

Institution: University of Chester
Unit of Assessment: B8 Chemistry
1. Unit context and structure, research and impact strategy

1.1 Context

This is the first REF submission that the University of Chester has made under Chemistry. We are therefore one of the youngest Units in the UK to become research active in this area and this statement is based on progress in the first seven years of activity. 12 FTEs are included in the return. Three other colleagues who have moved on to new positions are also referenced in this environment statement:

Name	Status
Dr Andrew Fogg	Senior Lecturer
Dr Gavin Hazell	Lecturer
Dr Simon Hodgson	Researcher
Dr Mark Mc Auley	Senior Lecturer
Dr Theodoros Papadopoulos	Senior Lecturer
Dr Gavin Phillips	Acting Head of Department
Dr Bob Smith	Researcher
Prof Graham Smith	Acting Dean
Dr Graham Spink	Senior Lecturer
Dr Gabriele Wagner	Senior Lecturer
Dr David Ward	Leading Research Fellow
Dr Noha Ziedan	Lecturer
Dr Trevor Davies	Industry
Dr Claudia Swanson	Universität Magdeburg
Dr Jianhua Tang	Industry

The Chemistry Unit of Assessment is formed from staff from the Departments of Mathematical & Physical Sciences, Chemical Engineering and Mechanical Engineering in the Faculty of Science and Engineering at the University of Chester. Research in the Faculty is based at Thornton Science Park, a unique location where industry, academia and commerce are co-located for mutual benefit. The Science Park is eight miles from the Parkgate Road campus and the city of Chester, and enjoys excellent access from North Wales, the Wirral, Cheshire, the Midlands and the North West conurbations of Liverpool and Manchester. Thornton Science Park forms part of the Cheshire Science Corridor and is a key player in the Northern Powerhouse initiative. The science park hosts around 40 companies working in the strategic areas of Energy, Automotive, Environment, and Advanced Manufacturing.

The Faculty of Science and Engineering was founded in 2013 with the objective of contributing to the University's strategic aim to further develop its STEM provision, broaden the curriculum and extend the range of its activities into engineering and the physical sciences. We believe this is the first new Science and Engineering Faculty at a UK University for at least 20 years, representing the ambition of Chester in this field. Key to success was the award of a HEFCE/STEM Capital grant of £7.1M, of which approximately £1.2M was used alongside the acquisition of legacy equipment from Shell Research Ltd, (the former operators of the Thornton site) to equip laboratories with near state-of-the-art and industry standard facilities. Development of the science park has subsequently benefitted from ERDF, LEP and other funding to a total of > £30M. A further HEFCE/STEM Capital grant has allowed development of a combined chemistry lecture/demonstration/laboratory facility, easing students' transition from undergraduate to a research mind-set. As a consequence of this investment and the Shell legacy, for its size, the Faculty is very well equipped particularly in the areas of analytical chemistry and in materials characterisation. Chemistry is an integral part of the Faculty's activities, and is fully aligned with the strategic areas of the science park. Consequently,

chemistry research was one of the first areas to be established within the new Faculty structure and continues as a vibrant and sustainable activity.

The University of Chester Corporate Plan - Vision 2015-2020 – has an explicit commitment to supporting an expanding and innovative University research environment that ensures high quality research and innovative practices that help influence the development and improvement of society. The University's Research and Impact strategy focuses on four Core Themes which build upon existing strengths and reflect the institutional values covering Health and Wellbeing, Culture and Society, Sustainability and Environment, and the Regional Economy. The strategy of the Chemistry Unit of Assessment is fully aligned with these core themes. Research is focused into three major themes: Materials Chemistry; Energy and Environmental Chemistry and Medicinal and Pharmaceutical Chemistry. The themes benefit from the proximity of companies on the science park for collaboration and industrial participation, and from the cross-fertilization of ideas and expertise from the associated Engineering groups within the Faculty.

The future strategic aim of the Chemistry Unit is to build on and strengthen its core activities through collaboration within and beyond the Faculty of Science and Engineering. The Energy and Environmental Chemistry group will work closely with the Energy and Environment theme of the Engineering Unit of Assessment, aligning with the Core Theme of Sustainability and the Environment. Pharmaceutical and Medicinal Chemistry is establishing stronger links with the Faculty of Medicine and Life Sciences, contributing to the theme of Health and Wellbeing. Materials Chemistry is pervasive, works alongside Engineering in many of its aspects, supports the other activities of the Unit, and has impact on the Regional Economy and on the Sustainability and Environment core themes.

1.2 Structure

The Chemistry Unit is cross-departmental, with a focus from Mathematical & Physical Sciences and Chemical Engineering, and with some contribution from other departments of the Faculty

The Unit is structured around three principal themes: Materials Chemistry; Energy and Environmental Chemistry; Medicinal and Pharmaceutical Chemistry. Materials Chemistry represents the largest grouping and has overlap with both the other two themes through synthesis and characterisation.

The Chemistry Unit is represented on the Faculty Research Committee which in turn reports to and is represented on the University Research Committee.

1.3 Research and Impact Strategy

The research and impact strategy of the Unit is closely aligned with the strategic aims of the University articulated through the Institutional statement and cascaded via the Strategic Executive Team and the University Research Committee. Our focus within the Unit is on developing critical mass, building strength and depth within the three core themes. We recognise that the Unit is relatively small, and therefore strategic aims will be achieved through collaboration and interdisciplinary working across the Engineering, Mathematics, Physics and Computer Science disciplines within the Faculty, and externally both nationally and internationally.

Materials Chemistry

The Unit is well equipped to develop and expand its Materials Chemistry theme. This is a broad theme including inorganic chemistry (**Fogg**), computational materials chemistry often with a focus on optoelectronics applications (**Papadopoulos, Spink**), surface property modification by physical and chemical processing (**Hodgson, Hazell, G Smith**). The theme benefits from the high-level materials characterisation facilities installed in the Faculty at Thornton Science Park, and from a number of specialist facilities including the laser materials processing laboratory and the Chester High Performance Computing cluster.

Medicinal and Pharmaceutical Chemistry

Work in this theme is focused around novel drug design, particularly the synthesis and evaluation of Pt-compounds for cancer treatment (**Wagner**) and the development of small active molecules as drug candidates (**Ziedan**). Selective apoptosis induction and protein-protein interactions are targeted for drug development. In a related activity, modelling work is in progress to better understand the processes of DNA methylation in ageing (**Mc Auley**). Anti-biofilm surfaces are under development using physical and chemical surface nano-modification techniques in collaboration with the Materials Chemistry theme (**Hazell, Hodgson, G Smith**). In a collaboration with the Demokritos research institute in Athens, the theme has engaged with studies of core-shell nanoparticle encapsulation of quercetin and curcumin for anti-cancer and anti-oxidant therapies (**Swanson, Tang, G Smith**).

Energy and Environmental Chemistry

Energy systems research within the Unit is focused on the exploitation of electrochemistry for energy generation and storage. Novel PEM fuel cells are under development (**Ward, R Smith, Davies**) and the unit has taken steps to exploit the commercial benefits of the research through the University's ownership of the equipment from a former technology leader in this field (Acal Energy Ltd.). A prototype system has been developed; this is now at the stage where scale-up is in progress and a demonstrator is being commissioned. The fuel cell work has required detailed knowledge of gas/liquid bubble and flow systems which, with further research, has generated spin-offs in environmental remediation for water systems (**Ward**). One such example is of a commercial application in remediation of contaminated run-off water from paved areas such as highways (Sustainable Drainage Systems (SDS) Ltd.). A further spin-off has resulted in the invention of novel electrochemical sensors also with applications in environmental monitoring (**R Smith**).

Within Environmental Chemistry the Unit is active in ongoing research in the chemistry of the ambient and indoor atmospheres (**Phillips**). Part of this work is currently funded by EPSRC in a consortium including the Universities of Chester, York and Nottingham, (FEC £1.1M, £0.2M to Chester, awarded 2020). The work on the ambient and indoor environments is also supported by the DOMESTIC micro building facility, allowing controlled experimentation and modelling activities on indoor spaces and the interaction with the ambient. The activity has two further funding bids pending: one through UKRI Networks and one through the EU Research & Innovation Actions. Ambient air chemistry research work is further supported by industrially-funded work on the development and commercialisation of automotive emissions measurement systems in collaboration with Thornton Science Park and by the mobile atmospheric pollution laboratory. Within Energy & Environment, the overall strategy for impact is through commercial exploitation, particularly for the fuel-cell and associated redox battery systems, and for impact on improved water and atmospheric environment in a number of applications.

2. People

The unit is relatively small and therefore staff are recruited to strengthen and consolidate current areas of strategic importance. The majority of the 12 FTEs in this return have joined the University since 2014. The emphasis in recruitment has been on alignment with Unit priorities as outlined above, with the ambitions of the University, and with the strategy of the Faculty of Science and Engineering. Staff are cross-disciplinary and come from a variety of backgrounds some of which (for example, physics or mechanical engineering) may have been outside the traditional chemistry route. This enriches the experience and diversity of the Unit. Staff development is partly through self-development, for example by participation in conferences, journal reviewing and editorship, and professional organisations such as the Royal Society of Chemistry or the Institute of Chemical Engineering. Staff also make use of the University's comprehensive professional development schemes, including in supervision of PGR students and in grant writing and management. Time is made available in the Workload Allocation Management System for these activities, and their value to the Institution is recognised.

During the period of this review the three members of staff have progressed to other positions. **Swanson** has moved back to her native Germany (2017) and now holds a position at Otto-von-

Guericke-Universität, Magdeburg. **Davies** and **Tang** have used their experience to move on to non-academic positions (Ineos Fluor 2018 and Cancer Research UK 2020 respectively). Vacancies were successfully filled by **Hazell** (Materials and biomedical chemistry) and **Ziedan** (pharmaceutical chemistry), significantly strengthening these two key areas.

The Faculty and the Unit encourage & promote equality and diversity. We are proud that the University has recently successfully renewed its Athena Swan Bronze award and holds the HR Excellence in Research award. The Chemistry Unit is represented on the Athena Swan Self-Assessment Team (**G Smith**). In 2014 the University was one of only 5 HEIs to be awarded the Gender Charter Mark Bronze award. The percentage of BAME PGR students in the Unit is higher than the University average and we are conscious that this needs to be reflected in our staff profile. To this end, (i) we have adopted a policy whereby all staff recruitment interview panels will have at least one female member where possible, and (ii) ensured the Unit is represented in the University's Widening Participation work (**Fogg**). We are also conscious of the need to attract a higher proportion of female participation in our undergraduate and postgraduate research student body. This is addressed through a continuing series of public lectures by well-known female science representatives for example celebrating International Women's Day, our traditional Christmas lecture series, the RAF and schools' events. These events have been organised by our (female) OFFA-funded STEM outreach coordinator.

Thornton Science Park offers good access to people with disabilities. There are reserved car parking spaces close to the entrance of most buildings, ground floor doors are mechanically activated on a touch of a button, and lifts are available in all Faculty buildings. Across the University, disabled staff are invited to join the Disabled Staff Support Group where various issues such as autism, dyslexia, epilepsy, hearing impairment, Meniere's disease, mobility, and visual impairment are addressed. The University also employs a dedicated Assistive Technologist who provides support on the use of assistive technology. The University has been awarded the Disability Two Ticks Symbol by Jobcentre Plus, which acknowledges those employers who make certain commitments regarding the recruitment, training, retention, consultation and awareness of disabled people and disability in general.

The University prides itself on its inclusive policies. It has established a support network for staff who identify as Lesbian, Gay, Bisexual or Trans, and holds the Navajo Merseyside and Cheshire LGBTIQA Charter Mark, which stands as an indication of good practice, commitment and knowledge of the specific needs, issues and barriers of this community. The University holds an annual Diversity Festival, and throughout the year staff can participate on several different equality and diversity discussion boards. The University's Equality Forum takes place on a quarterly basis and all staff are welcome to attend.

Progress of research-active staff is considered as part of the annual Personal Development Review (PDR) process. The Unit and its contributing departments are keen to recognise and reward excellence in all fields of academic endeavour including research. Consequently, promotion is based on research record and on contribution to the wider University community. During the 2014 – 2021 REF period **Papadopoulos** and **Spink** were promoted to senior lecturer, **Phillips** to Deputy Head of Natural Sciences and subsequently Acting Head of Mathematical and Physical Sciences, **Mc Auley** to senior university teaching fellow (equivalent to associate professor), and **G Smith** was promoted to Associate Dean with responsibility for research. **Ward**, **Fogg**, **Hodgson** and **R Smith** were appointed to permanent faculty positions following periods on temporary/fixed term contracts.

The Chemistry UoA hosts a small but active PGR community. These students are supported by a first and second supervisor, with the Faculty Senior PGR tutor maintaining oversight of their well-being and progress. All PGR students are subject to a rigorous supervision and monitoring regime which includes 6-monthly progress reviews, and a MPhil to PhD progression review at 12-18 months. Current numbers are as below:

PhD completed:	2
MPhil/PhD in progress:	4
MRes completed:	3
MRes in progress:	10

Chemistry PGR students work alongside research students in the Engineering, Mathematics and Computer Science Units, to give an overall community of approximately 65 research students working at Thornton Science Park.

PGR students participate in the annual Institutional PGR Conference and the Research Festival. All Thornton-based PGR students take part in an active seminar series, and are required to present their work at the end of the project (for MRes and PhD) and on transfer from MPhil to PhD registration. The seminar series includes presentations from more senior members of staff, and external speakers including those from commercial companies based on the Science Park. Typically, seminars run every two weeks during term time, with a lower frequency over the summer.

The Chemistry Unit is growing the PGR student population through engagement with the Faculty-wide EU funded P4 Eco-Innovation project in partnership with the University of Lancaster. This project funds studentships where an SME is identified and the research leads to a carbon footprint reduction. This aligns well with the Unit's Energy & Environment theme. To date, this project has funded two MPhil/PhD and 6 MRes project students. Further steps to increase the PGR population include applications in progress through the EPSRC (**Papadopoulos**), and through Faculty fee-waiver arrangements. **Ziedan** has successfully secured funding for a post-doctoral Research Fellow through an Egyptian government scholarship scheme. In a recent development, the University has initiated a Sustainability Scholarship Fund and the Chemistry unit has one further PhD student through this route (**Fogg**).

In 2018, an annual Research and Knowledge Transfer Festival was established at the University. This encourages researchers from all departments to collaborate and exchange ideas whilst participating in a ten-day programme of events that cover promoting research activities, supporting research applications, and insights from eminent external keynote speakers. As a part of the festival, the Unit staff delivered sessions that included an event on learning lessons from industrial collaborations, facilitated by the University's Commercial Operations department.

3. Income, infrastructure and facilities

The table below gives a summary of key grants awarded to the Unit during the REF period.

Income Summary

Grant Holder	Topic	Grant £	Sponsor	Year awarded
Papadopoulos	Organometallic halide perovskites	11,380	Royal Society	2019/20
Fogg	Mesoporous silica from geothermal colloidal silica	50,000	UK Industry (Rothon Research)	2019/20
G Smith	Modelling Gastro-intestinal stents	3,455	UK Industry (MDecon)	2018/19
Ward	Water sample analysis	18,827	UK Industry	2017/18 & 2018/19
Phillips	Air quality investigations (InterCity Air project)	20,010	Innovate UK	2017/18
Mc Auley	Seminar organisation, modelling of healthy ageing	2,982	BBSRC	2016/17

Unit-level environment template (REF5b)

Davies	Electrochemical Energy Systems	42,982	UK Industry (ACAL, CTech, SDS, Nukey, Medtechtomarket)	2015/16 & 2016/17
Phillips	Air Quality Research	12,331	NERC	2015/16
Davies	Graphite Felt Electrochemical Sensors	4,000	RSC	2015/16
G Smith	Technical Support	5,417	UK Industry (SGS, Stopford, AQR)	2014/15
	Total:	171,384		

The table above gives the total of grant and other external income received by members of the Unit during the assessment period. In addition, the Unit carried out commercial chemical analysis service work through the Analytical Centre to a total of £70,057 in the period 2016 – 2019.

Infrastructure and Facilities

The Chemistry Unit is well equipped to support research in the areas of strategic focus. All laboratories where research students are allocated dedicated persistent space have fume cupboards, gas lines, extraction and basic facilities such as balances, etc. Specialised facilities are briefly summarised below:

Chemistry Instrumentation Laboratory:

- TGA, DSC, GC, Bench-top NMR

Electrochemistry Laboratory:

- potentiometers, laser particle sizer, ultrasonic probes.

Organic synthesis laboratory:

- polarimeter, microwave reactor, rotovap, fluorescence spectrometer

Laser Materials Laboratory:

- 60W CO₂ laser, 300 W fibre laser 1032 nm, picosecond ultra-short pulse laser 1032 nm, 850 mJ Nd/YAG laser + characterisation facilities including UV-vis, optical microscope, carbon coater for coupling layers.

Materials Characterisation Laboratory:

- XRD, SEM-EDX, TEM, XPS, AFM/STM, optical microscopy (polarisation, DIC, phase, fluorescence), preparation equipment (ball mill, ultra-microtome, vacuum evaporator, sputter coater)

Atmospheric Chemistry Laboratory:

- dedicated mobile air pollution monitoring vehicle, range of air quality monitoring instruments for trace gas and particulate matter analysis. DOMESTIC facility which consists of dual controlled environment laboratories for investigation of indoor air quality and chemistry.

Fuel Cell Laboratory:

- 2 self-contained modular vanadium redox flow battery systems, conventional fuel cell, 2 x fuel cell / flow battery hybrid rigs, prototype water treatment rig, 3 kW pilot plant fuel cell demonstration & test scale-up facility.

Class II Microbiology Laboratory

- For the preparation, growth and testing of cell structures for biocompatibility investigations.

The Unit also operates the Analytical Centre. This is a dedicated analytical chemistry facility that exists to provide a modern analytical service for the benefit of teaching, research and commercial customers. Its facilities include ICP-MS, CHONS elemental analysis, FT-IR, GC-MS, ToF-MS, HPLC, bench-top SEM and a number of further minor items. The Centre acts as a front-end for commercial access to Faculty-wide facilities and expertise, with a current focus on analytical chemistry and materials characterisation.

Theoretical materials chemistry is carried out in part using the University's high-performance computing cluster which consists of a combined processor power of 312 cores. Intel Xeon E5 series

Unit-level environment template (REF5b)

@ 2.5GHz CPUs are incorporated adding up to 530 GB of memory in total. Cores are divided among 17 computer nodes linked via high-speed infiniband interconnects.

Members of staff have access to a wide range of external facilities. Within the assessment period, use has been made of 1,500,000 hours of CPU time (Hartree Centre, Edinburgh supercomputer cluster); the Diamond SRS, the ISIS Spallation Neutron Source, and National NMR and Mass Spectrometry facilities.

4. Collaboration and contribution to the research base, economy and society

Collaborations, Networks and Partnerships

The Chemistry Unit has a strong belief in the power of networks and collaboration to build and strengthen research impact and reach. Our collaborations are cross-disciplinary, multi-national, and focussed around our three key themes. We work with Universities, research institutions, local authorities and commercial enterprises to maximise the contribution of our skills and expertise for economic and social good.

Within Materials Chemistry, **Papadopoulos** has extensive international collaborations on electron transport modelling for optoelectronics. These include Bath University (Co-sponsored PhD studentship with Walker), National Taiwan University (with G-Y Gua, 2-year Royal Society travel grant awarded £12k), Georgia Institute of Technology (Bredas) and Demokritos National Laboratory Athens (Vasilopoulou). In related work, **G Smith** has collaborated with Bangor University (Kettle) on characterisation of optoelectronic devices. **G Smith** also collaborates with the group of Banks at Manchester Metropolitan University on the use of low-dimensional materials for electrochemical sensing. The Materials Chemistry activity on laser modification of surfaces is carried out with extensive external collaboration. **Hodgson** and **Hazell** work with Bangor University (Thomas) on anti-microbial surfaces; **Hodgson** has worked with Aberdeen University (Udoh) on enhanced oil recovery. **G Smith** works with Queens University Belfast (Chan, Carson) and Technical University of Denmark (Lee) on laser treatments for improved tribological and anti-microbial properties of articular joint implants. **Swanson, G. Smith, Tang** and **Papadopoulos** have also worked with the Demokritos research institute in Athens (Litsardakis, Havelas) on curcumin and quercetin-based pharmaceutical agents.

Wagner, in Medicinal and Pharmaceutical Chemistry, collaborates widely in the synthesis and characterisation of anti-cancer drug candidates at the Universities of Ulm (Linden), Augsburg (Hermann), Lisbon (Carvalho), Southampton (Coles) and Manchester (Watson, Adams). Within this theme, **Ziedan** collaborates with Zhao at Liverpool on anti-fungal compounds, and both **Ziedan** and **Fogg** work with UCL on medical imaging, drug delivery and anti-cancer drug formulation (Williams, Kozielski). In related work, **Ziedan** collaborates with UCLan (Ameer) on computational studies of anti-cancer drugs. Further collaborations include those of **Mc Auley** on nutrition and health with Liverpool Hope University (Salcedo-Sora) and Sheffield University (Corfe). **Wagner** and **G. Smith** have worked with the Christie Hospital, Manchester on the chemical degradation of oesophageal stents (Laasch – Visiting Professor), and this collaboration continues through **Wagner's** work on interaction of collagens and X-ray contrast agent.

Work in the Energy and Environment theme is strengthened by **Phillips'** collaborations with York and Nottingham Universities (Carslaw, Dillon, Jones) on indoor air quality and the Max Planck Institute for Chemistry in Mainz (Crowley) on atmospheric chemistry and membership of the EU COST action on indoor chemistry. **R Smith** works with Liverpool University (Alston) on alternative fuel cell catalysts for incorporation into novel fuel cell designs. **Ward** is working with the Manchester graphene centre on graphene enhanced membranes for improved redox flow battery performance.

The Unit, through the Faculty and the Science Park, has hosted conferences and related scientific/industrial activities throughout the assessment period. Examples include:

- UK Surface Analysis Forum Summer Meeting, July 2015. Approximately 80 delegates, 7 invited speakers, 12 companies exhibiting. Surface and interface science is a key thread in our Materials Chemistry theme; this meeting enabled expansion of our networks and

Unit-level environment template (REF5b)

exposure of our research to a wider audience through 2 keynote presentations and a number of poster presentations by PGR students.

- Several early-evening meetings co-hosted by the local branch of the SCI (Society for Chemical Industry)
- Vienna Ab-initio Simulation Package (VASP) Computational Workshop co-sponsored by Institute of Physics, October 22-23 (2019), with 38 delegates and 5 international speakers. VASP allows atomic scale modelling of materials from first principles and is widely used in Materials Chemistry.

Through **Papadopoulos**, the unit has been instrumental in establishing a North Wales and Cheshire Centre of the Institute of Physics (IoP) as a sub-division of IoP Wales. This will act as a focus for future events and meetings at Thornton Science Park. Recent events have included a workshop on Linux and webinars on career prospects in the nuclear sector, and on applications of particle accelerators.

Contributions to Research Base, Economy and Society

Staff within the unit demonstrate commitment to the research base through participation in professional bodies, learned societies, journal editorial board membership, and conference organisation. All members of staff in the unit exercise good research community citizenship through the peer-review process for a range of scientific journals.

In Materials Chemistry, **Papadopoulos** is a committee member of the Institute of Physics Thin Films and Surfaces Group, a member of the Collaborative Computational Project CCP9 working group, a member of the EPSRC Associate Peer Review College, and a visiting scholar at the National Centre for Theoretical Sciences Taiwan. **G Smith** is committee member and past chair of the UK Surface Analysis Forum and was awarded the Rivière prize of the UK-SAF in 2015 and Fellowship of the Institute of Physics in 2019. In Energy & Environment, **Phillips** was an Associate Editor of Atmospheric Measurement Techniques 2014-2019 (EGU), and is Academic Editor of Peer J Analytical Chemistry and MDPI Environments. He is also a sub-theme leader of the EU COST Indoor Chemistry network. In Pharmaceutical and Medicinal Chemistry, **Wagner's** esteem has been recognised by the award of Fellowship of the RSC in 2017.

The Chemistry Unit of Assessment has made a broad and growing contribution to the regional economy during the short time of its existence. This has been made possible by its unique value proposition to companies on and in the vicinity of Thornton Science Park. The presence of a University Faculty embedded within the Science Park has allowed us to cut through many of the barriers which traditionally exist between academia and industry, supporting the local economy through provision of access to analytical and other chemistry facilities either on a commercial or collaborative basis. Our undergraduate students enjoy work-based learning placements on-site as an integral part of their academic experience. The benefit to postgraduates in terms of company-sponsored and collaborative research is seen in terms of subsequent employment, in addition to the industry-focussed research outputs. This is particularly the case for PGR students working with SMEs which have access to the prototyping and laboratory facilities of the ERDF-funded Innovation to Commercialisation (I2C) Centre and High Growth Centre, and the Local Enterprise Partnership (LEP) co-sponsored Energy Centre.

Contributions to Society

Staff of the Chemistry Unit are mindful of their social responsibilities and take care to engage in a wide range of Outreach activities. Examples include talks and demonstrations at local schools, hosting public events such as our popular Christmas lecture series, organising A-level revision events, SciBar talks and occasional contributions to public media such as local radio.

The Unit has engaged with society in the wider public domain through a wide range of STEM Outreach activities drawing on our research as examples with which to inspire and motivate future generations of science and engineering students. In addition to visits to local schools and colleges these activities have included A-level revision events, public lectures including a series of Christmas

lectures by well-known personalities such as Dr Maggie Aderin-Pocock, and support to International Women's Day events

The Chemistry team has links with the Christie Hospital, a specialist cancer treatment centre, deploying our research in Materials Chemistry for the better understanding of corrosion and degradation of oesophageal stents. Through this connection, work in our pharmaceutical and medicinal team has led to a better understanding of the mixing and shelf life of contrast agents used for radiography. More directly, the research in the team is leading to a better understanding of the underlying molecular contributions to ageing, and to the search for new anti-cancer treatment agents.

Within the Energy and Environment theme, research is directly targeted to societal benefits. Longer term aims include the improvement of indoor and outdoor air quality, and the development and exploitation of novel fuel cell technologies for energy generation and storage with associated impact on CO₂ reduction.