiddle event in November 2017.

Teresa's presentation took place in February 2018 when she talked about her research on catalysis and C-H bond activations.

Tourist in own city—Oslo

15 April 2018

Jennifer Wakefield, a CDT student working on alternative conservation methods for preservation of wooden artefacts from a Viking ship burial, has recently had the opportunity to help explain the problems with the artefacts and research being done as part of the Saving Oseberg project at the 'Tourist in own city' event, which took place in Oslo, Norway in April 2018.

The aim of the event is to encourage more locals to experience what their city has to offer that they might be missing out on daily basis. Jennifer is currently on her internship at the University of Oslo, continuing her work on Saving Oseberg Project and participated in the stall at the Viking Ship Museum.



Oseberg Animal Head
by Mike Fay under CC BY 2.0

CDT Students Re-visiting their Old Schools

CDT students Grace Lowe and Sarah Farthing recently conducted outreach activities in their old schools; Joseph Whittaker Academy, Mansfield and Rugby High School, Rugby.

Over a period of six months, Grace engaged a group of year eight students in a series of lectures, discussions and practical experiments related to the topic of her research - sustainable energy storage. The students got the opportunity to produce their own vegetable batteries and a poster demonstrating their newly acquired knowledge.

Sarah Farthing took part in Rugby High School, Career Dating Event in March 2018. As this is a traditional girls school, Sarah was particularly keen to speak to year 10 students about the opportunities of a career in engineering and research that takes place within the University. Sarah was pleased to engage in conversation with over 50 students.

Awards and prizes

CDT students win Environment YES competition

DT students Rhona Savin and Sarah Farthing, along with Bumni Omorotionmwan and Francois Seys from the Synthetic Biology Research Centre participated in the annual 22nd YES (Young Entrepreneurs Scheme) competition, which took place during the period between September and December 2017. YES is designed to develop business awareness and an understanding of entrepreneurship in UK postgraduate students and postdoctoral researchers.

The participating teams are required to set up a hypothetical company and develop an innovative product which they present to a panel of experts acting as venture capitalists.



Going under the name of Hygrow Ltd, the Nottingham team developed a hypothetical product called Chloroblast - a chemical that enhanced crops' natural protection against drought.

During the competition process the team attended a number of training workshops, developed the product and business plan and delivered a convincing pitch for a hypothetical product to a panel of judges involving



representatives from companies including JF Crilly Associates, Syngenta, P&G, GSK, James Cowper Kreston and Potter Clarkson.

Months of hard work paid off when the Hygrow team was crowned the winner in the Environment YES category and was also awarded Best Plant, Microbial and Environmental Business Plan sponsored by Syngenta. The key to Hygrow's success was that it was a truly multidisciplinary team, involving students from Chemistry, Engineering and Synthetic Biology and each team member brought their own unique set of skills and knowledge.

Well done to our students for the following prizes/awards

Claire Stringer -for obtaining a place at the Medical Research Foundations National AMR Training Programme, June 2018

Laura Finney - for winning ACS Green Chemistry Institute® (ACS GCI) Pharmaceutical Roundtable Student Travel Grant to attend the upcoming 2018 Annual Green Chemistry & Engineering Conference to be held from 18-20 June, 2018, in Portland, Oregon.

Lidia Delgado - best Poster Prize for her poster entitled 'Performance of an Extremo Adpated Glycosyl-Hydrolase (GH1) from Halothermothrix Orenii in Wine-like Environment' at the Biotransformations: From Science to Industrial Application Symposium, London, 19 December 2018

Vera Salgado - prize for her talk titled 'Exoelectrogenic intensification of CO₂ /H₂ fermentations using O₂ as final electron acceptor' at C1 Net Conference 3- Chemicals from Gas, Nottingham, 5-7 November 2017

Astrid Delorme - Green Chemistry Poster Award at the 3rd EuCheMS Congress on Green and Sustainable Chemistry (EuGSC), York, 3-6 September 2017

CDT Internships

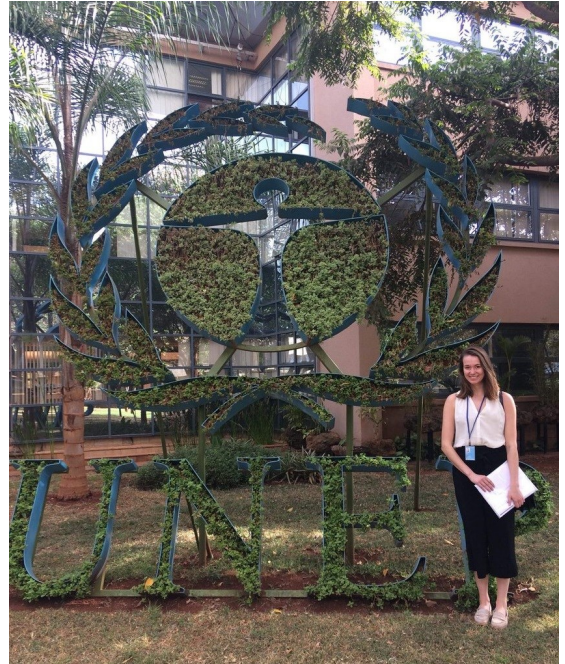
As a part of its training programme, CDT offers its students the opportunity to go on an external placement, usually for the period of up to three months. This placement can be directly linked to their PhD research or completely unrelated but beneficial to the students' chosen career path. Students are advised to plan for their placement to take place in the second half of year two or in the year three of the programme and to date, nine students, mainly from the first two Cohorts have taken advantage of this opportunity.

Recent internships

Astrid Delorme **United Nations, Nairobi, Kenya**

Astrid has spent three months working in the Science Division in Nairobi, Kenya and has been involved in the 'Environment under Review' programme. She worked on a number of projects such as developing a proposal for enhancing networking and sharing of environmental information, including the development of timelines and milestones, budget allocation and compiling of information and inputs from other internationally based UN offices. She also worked on a project focusing on improving climate change resilience in 14 pacific island countries by improving climate information services in the region.

The placement has given Astrid a great overview of how climate change affects different parts of the world and what measures being taken to minimise the effects.



Jennifer Wakefield **Viking Ship Museum, Oslo**

Following a period of two years working on her project 'Characterisation and modification of natural polymers discovering new consolidants to save the Oseberg artefacts', Jennifer commenced the third phase of her research, located at the specially designed lab of the Viking Ship Museum in Oslo.

During the first part of her placement, Jennifer worked on the treatment of artificially degraded wood, prepared for her in advance by the Museum conservator. The polymer uptake was measured through weight and dimensional changes. The penetration into the wood was established by SEM (scanning electron microscopy) with optional EDS (energy dispersive spectroscopy) and IR (infrared spectroscopy). At the end of this phase, Jennifer set up the experiments on the archaeological wood and will return to analyse them during the second part of her placement in Oslo.

This placement was essential to Jennifer's PhD as it was extremely beneficial to spend a period of time working from a lab where the samples are located, learn to use the specialist equipment, learn new techniques and access relevant expertise offered by the local researchers.

Publications

Hydrodynamics of the VanA-type VanS histidine kinase: an extended solution conformation and first evidence for interactions with vancomycin, M. Phillips-Jones, G.Channell, C.J. Kelsall, C.S. Hughes, A.E. Ashroft, S.G. Patching, V.Dinu, R.P. Gillis, G.G. Adams and S.E.Harding, *Nature Scientific Reports* 7, 46108., 2017 (doi: 10.1038/srep46180)

Progress in the synthesis of sustainable polymers from terpenes and terpenoids, M. R. Thomsett, T. E. Storr, O.R. Monaghan, R. A. Stockman, S. M. Howdle, *Green Mater.*, 2016, **4**, 115-134 (doi: 10.1680/jgrma.16.00009)

Redox-active organic–inorganic hybrid polyoxometalate micelles, K. Kastner, A.J. Kibler, E. Karjalainen, J. A. Fernandes, V. Sans and G. N. Newton, *J. Mat. Chem. A*, 2017, **5**, 11577-11581 (doi: 10.1039/C7TA00408G)

Enantioselective Nickel-Catalyzed Intramolecular Allylic Alkenylations Enabled by Reversible Alkenyl, C.Yap, G.M.J. Lenagh-Snow, S.N. Karad, W. Lewis, L.J. Diorazio, H.W. Lam, *Angew. Chem. Int. Ed.*, 2017, **56**, 8216–8220 (doi: 10.1002/anie.201703380)

Controlled depolymerisation assessed by analytical ultracentrifugation of low molecular weight chitosan for use in archaeological conservation, J.M.K. Wakefield, R.B. Gillis, G.G. Adams., C.M.A. McQueen and S.E. Harding, *Eur. Biophys. J.*, 2018 (doi:10.1007/s00249-018-1290-6)

Iron-catalyzed indolizine synthesis from pyridines, Diazo Compounds, and Alkynes, T. Douglas, A. Pordea and J. Dowden, *Org. Lett.*, 2017, **9**, 6396-6399 (doi: 10.1021/acs.orglett.7b03252)

Visible light mediated oxidation of benzylic sp³ C–H bonds using catalytic 1,4-hydroquinone, or its biorenewable glucoside, arbutin, as a pre-oxidant, L.C. Finney, L.J. Mitchel and C.J. Moody, *Green Chem.*, 2018, **20**, 2242-2249 (doi: 10.1039/C7GC03741D)

Sulfonylative and Azidosulfonylative Cyclizations by Visible-Light-Photosensitization of Sulfonyl Azides in THF, S. Zhu, A. Pathigoolla, G. Lowe; D. A. Walsh, M. Cooper, W. Lewis, H.W., Lam, *Chem. Eur. J.*, 2017, **23**, 17598 –17604 (doi: 10.1002/chem.201704380)

Full hydrodynamic reversibility of the weak dimerization of vancomycin and elucidation of its interaction with VanS monomers at clinical concentration, M. K. Phillips-Jones, R. Lithgo, V. Dinu, R. B. Gillis, J. E. Harding, G.G. Adams and S. E. Harding, *Scientific Reports* 7, Article number: 12697, 2017, (doi:10.1038/s41598-017-12620-z)

Future events

Industrial Showcase, 26 September 2018, East Midlands Conference Centre, University Park

Cohort 5 Induction, 27-28 September 2018, East Midlands Conference Centre, University Park

Dragons' Den 2019, 4-5 April 2019, Breadsall Priory Hotel, Breadsall, Derby

I hope that you have enjoyed reading our fourth newsletter.

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