Institution: Lancaster University

Unit of Assessment: 8 Chemistry

a. Context

The Chemistry Department was re-established in October 2012, with the ambition to become one of the leading departments in the UK and internationally in terms of the impact of its high quality research. However, high quality and impactful chemistry research at Lancaster University has been flourishing throughout the assessment period in the Lancaster Environment Centre (LEC) (environmental chemistry), the departments of Physics (materials chemistry) and Engineering (nuclear chemistry), and within Biomedical Sciences (biophysical chemistry). Chemistry builds on this research excellence, strengthening and integrating chemical research in these established areas. Research in Chemistry is organised within three themes: Synthetic Chemistry; Chemical Theory & Computation; and Analytical Chemistry & Spectroscopy. Research in these themes is advancing the core sub-disciplines and generating impact within the application domains of: Energy and Sustainability; Life Sciences and Health Care; and Functional Materials. The impact of chemical research is ubiquitous (see The Economic Benefits of Chemistry Research to the UK, 2010, Oxford Economics), and central to our response to the global challenges of climate change, energy supply, security, food security and health. Addressing industry needs for quality research and training is a core and integrated activity within Chemistry's emerging research programmes, demonstrated by very early successes in terms of collaborative grant income from industry, a PhD CASE award, and a knowledge transfer partnership (KTP) being in place by the end of our first year of existence. Advanced plans are also in place to bid for £10M of European structural funds to build a dedicated, shared-use research facility for chemical-based industries including small and medium enterprises (SMEs), which would be additional to the Department's established £22M capital investment programme to 2015.

b. Approach to impact

As a new department we are developing and consolidating our strategy and associated framework for supporting and promoting the impact of our research. Fundamental to this has been the establishment of Chemistry's Impact Strategy Group (ISG) that meets regularly to evaluate the potential impact of research projects, and to promote opportunities by driving the agenda of our research funding activity. This group actively seeks industrial collaborators to partner our research. The ISG has representation and support from a dedicated Business Partnerships Manager for the Physical Sciences, who works closely with our departmental research committee. Complementing the ISG is Chemistry's Strategic Advisory Board with membership from industry, local healthcare trusts, and government, whose remit includes the development of an effective impact delivery strategy, the facilitation of impact-rich networks, and the promotion of impact awareness.

Our approach to interaction and engagement with beneficiaries of our research comprises the following key components:

- *We pursue collaborative chemical research at disciplinary interfaces*, which widens and increases the opportunities for impact and interactions beyond traditional chemistry. Chemistry is integrating with existing centres of impact (LEC, Physics, Biomedical Sciences and Engineering), giving Chemistry access to a wide spectrum of beneficiaries who could benefit from its research. For example, the submitted galantamine impact case study (ICS) arose from collaborative research with biomedical scientists.
- *Proactive engagement with key industrial stakeholders*. This is facilitated through publicity of our research foci and relationship building via: on-site seminars (e.g. Fielden at Syngenta; Anwar at GSK and Syngenta; Gortz at L'Oreal Paris); promotion of our research by our business partnerships and enterprise team; targeted marketing campaigns to key sectors and alumni; the development of key national relationships (e.g. with the Chemistry Innovation Knowledge Transfer Network); our access to resources from Lancaster's EPSRC impact acceleration account and Higher Education Innovation Fund (HEIF); collaborative engagement with larger industries with the N8 group (the 8 research intensive universities in the north of England) (e.g. the N8 Industrial Biotechnology event, 2013); and national and international research conferences. The printing inks ICS resulted from an enquiry from the Royal Mail, with Lancaster being approached on the basis of its research reputation built via the kinds of activities outlined.
- *Horizon scanning and seeking research opportunities* that are driven by industrial demand and the delivery of new capability. We have a willingness to consider small and short-term projects

and an enthusiasm to work on research-based relationships with SMEs. (The Witty Review (2013) recognises Lancaster as one of only four research intensive universities within a ranking of the top 10 UK universities, with respect to the number of relationships with SMEs). This is something that Chemistry has taken early advantage of, with examples including, a KTP with a NW SME to develop a new sensing system for waste-water management, in addition to partnerships with larger industry, including a CASE studentship with AstraZeneca. We are also in discussion with a number of major companies towards developing longer-term research partnerships; these include Crown Paints, United Utilities, Shimadzu, and Johnson Matthey.

- *Impact being an appointment criteria supplemented by support and recognition for staff engaging in impact activities*. Staff appointments include individuals with experience of working in industry, or who have engaged in innovation, with a view to championing translational research within the Department. Anwar was at GSK (1981-1986), Middleton at SmithKline Beecham Pharmaceuticals (1993-1998), and Franckevicius at Adprotech Ltd (2001-2) in the early stages of their careers. The importance of translational research is featured in probationary agreements, the Personal Development Review (PDR) process, the award of sabbaticals to include industrial exchange, and as fundamental criteria for promotion. Lancaster's academic promotions criteria require "*involvement in activities designed to ensure that appropriate impact of the research (outside academia) is achieved*." Training of early career staff in impact awareness is achieved through close mentoring by staff experienced in impact delivery. A key element of this training is to facilitate initial links with industrial partners through meetings and visits, which are then followed through to the generation of a working research relationship with an industrial partner, via routes such as feasibility study projects, joint grant applications, or consultancies. This is complemented by courses on open innovation and intellectual property at the University level.
- *Full utilization of University expertise and resources*. Support from University's Business Partnerships & Enterprise professionals is essential to Chemistry's ambition of delivering impactful research. A dedicated Business Partnerships Manager, as part of, and supported by a wider team, facilitates and mediates interaction with industrial partners at all levels. This support includes the promotion of our research to industry, the development and management of specific project-based collaborations and the use of appropriate and 'pro-exploitation' IPR and contractual agreements. They also provide training for staff to enhance their effectiveness in building networks and partnerships with industry. The department is also supported via access to funding through the University's Pathway to Impact Small Grant Scheme and Proof of Concept Fund.
- *Capitalisation on the increased role universities need to play in economic growth.* The chemical sector in the Northwest of England comprises over 800 companies with 160,000 employees, and an annual turnover in excess of £9B with 80% of production as export. Developing partnerships with some of these companies is a high priority for Chemistry. In our strategy and plans we have advanced proposals for major investment to support our work with existing local SMEs and larger companies, and those re-locating from elsewhere in the UK and overseas, building on a number of partnerships already developed, including with SMEs such as Process Instruments Ltd.; Microfab Ltd.; KP Technology Ltd.; Arid Agritec Ltd; and larger companies including GSK and Sharp, with funding from the institution's Impact Acceleration Account (EPSRC).
- *Additional impact activity*. Examples include: a member of staff serving as a scientific advisor to the Cabinet Office (High Impact Threats Advisory Group); End-user meetings in the area of electroanalytical sensors; and Schools engagement to enhance chemistry interest (e.g. key role in the Ogden Trust funded Bury Schools Science Partnership).

We give examples below of impact (current and emerging) resulting from quality chemical research at Lancaster:

- Research in persistent organic pollutants (POPs) carried out within the Lancaster Environment Centre (LEC) underpins the UK National Implementation Plan for the Stockholm Convention on POPs. Research into the impact of municipal solid waste incineration led to a quantitative understanding between environmental concentrations and human exposure to dioxins, through chemical fingerprinting and food-chain modelling.
- The REACH Centre (a start-up company from and based in LEC, employing 10 Lancaster alumni) provides research-based expertise and training to industry to both meet and exploit the commercial opportunities offered by EU REACH legislation (the Registration, Evaluation, Authorisation and restriction of Chemicals). This operation has expanded to meet international

needs, most recently in Japan.

c. Strategy and plans

To promote the translation of quality research within the Department into societal impact, we endeavour to create an impact-inducing environment via the following specific actions:

- *The development of links, networks and exchanges with industrial partners by targeting businesses in and locating to the NW region, which complement with our research themes*. This will lead to collaborative and contract research bids to a range of sources, including the research councils, the TSB, and directly to the private sector.
- A £10M proposed investment from European Structural Funds to build, equip and staff the Reaction Centre, a shared-use facility with SMEs and larger industry. Supported by the Local Enterprise Partnership, this proposal stands as the top priority for remaining European funds of the current programme and an early priority of the new 2014-2020 structural fund programme. Funding is being sought to build a three-story, shared use laboratory facility, equipment, dedicated staff to develop partnerships with business, along with a dedicated technical team.
- *The development of a Doctoral Training Centre in Industrial Metrology*, with an emphasis on chemical measurements relevant to industrial and/or healthcare impact. This interdisciplinary centre will involve Chemistry, Engineering, Physics, and Biomedical & Life Sciences.
- *The promotion of impact awareness through the staff PDR process.* Staff will be supported to work with end-users (both industry and healthcare) through an internal impact fund. This will support travel and subsistence for staff to develop new strategic links with industry.
- *The promotion of interaction between local industry and undergraduate (UG) and postgraduate (PG) research projects*. This is part of our strategy of embedding impact awareness and activity throughout Chemistry. We will develop feasibility studies with industrial partners that will add realism and impact to the student experience and facilitate knowledge transfer to industry. The industrial links will form the basis for the development of a four year MChem taught programme with a year in industry option. We will approach local, chemically-orientated companies to develop a portfolio of placements for our top-performing students, as well as industrially-relevant projects for final year students. Linked with this activity will be the introduction of enterprise, innovation, and impact training for all UG and PGR students and PDRA staff.
- *The delivery of a balanced seminar programme which promotes both academic excellence in research, and also applied research with external impact*. The seminar programme will include speakers (national and international) from academia and industry. Annual 'showcase' seminars will be organised to encourage engagement with industry. Workshops to explore unmet needs will be introduced as specific vehicles to promote links with local industry and SMEs.
- *Provision of Continued Professional Development workshops for industry*. For example, in collaboration with the REACH Centre who work in partnership with the University to deliver a postgraduate certificate in REACH Compliance.
- *Enhancement of our outreach and public engagement to promote chemistry and the ubiquitous impact of chemistry in areas such as healthcare and technology* (including support through the RCUK Concordat for engaging the public with research).

d. Relationship to case studies

1) **Galantamine and Alzheimer's disease.** This ICS demonstrates how interdisciplinary collaboration between chemists and biomedical science researchers led to expertise in NMR spectroscopy of biomolecules contributing to impact in therapeutics. The collaborative research uncovered how the drug galantamine inhibits the aggregation of the amyloid peptide Aβ in the treatment of Alzheimer's disease. The research results contributed to the re-appraisal by NICE to adopt galantamine on the NHS for early stage treatment of Alzheimer's disease.

2) **Luminescent inks for mail coding and sorting.** The Polymer Group in the former Chemistry Department at Lancaster had expertise in both ink-jet inks and luminescent materials. Royal Mail approached the group, based on the group's reputation, to improve the properties of luminescent inks used for the coding of mail. This led to a joint research programme, funded by Royal Mail, with staff members from both organisations working together to ensure successful technology transfer. The route to impact started with the excellence in polymer research at Lancaster, followed through a partnership research programme, and was completed through embedding the novel technology within Royal Mail through subsequent employment of one of the Lancaster researchers.