

2014

ResearchNews, Volume 8, 2014.

Dublin Institute of Technology

Follow this and additional works at: <https://arrow.tudublin.ie/jouresiss>



Part of the [Education Commons](#)

Recommended Citation

Dublin Institute of Technology, "ResearchNews, Volume 8, 2014." (2014). *Issues*. 8.
<https://arrow.tudublin.ie/jouresiss/8>

This Other is brought to you for free and open access by the ResearchNews at ARROW@TU Dublin. It has been accepted for inclusion in Issues by an authorized administrator of ARROW@TU Dublin. For more information, please contact yvonne.desmond@tudublin.ie, arrow.admin@tudublin.ie, brian.widdis@tudublin.ie.



This work is licensed under a [Creative Commons Attribution-NonCommercial-Share Alike 3.0 License](#)

ResearchNews

Dublin Institute of Technology Vol. 8



Editorial



This issue of Research News celebrates the tenth anniversary of DIT's FOCAS Research Institute. Located close to DIT Kevin Street, FOCAS is a state of the art research facility hosting microscopy and spectroscopy technologies for a range of research groups and activities. It has become home to over 150 research staff, 12 research centres of excellence and a hub for internationally-regarded interdisciplinary research in Science and Engineering.

FOCAS is a national, open access facility for optical characterisation and spectroscopy. It has given unprecedented access for researchers to a range of specialist equipment that has enabled a step change in DIT's research activities. Biospectroscopy and Nanoscience remain core fields of activity for FOCAS. But as this issue illustrates, FOCAS hosts an extraordinary breadth of research that includes radiation science, applied electrochemistry, modelling of industrial elastomers and advanced surface coatings. Importantly, FOCAS offers high-end technology services to industry such as CREST, Ireland's only dedicated surface coatings laboratory in Ireland and part of the Technology Gateway network. FOCAS is also a very important centre for doctoral education and has an impressive number of PhD students working in its various research groups.

FOCAS alongside the creation of vibrant, dynamic environments that facilitate collaborative working and interdisciplinary research is central to DIT's research vision. FOCAS alongside ESHI (featured in the last issue of Research News) is first of four such Research Institutes that will create critical mass in areas of research strength and will achieve recognition for the relevance, excellence, as well as the social and economic impact of DIT's research. FOCAS@10 represents a great achievement for the entire DIT research community. As we look towards new collaboration in the Technological University for Dublin Alliance, the next 10 years promise more exciting developments.

Dr Brian O'Neill

Director of Research, Enterprise and Innovation Services

e: brian.oneill@dit.ie

Contents

- 01** FOCAS Research Institute — in a nutshell
- 02** Specialist equipment for research and industrial applications in FOCAS
- 03** FOCAS – Technologies to License
- 04** Professor Hugh J Byrne
- 07** Graduations and Publications
- 08** Pint of Science
- 09** FOCAS Postdocs
- 10** Research Institute aims for a Tobacco-free Society
- 11** FOCAS spin-out aims to solve global counterfeiting problem
- 12** Applied Electrochemistry Group
- 15** The Centre for Elastomer Research
- 16** Applied Intelligence Research Centre
- 18** Communications Network Research Institute
- 19** Dr Mark Davis
- 21** Centre for Research in Engineering Surface Technology
- 22** Dr Brendan Duffy
- 26** FOCAS Alumni
- 33** Nanolab
- 34** Dr Gordon Chambers
- 37** Radiation and Environmental Science Centre
- 38** Professor Fiona Lyng
- 42** tPOT Research Group
- 44** Industrial & Engineering Optics
- 47** Dr Jacinta Browne
- 48** Dr Suzanne Martin
- 51** Dublin Energy Lab
- 53** Professor Aidan Duffy
- 55** DIT expertise goes from strength to strength
- 58** FOCAS encourages students to study science & engineering

Editor: Jean Cahill

Centre manager profiles: David Quin

Design: www.designetc.ie

Print management: Arrow Print Management Ltd

e: research@dit.ie

FOCAS Research Institute – in a nutshell

Building cross-disciplinary teams, developing key partnerships with academia and business and creating links with research partners across the globe have helped FOCAS researchers to develop new technologies, support local industry, health services and other state agencies, make ground breaking discoveries and develop high impact papers for publication in prestigious journals and for presentation at conferences worldwide.

Officially launched in 2004, the FOCAS Research Institute is home to more than 150 research staff -70% of whom are PhD students, clustered into 12 research centres of excellence. The research teams work across a range of fields including: surface engineering, nanotechnology, photonics and biophotonics, materials science, radiation biology and communications. In 2010, following an international review, FOCAS was formally designated the first of DIT's Research Institutes.

Originally established as a facility for optical characterisation and spectroscopy, the 3200m² building provides core laboratory support and houses an unrivalled suite of instrumentation for spectroscopic (UV to far IR) characterisation and imaging (Raman, FTIR) and optical (Confocal fluorescence), scanning probe (AFM, conductive AFM) and electron (SEM, WDX, EDX, variable pressure/cryo SEM, TEM) microscopy.

Professor Hugh J Byrne, Head of FOCAS Research Institute, explains where the funding for this unique facility was sourced: "Following a highly competitive process in 1999, DIT was awarded funding for FOCAS by the Higher Education Authority Programme for Research in Third Level Institutions (PRTL1), Cycle 1 (1999-2001). It was co-funded by the EU Structural Fund and Allied Irish Banks, under a Public Private Partnership agreement providing a total of €10.4m for construction and set up costs."

"The new building was completed in 2004, although the research teams who moved into the facility had been established for several years within Schools across DIT", says Professor Byrne. "Initially we planned to accommodate 6 research groups but very soon designated Research Centres were established and new groups were located in the Institute. It was clear we needed more space."



"In 2007, DIT was awarded €8m funding under PRTL1 Cycle 4 (2007-2013), co-funded by the EU Regional Development Fund for activities associated with the National Platforms: Integrated NanoScience Platform for Ireland and the National Biophotonics and Imaging Platform Ireland. The funding helped to upgrade the facilities and also added a 3rd floor extension which was completed in 2012."

The past 10 years has seen the FOCAS Research Institute go from strength to strength as it grows in scale and reputation nationally and internationally. Over the next few years there will be major changes within DIT that will have a positive impact on the FOCAS Research Institute and its researchers. In 2015, Institute of Technology Tallaght and Institute of Technology Blanchardstown will merge with Dublin Institute of Technology to form one Institute (DIT). This merged Institute is making an application to the Department of Education to be re-designated as a Technological University. Construction has already started on a new campus in Grangegorman, where all Colleges will eventually be re-located. The first 1,200 students from Art, Design, Photography and Social Sciences, along with 200 staff, re-located to Grangegorman in September to 8,000m² of newly refurbished buildings. A new building which will house DIT's Environmental, Sustainability & Health Institute (ESHI) and Hothouse is also under construction. Eventually a new research building for FOCAS will be built and located alongside ESHI to complete the Research Hub.

e: hugh.byrne@dit.ie

Specialist equipment for research and industrial applications in FOCAS

The FOCAS Research Institute has an open access policy for its specialist equipment and expert technical and scientific support is available in-house. The facilities are registered on the HEA Large Items of Research Equipment Database and ATLAS (Access to Third Level Analytical Services). The equipment has many applications in research as well as industrial applications. There are two main groups of instrumentation: spectroscopy and microscopy supported by expertise in sample preparation and analysis.

Spectroscopic analysis is fundamental to the understanding of both the properties of materials and chemical, physical and biological processes. It is a basic tool for the understanding and development of novel materials and processes. It is routinely used for analysis, problem solving and diagnosis. Any one regime of spectroscopy can only probe a limited range of physical properties, however, and therefore the availability of a full range of techniques is essential for any competitive research programme.

FOCAS has a suite of spectroscopic instruments, including absorption spectrometers and two Fourier Transform infrared (FTIR) microscopes, which can measure material absorption continuously from the UV to the IR spectrum. There is also a fluorescence spectrometer that measures luminescence across the visible range and three Raman spectroscopic microscopes providing vibrational analysis to complement the FTIRs. There is also a scanning polarimeter for measuring circular dichroism and optical rotary dispersion across the visible spectrum. A range of voltage and current sources are available and measurements can be performed over a wide temperature range (20K - 600K).

The microscopy facilities allow the 2-D and 3-D observation and study of physical, chemical and biological samples. They include light microscopes, configured specifically for wide-ranging applications such as phase contrast, fluorescence, bright field and dark field.



Confocal laser scanning microscopy allows blur-free, crisp images of thick specimens at various depths to be produced. A 3-D reconstruction of a specimen can be generated by stacking 2-D optical sections collected one after the other. Fluorescence spectra can be recorded with the spectrometer attachment.

A room temperature atomic force microscope allows imaging in the native liquid environment with resolution 100 - 1000 times that of optical microscopy and comparable to or better than electron microscopy. Dynamic processes can be imaged in progress eliminating the time-consuming and often damaging sample preparation for electron microscopy. This is particularly useful for biological materials where live cells can be imaged in physiological fluids. The Instrument can also be used in conductance mode to map the surface electrical properties.

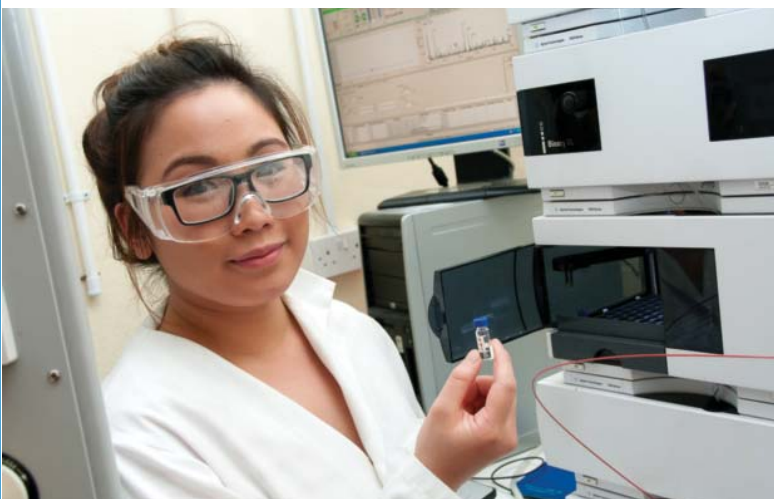
FOCAS has two Scanning Electron Microscopes for surface imaging down to the nanometer range. Both also have Scanning Transmission Electron Microscopy capabilities. One instrument is specialised for elemental X-ray analysis, while the second can image non conducting samples under variable pressure and the cryofeed option allows hydrated samples to be imaged.

**Information on all the equipment is available on the FOCAS website: www.dit.ie/focas/facilities
The HEA database is available here: www.heai.ie/lire
Mapping Academic Analytical Capabilities in Ireland (ATLAS) www.attlas.ie**

FOCAS – Technologies to License



DIT Hothouse works with FOCAS researchers to develop technologies to a stage where they are commercially focused, have demonstrated market potential and are industry-ready with the capability of providing significant competitive advantages. Here is a selection of some of those technologies developed within FOCAS Centres:



AIRC

KAPTI: A Receipt Capture and Analytics Platform

KAPTI is a software platform which enables the automatic capture of data from receipts and printed documents, which can then be stored, categorised, or analysed. The approach used is more accurate than existing approaches, because it uses a dual machine/human process. In a typical scenario, a user can use the KAPTI mobile app to take a picture of the receipt using their smartphone; the receipt is logged onto the KAPTI web platform which uses intelligent image processing and text extraction algorithms to digitise the data.

DEL

Polaris: Solar Farm Performance Optimisation

Polaris is novel highly accurate, high-speed software for the prediction, control and optimisation of utility-scale solar photovoltaic (PV) power plants. Polaris addresses some of the key challenges and uncertainties currently experienced by both solar farm and solar grid operators. Through simulation, highly accurate predictions can be achieved for PV farms in terms of their power output, including fluctuations caused by changing weather conditions. The energy yield predictions can be used to independently validate the performance of PV Systems.

IEO

Anti-Counterfeit Pressure Holograms

This technology is a novel hologram which is sensitive to changes in pressure on its surface. The technology can be integrated with anti-counterfeit products allowing a unique verification feature in which the user presses on a product. The technology also has applications in life science, electronics, or tactile pressure sensing, where changes in the surface can be used to create a sensing reaction.

Humidity Sensitive Holograms

IEO researchers have developed a unique humidity indicator in the form of a low cost lightweight polymer hologram (30–70µm) which is easily incorporated into packaging and graphics (logos, text, numerical data and three dimensional images). The hologram changes colour as the humidity of its environment changes. It can be used in many applications including intelligent packaging and product authentication.

CREST

Chromate free Sol-Gel Primer for Aluminium

This is a novel sol-gel coating for aluminium. This chromate free coating called Dualion is thinner than chromium free primers leading to cost savings in fuel consumption. It is also easily applied and disposed of. It is especially suitable for aerospace, automotive, architectural and construction environments.

Light-Activated Anti-Bacterial Powder

This technology is an anti-bacterial additive effective against harmful bacteria such as E. Coli and MRSA. This patented self-sterilising material is activated by indoor light and reduces the need for repeated cleaning using chemicals such as bleach. This powder can be incorporated into a number of products such as paints, fabrics, furniture etc.

CNRI

VoIP Quality Optimisation Software

This is a patent-pending VoIP quality predictor that can be used to optimise VoIP transmission and thus improve the quality of VoIP calls. It can also be used for pre-deployment testing, traffic monitoring and network troubleshooting.

e: stephen.davis@dit.ie



Professor Hugh J Byrne

Head of the FOCAS Research Institute, DIT

FROM THE ROOF OF THE FOCAS BUILDING AT KEVIN ST, PROFESSOR HUGH BYRNE CAN SEE THE EDIFICES OF HIS CHILDHOOD: PRIMARY AND SECONDARY SCHOOL (SYNGE ST), ST KEVIN'S CHURCH, ETC. BUT SINCE THAT TIME, HE'S BEEN AROUND MANY DIFFERENT BLOCKS, BOTH NATIONALLY AND INTERNATIONALLY.

In school, he was good at maths. He also enjoyed science, but did not fix particularly on becoming a scientist, although he did Experimental Physics at TCD. While his scientific ability is unquestionable, he found that his interest and talents also lay in educational matters, in working with people and organising things.

He went to TCD before he was 17. "I loved being there...!" His final-year project at TCD was a joint physics, chemistry and genetics project, hinting already at his interdisciplinary future. In his postgraduate work, he was exposed to new science and had the "great feeling" that the work was relevant worldwide. In managing projects, he already faced the kind of questions that would later become central to his work: What should we buy next? How shall we build up the facilities?

Fantasy equipment

He submitted his PhD (laser physics, with a focus on organic materials) just before his 25th birthday. Then he worked in the Max-Planck-Institute in Stuttgart as a laser specialist. The equipment available would have been a matter of fantasy for scientists back in Ireland. He also noted that if equipment was not tied up, it had to be made available to whoever wanted it. Again, “a great experience” – as well as great experience. Some Japanese researchers he met there invited him to Japan as a short-term visiting expert in the National Materials and Chemistry Research labs. He found Japan in many ways less of a culture shock than staid, highly structured and disciplined (but not necessarily always efficient) Germany.

In January 1996 he began lecturing in physics in Kevin Street at a time when a strong focus was emerging on building up the research agenda and capabilities. He felt more comfortable in the lab, doing hands-on work with students, than standing in front of a class. He got to know some of the chemists, and, finding common ground, they bought a Raman microscope, a spectrometer, that Physics and Chemistry jointly owned; then set up a lab with more equipment. “Suddenly we had a research lab!” He had started to build shared facilities.

“My father, who worked with Scott Tallon Walker, did some feasibility studies for space extensions for DIT, and a possible research building was mentioned. So I thought, why not build a research building in DIT? I thought it would probably take me about thirty years. Then I’d retire and go fishing.” In 1999 came the Programme for Research in Third-Level Institutions, which “completely changed the landscape of research academia in Ireland”. An institute could only put in one proposal, and the emphasis was on strategy, capacity and capability. “I thought, this is totally different, and it was just right for DIT at the time.”

The maximum budget per institution was for IR£28m which, although half had to be self-funded, was “unprecedented, massive!” The crucial concepts developed by the team of about twenty were: shared facilities, with maximum use of equipment for the maximum number of activities, and interdisciplinary work. They proposed an Optical Characterisation and Spectroscopy Facility and, with great support from Matt Hussey, then Faculty of Science director, and DIT overall, they succeeded. It was a first for DIT in more than one way: level of funding, interdisciplinary cooperation, forward-planning on a large scale.

Exciting step

The same thing was happening all around Ireland, for the first time. “It was very exciting. The nation was taking a step we hadn’t taken before – and DIT was part of that.” In early 2000, presumably seeing a role that he was made for, Hugh volunteered to manage the whole project. He wasn’t overwhelmed – thanks to “blind naivety!” Tia Keyes (now in DCU) noticed that adding an F at the start of the acronym made it FOCAS. Fócas... Irish for focus (Hugh’s mother confirmed it!). Optical spectroscopy, microscopy, bringing people together – focusing them in a facility (Latin *facilis*: easy), a place of open access, easing research work right across the board.

“It was very exciting. The nation was taking a step we hadn’t taken before – and DIT was part of that.”

In 2004, fifty people moved in. The mix consisted of physicists, chemists, biologists and engineers. The process was not merely multidisciplinary. It was interdisciplinary – they worked together. Progress was rapid. By 2007, FOCAS was invited into what ended up being the two largest funded platforms (€62m between them) in the history of the State: the National Biophotonics and Imaging Platform, Ireland (NBIPI) and the Integrated NanoScience Platform for Ireland (INSPIRE). FOCAS is now on the international as well as national stage; it has strong links with key researchers in universities and research centres across Europe. Despite the FOCAS work, in 2010 alone Hugh was involved in 20 full, journal, peer-reviewed publications, national and international. FOCAS is involved in European projects; he’s on a number of international advisory committees, and, along with colleagues, also involved in national advisory projects as well as his own research (he’d particularly like to get into water, so to speak, but that’s for another day).

Principal research interests: applications of spectroscopy and study of molecular and nano-materials. Recent activities: biospectroscopy for diagnostics and biochemical analysis and nano-bio interactions.

FOCAS—10 years on

The FOCAS approach (no doubt partly due to a transfusion of Hugh's Cavan blood) is: maximum use for the maximum number of people. A good one for recessionary times. In contrast to the Celtic Tiger "famine to frenzy" tendency, "I'm quite careful, one step at a time." As regards the emphasis on commercialisation, he thinks that there's a risk of forgetting that one of the primary jobs of a third-level institution concerns education.

Could all the economic progress have taken place without all the educational work of the 1960s and 70s? "So we shouldn't get carried away by an over-emphasis on commercialisation."

Next decade?

What about the next ten years? Hugh sees FOCAS as a facility that not only provides equipment, as well as technical and administrative support, but also facilitates people not even in the building, in other research centres – adding much to the credibility of DIT nationally and to Ireland internationally. As regards the move to Grangegorman, "we've funding for a similar type of Research Institute for Environmental Sustainability & Health", which he feels is a special niche for DIT. He is now looking forward to seeing how they can integrate the two, uniquely spanning the Physical, Life and Environmental Sciences in the new custom built DIT campus.

Hugh Byrne has achieved much already, and yet what most excites him relates to the education side of his work, in particular postgraduate education, and the students "who always remain the same age". He sees "the buzz in their eyes when, for example, they get a paper published". And he notes how people doing postgraduate work "learn as much about themselves" as about science itself: about their analysis and problem-solving techniques, their methods of self-motivation, and so on.

Professor Byrne is not a spring chicken now, but there's a spring in his step, and he youthfully conveys a sense of enthusiasm and energy. He clearly has not settled into a comfortable academic bed with the aim of gradually falling asleep. He's done a lot, and he's ready for more.

e: hugh.byrne@dit.ie

- **BA (Mod), Experimental Physics, TCD**
- **PhD in Experimental Physics, TCD, 1989**
- **Postdoctoral Research Fellow, TCD, 1989-91**
- **Research Scientist at Max Planck Institut für Festkörperforschung (Solid State Research), Stuttgart, 1991-95**
- **Visiting Research Scientist at National Institute of Materials and Chemistry Research, Tsukuba, Japan, 1995-96**
- **Appointed as lecturer in School of Physics, DIT, 1996**
- **Seconded as manager of FOCAS, 2000**
- **25+ years' experience in research science**
- **Has published 250+ peer-reviewed journal and conference papers**
- **Responsible for over €20m in funded projects**
- **15+ years' experience in managing and developing research infrastructure**

Graduations and Publications

The number of peer-reviewed publications more than doubled between 2003 and 2009.

Dr Raghavendra Jallapuram (Optimisation of an acrylamides-based photopolymer for reflection holographic recording) and Dr Peter Olwell (2005) were the first two PhD graduates to complete their research in FOCAS Research Centres. Dr Jallapuram was based in the Centre for Industrial Engineering Optics and Dr Olwell was based in the Radiation and Environmental Science Centre.

The top 5 disciplines represented in FOCAS publications are: Materials, Science Multidisciplinary; Chemistry Physical; Energy Fuels; Optics; Radiology Nuclear Medicine Medical Imaging.

The first postgraduate students linked to FOCAS however, graduated in 2000. The number of PhD graduates has increased substantially each year, with a marked step change after 2004, which saw the completion and occupation of the 2400m² facility. This step change will be replicated over the next few years as a result of increasing the capacity of the building from 100 to 150 desk spaces when the 3rd floor extension was completed in 2012.

The number of PhD graduates per year has more than quadrupled in the last 10 years.



Publications

The number of International peer reviewed publications follows a similar pattern with a dramatic increase after 2004. The number of publications is also expected to rise again with the increased capacity in FOCAS.

The publication profile highlights strong international collaboration activities across the EU and with the US, Canada, and China.

FOCAS publications are strongly linked to DIT's core research themes as well as National Research Priority Areas for research and the Societal Grand Challenges identified for the EU Horizon 2020 programme. Notably, an analysis of the subject classification of the research outputs (Thomson Reuters, Web of Science) shows that FOCAS research strengths span a number of ISCED 2 codes, including 42 Lifescience, 44 Physical science and 72 Health. The publication profile also highlights strong international collaboration activities across the EU, and with the US, Canada, and China.

FOCAS on Pint of Science 2014



The Pint of Science festival aims to deliver interesting, fun and relevant cutting-edge science talks in an accessible format open to the public—in the pub! It provides a platform which allows people to discuss research with the people who carry it out. It is a non-profit organisation run by volunteers and was established by a community of postgraduate and postdoctoral researchers in 2012.

In 2014, the Pint of Science Festival came to Dublin for the first time and FOCAS researchers Professor Hugh J Byrne, Head of FOCAS and Dr Gordon Chambers, Manager of Nanolab, were invited to take part. The 2015 event will take place in May.

In his presentation, “Medical Diagnostics: But not as we know it!” Hugh discussed the physics origin of diagnostic technologies such as medical ultrasound, magnetic resonance imaging (MRI) and X-rays, and outlined developments in FOCAS and worldwide in the development of molecular spectroscopic techniques, likening the potential of the optical based technologies to those used by Star Trek’s Dr “Bones” McCoy.

Gordon’s talk: “The nanotechnologists to do list: fresher beer—done, fat free kebabs—done, no more hangovers—done... save the world—not tonight!!!”, covered the impact which nanotechnology has had on everyday consumer goods to date, while also highlighting the as yet unknown potential health and environmental hazards of nanoscale materials.



Dr Gabriele Dadalt Souto

Gabriele Dadalt Souto has a PhD in Pharmaceutical Nanotechnology awarded by Federal University of Rio Grande do Sul, Brazil.

She worked with dermal absorption and human skin effects of fullerene C60 aggregates under the influence of ultraviolet A radiation. She undertook different projects during her PhD, including the development and characterisation of polymeric, lipid and protein nanoparticle formulations. Gabriele is currently Postdoctoral Researcher through the Brazilian program Science without Borders at the FOCAS Research Institute, DIT, where she works in the development of drug-loaded chitosan nanoparticles, cell biology, confocal microscopy and Raman spectroscopy.

e: gabriele.souto@dit.ie

Dr Furong Tian

Dr Furong Tian joined FOCAS in April 2013 as an FP7-funded Marie Curie Research Fellow. As a senior researcher, she is focusing on developing gold nanoparticles for disease diagnostics.

As well as managing her research, she is teaching undergraduate and postgraduate students in Chemistry, Biology, Microbiology, Pharmacology and nanomedicine at DIT as part of her career development plan.

Dr Furong Tian has a Bachelor's degree in Medicine and a Masters in Biochemistry. She was awarded her PhD in Chemistry from Stuttgart University and Max-Planck Institute for Metal Research in 2006. She has been a visiting Research Scientist in the Radiation department, in Kyoto University and National Institute for Materials Science in Japan and prior to her move to FOCAS, was a postdoctoral researcher in Helmholtz Zentrum München, supported by a Helmholtz-DAAD scholarship and ANTICARBON Seventh Framework Programme.

In 2009, she received funding within the European network programme ERANET Nanoscience, through the ERA-NET Plus scheme of the EU Seventh Framework Programme, for the development of gold nanoparticles for cancer diagnostics. She has published more than 30 peer reviewed articles in major international journals and one book chapter and has over 1300 citations.

The publications include Nanotoxicology, Particle & Fibre Toxicology, ACS nano, Journal of Controlled Release, and Small and Biomaterials.

Dr Tian is a member of the American Chemical Society, European Respiratory Society, European Foundation for Clinic and Nanomedicine. She is a regular journal reviewer of the International Journal of Nanomedicine, ACS Nano, and Journal of Controlled Release. She is one of the editors of on-line Journal Frontier.

e: furong.tian@dit.ie



Research Institute aims for a Tobacco-free Society



Pictured at the launch of A Tobacco-Free Future in 2013 are (l-r) Dr Helen McAvoy, Institute of Public Health in Ireland (co-author), NI Health Minister Edwin Poots, James Reilly TD, Minister of Health and Professor Luke Clancy.

The TobaccoFree Research Institute Ireland (TFRI) joined the FOCAS family in February 2014. DIT Adjunct Professor Luke Clancy is the director of the Institute, Dr Kate Babineau is a postdoctoral researcher, and Sheila Keogan is the research clinical nurse specialist for the organisation. The TFRI focuses on four research themes: treatment of tobacco dependence; Tobacco Control policy; smoke-free areas; and health and social inequalities concerning tobacco-related issues.

This year, TFRI is conducting a number of tobacco-related research projects. The ‘Youth Perceptions of Plain Packaging’ study is exploring smoking behavior and attitudes towards standardised tobacco packaging among 16 and 17 year olds in Ireland. Data collection in the Republic of Ireland finished in May 2014 and data collection for wave 2 of the project will take place in Northern Ireland during the end of 2014/early 2015. Fieldwork is also currently underway on the ‘Smoking Behavior among HIV Infected Individuals and STI patients’ study, which is being conducted in conjunction with the Guide

Clinic at St James’ Hospital. The TFRI also collects data on tobacco smoking prevalence and e-cigarette use among young people in Ireland.

Recent international publications from TFRI showed that smokefree legislation both reduced mortality from heart disease, stroke and COPD that found that it also reduced inequalities in smoking-related mortality. These results were also presented at the TFRI/ASH/RCPI 10th Anniversary of Smokefree Symposium at the RCPI in March 2014. TFRI collaborates with Professor Pat Goodman, DIT and partners in the DOE/NSMC Joint North South Study into Household Emissions and with the IPH. New projects beginning in the autumn include measurements of exposure to secondhand smoke (SHS) and respiratory responses in patients with COPD and Asthma as well as a trial of Allen Carr’s ‘Easyway to Stop Smoking’ compared to standard medical treatment.

e: lclancy@tri.ie
w: www.tri.ie

FOCAS spin-out aims to solve global counterfeiting problem

The global spread of counterfeit goods costs companies and governments billions of dollars a year because of the loss of sales and tax income. The products are not only inferior in quality but may also be unsafe and pose a serious risk to consumers. The pharmaceutical industry is particularly susceptible. Counterfeit medicines represent an enormous public health challenge and range from random mixtures of harmful toxic substances to inactive, useless preparations. According to the World Health Organisation, an estimated 10% of drugs worldwide are counterfeit costing the industry approximately \$40 billion per year in lost revenue. The regular use of substandard or counterfeit medicines can lead to therapeutic failure or drug resistance. In some cases, it can lead to death.

The industry is continuously increasing measures against counterfeiting and legislation such as the European Falsified Medicines Directive has led to the need for improved traceability and authentication of products.

Holograms are a well-accepted authentication device, but existing holograms are always identical to one another and don't have any individual features that could be used for further verification. This is because they are usually mass produced from an expensive "master" hologram and it is not commercially viable to individualise them.

Typically holograms are identical for each product range. They are quite easy to replicate and provide insufficient protection against counterfeiting. The "holy grail" of holography is a cost-effective process for manufacturing unique holograms that can be individualised.

In 2013, Dr Izabela Naydenova, Centre for Industrial and Engineering Optics (IEO) did exactly that. She successfully completed an Enterprise Ireland Commercialisation Fund research project which commercialised a novel hologram production technique for the mass production of individualised holograms. This led to the formation of spin-out company Optrace Ltd in June 2013.

Stephen McDonnell is the company CEO. The team comprises Professor Vincent Toal, Director; Dinesh Vather, a graduate of DIT Bolton St, CTO; Dr Emilia Mihaylova (former IEO researcher), Head of Research; Amanda Creane (former researcher with IEO), Head of Business Development; and Claire Harding, Quality Assurance Associate.

Dr Izabela Naydenova, who led the commercialisation fund project and Dr Suzanne Martin, IEO Centre Manager are actively involved as scientific advisors to the company.

Optrace Ltd was awarded a place in the first cohort of the NDRC's VentureLab programme, which supports start-ups based on science and research outputs. The 6-month intensive, deeply experiential and focused accelerator programme aims to get start-ups "investor ready". Enterprise Ireland subsequently recognised Optrace as a High Potential Start Up (HPSU) and the company secured first round funding.

In its first year Optrace Ltd has successfully taken the process from single holograms in the lab to roll to roll pilot manufacturing capable of producing thousands of holograms in an hour.

With this type of hologram, consumers will be able to check the authenticity of products they have purchased. A unique holographic code on a transparent film will be placed on the packaging of each one. When the film is removed and held into a light source, the code is visible and can be verified against a code written on the packaging. Alternatively, using a web based or smart phone application or a text message, one can verify the product is the genuine article. As each code is unique, counterfeiters will not be able to reproduce it.

Optrace Ltd is currently based in the FOCAS Research Institute which is ideal, as the staff has easy access to its scientific advisors in the Centre for Industrial and Engineering Optics. Stephen McDonnell, Optrace CEO states "FOCAS is an excellent facility. The support we have received from Professor Hugh Byrne and the FOCAS staff in providing us space for our technical development has been invaluable. We have the use of world class facilities with direct access to our founding researchers which is of critical importance in the early stages of a start up."

The team is currently manufacturing and pilot testing the product with clients. They also have an extensive product pipeline under wraps and in development.

e: amanda.creane@optrace.ie
www.optrace.ie

Applied Electrochemistry Group

The Applied Electrochemistry Group (AEG) carries out research in electrochemistry with a special emphasis on applied or practical aspects. It is co-managed by Professor John Cassidy, School of Chemical and Pharmaceutical Sciences and Dr Tony Betts, Head of Research, College of Sciences & Health. Dr John Colleran and Dr Ben Schazmann are other important members of the Group. Located in the FOCAS Research Institute, group members conduct electrochemically-oriented research in a number of technologically important areas.

Electrochemistry is an important branch of physical chemistry. It deals with the chemical action of electricity and/or the production of electricity by chemical reactions. A diverse range of important industrial, technological and biomedical applications exist, including:

- Electroanalytical Chemistry enabling identification and quantification of chemical species which can lead to the development and operation of electrochemical sensors.
- Materials Science and Nanotechnology involving materials performance issues such as corrosion prevention and mitigation and development of materials found in devices such as electrochromic displays (which change colour upon the imposition of an electrical potential). Electrical Energy production through operation of devices such as batteries, fuel cells and other electrochemical energy storage systems.
- Solar Energy utilisation of light to produce electricity and/or effect chemical change (through use of semiconductors and photoelectrochemical reactions).
- Surface Science such as electrodeposition and anodic film alteration (for example anodising of metals such as aluminium, magnesium and titanium and electropolishing processes).
- Environmental Electrochemistry and Green Chemistry including heavy metal remediation, industrial effluent control and use of novel ionic liquids to replace hazardous chemicals in various processes.
- Organic and Industrial Electrochemistry (such as electrosynthesis) which provides a means of producing industrially important inorganic and organic chemicals.
- Bioelectrochemistry the study of electrochemical reactions in biological systems which has great potential in biomedical applications.
- New Applications of electrochemistry are constantly arising leading to a very dynamic and often multidisciplinary research activity.



Over the past few years, funding has been secured for projects in a number of these areas and 5 students have graduated from AEG with PhD awards. Over €1 million has been secured from a range of industrial and national funding agencies.

Two former student members of the Group have won prizes for their work (Dr Aoife Power, from Materials Ireland and Dr Dave Culliton, in the Sir Bernard Crossland Symposium for his project "Improving Efficiencies through Application of Wear-Resistant Thermal Spray Coatings to Cast Al-Si alloys").

In addition to both national and international Conference presentations, the AEG has also published scientific papers in leading peer-reviewed journals in the electrochemistry, analytical chemistry and materials science and engineering fields. Publications include articles in the Analyst, Journal of Applied Electrochemistry, Journal of Electroanalytical Chemistry, Electrochimica Acta, Corrosion Science and Journal of Thermal Spray Technology.

Over the past few years the AEG has collaborated with other DIT groups (such as the Centre for Elastomer Research, CER) and with other third level institutions (including the MSSl at the University of Limerick and the Advanced Processing Technology Group of Dublin City University).

Both Dr Betts and Professor Cassidy were members of the Management Committee of the European Science Foundation COST Action 543 project “Bioethanol Processing for Fuel Cells”. Together with Mr Daryl Fox (AEG PhD student), they actively participated in this network for several years, through contribution of their research results in the development of catalysts for Direct Ethanol Fuel Cells.

A Short Term Scientific Mission was conducted at the Technical University of Munich as part of this COST Action which explored the use of liquid ethanol fuel in a Direct Ethanol Fuel Cell. Ethanol offers enormous benefits in comparison with the conventional fuel cell utilising hydrogen, which is both costly and extremely difficult to compress, store and transport. Some work on this project was also conducted in conjunction with the Tyndall Institute (Cork) through their Science Foundation Ireland-funded National Access Programme.

Members of the AEG are currently working on an industrial project to develop a special surface treatment technology to provide enhanced wear and corrosion resistance to metal components normally suffering one or indeed both of these issues. This illustrates the breadth of work undertaken in the AEG, which ranges from quite fundamental work aimed at gaining insight into electrochemical mechanisms, to applied research and development work of direct benefit to Irish industry.

Graduates of the Group are: Dr Yanmei Ma (“Silver Dissolution in Biomedical Devices and Hygienic Coatings”), Dr Patrick Enright (“Photoelectrochemical Fuel Cell for Remediation of Organic Compounds in Water”), Dr Aoife Power (“Silver Nanomaterials in Sensing Applications”), Dr David Culliton, co-supervised by Professor David Kennedy, College of Engineering & Built Environment, (“Advanced Wear and Corrosion Resistant Treatments for Cast Aluminium Alloys”) and Dr Lavinia Astratine, co-supervised by Professor Edmond Magner of Materials & Surface Science Institute (MSSI), University of Limerick (“Conducting Polymer Materials for Electrochromic Devices”).

Postgraduate research is currently being undertaken by Caoimhe Ní Neil and Daryl Fox, who played an active role in European COST Action 543. Its members are always interested in extending their range of electrochemical activities and welcomes enquiries from potential industrial and academic collaborators to undertake joint research projects and similar activities.



Professor John Cassidy

Professor John Cassidy graduated from DIT with a Diploma in Applied Science in 1981. Following that he graduated from the University of Utah in 1984 with a PhD in Electroanalytical Chemistry.

He held a postdoctoral position in NIHE (Glasnevin) and Tokyo Institute of Technology before joining DIT in 1986 as a Lecturer in Analytical chemistry.

He subsequently became Assistant Head of School in 2000. He has supervised 13 PhD students and 3 MPhil students to completion and has published over 70 research papers. He is a co-manager of the Applied Electrochemical Group and a fellow of the Royal Society of Chemistry. He is also a member of the DIT Environmental Sustainability & Health Institute Team.

His research interests include electroanalysis, sensor development, simulation of electrochemical events and water monitoring.

e: john.cassidy@dit.ie



Dr Tony Betts

Currently the Head of Research in the College of Sciences and Health, Dr Tony Betts is also an active researcher specialising in the field of electrochemistry.

Dr Betts obtained his BSc and MSc (Hons) degrees in Chemistry (along with Certificates in Radiochemistry) from the University of Auckland in New Zealand. After working as an industrial chemist, he returned to Auckland University to undertake a PhD degree in Physical Chemistry on the detection of hydrogen in ferrous metals using an electrochemical technique. Postdoctoral research was then performed at the University of Manchester Institute of Science and Technology (now part of Manchester University UK) on the electrochemistry of the localised corrosion of stainless steels. After working as a corrosion scientist, he moved to Ireland, joining Forbairt (now Enterprise Ireland) before being assigned to DIT. His research interests lie in applications of electrochemistry in many of the areas outlined above, especially in corrosion science, electrochromic materials, electrocatalysts for fuel cells and in materials science.

e: anthony.betts@dit.ie

Dr John Colleran

Dr Colleran has BA (Mod) degree and PhD in Chemistry from Trinity College Dublin. Following a Post-doctoral appointment in NUI Maynooth where he also lectured for several years he developed a strong interest in electrochemistry. His current research interests are focused on the development and characterisation of composite materials for novel biological, inorganic and environmental applications. Some key topics of interest to him in the electrochemistry and associated fields are:

- Composite modified electrodes for applications in electrochemical sensing and bio-sensing, energy, & environmental technologies.
- Elucidation of mechanism and kinetics of redox reactions at modified electrodes.
- Composite fine-tuning using nano-materials.
- Electrochemical characterisation of organometallic compounds.
- Surface and materials chemistry.

e: john.colleran@dit.ie

Dr Ben Schazmann

Dr Schazmann obtained a BSc in Chemistry and Languages from Queens University, Belfast where he became interested in chemical sensors, related material synthesis and analytical chemistry.

Following an MSc in Chemical Oceanography from NUI, Galway he worked for several years in the Pharmaceutical industry, before joining Prof. Diamond's group in the National Centre for Sensor Research (NCSR) at Dublin City University (DCU) to undertake a PhD degree. This project involved the organic synthesis of both electrochemically and optically useful host (or complexing) agents for use in Ion Selective Electrodes (ISEs) and testing their analytical merits.

He continues to apply the philosophy 'from material synthesis to device application' to this day, with interests revolving around the synthesis and application of dyes and electroactive materials focusing on polymer membrane based ISE sensors, whereby the membrane in contact with the sample at the tip of the ISE contains the required functionality.

Current research interest aims to functionalise or chemically modify polymers for inclusion in the final ISE 'membrane cocktail' with functionality that could help in the development of reliable miniaturised all solid-state alternatives to the classical/large form of ISEs. This could pave the way for novel analytical tools and applications, targeting a variety of ionic analytes such as fluoride, iodide or nitrate. An on-body sensor for monitoring the sodium content in sweat was developed by Dr Schazmann whereby the level of dehydration of an athlete (sports performance) could be ascertained. This can also serve as a tool for diagnosing diseases such as Cystic Fibrosis (indicated by unusually high sodium levels).

e: benjamin.schazmann@dit.ie

The Centre for Elastomer Research

The Centre for Elastomer Research (CER) has its roots in a rubber research unit in Coventry University in the mid-nineties. This unit evolved into a nonlinear materials group at DIT in 2000 and the group gained centre status as CER in 2008.

In the beginning, the research was focused on the characterisation and finite element modelling of industrial elastomers in partnership with the German rubber industry, but it has evolved to gain a global reputation in rubber fatigue analysis and the dynamic characterisation of advanced elastomers. Throughout the centre's entire history, it has enjoyed a successful partnership with the German Institute for Rubber Technology (DIK - Deutsches Institut für Kautschuktechnologie) who are world leaders in rubber research.

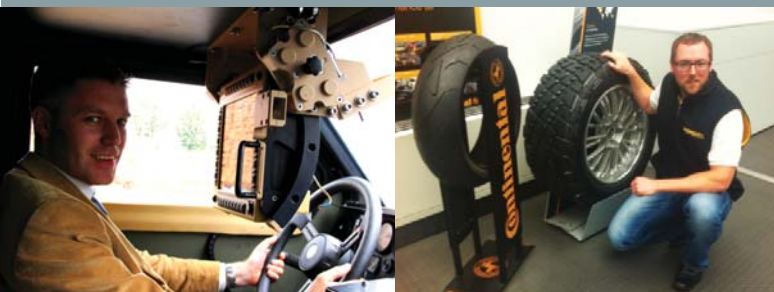
As a consequence of carrying out leading edge research into intelligent materials, CER needed more advanced facilities and the centre found its natural home in the FOCAS Research Institute. Industry and our research partners still have a requirement to carry out dynamic testing of elastomers and indeed our equi-biaxial dynamic test system continues to offer a unique and reliable system for fatigue testing of rubber. However, CER's new generation of doctoral and postdoctoral researchers had to fabricate and conduct spectroscopic analysis on their own smart materials.

The centre could not have maintained its position or reputation without the welcome it received into the FOCAS community and since the move we have developed 'intelligent' magnetorheological and dielectrical elastomers and excitingly have begun to improve the properties of rubber by the inclusion of graphene particles in traditional compounds.

This research would not have been possible without the support of the Irish Research Council which has funded the research of high quality PhDs and postdocs from China. Currently, a visiting professor from the Beijing University of Chemistry is leading the research into improving the fatigue properties of rubber by the inclusion of graphene particles. CER has published more than 125 refereed papers and book chapters, secured €2.75m in research funding and ten PhDs and two MPhils have graduated from the centre.

In recent years, CER students have been recognised by German industry. In particular Dr Stephen Ronan and Dr John McNamara were each awarded the German Rubber Industry's Award for their PhDs. Stephen was also presented with the prestigious Lanxess prize for his doctoral thesis and more recently the Continental Tire Award, 2012, for Light Truck Tire Technology. All of CER's graduates are working in challenging positions throughout European industry and academia.

www.dit.ie/cer



Left: John in his role as Design Engineer for Timoney Technology

Right: Stephen working as Project Leader, Tire Development, in Continental Tires, Hanover

Applied Intelligence Research Centre

The Applied Intelligence Research Centre (AIRC) was founded in 2008 and researches computational intelligence technologies that can be applied to real world problems. The core competencies of the AIRC include data analytics, machine learning, language technologies, intelligent agents, and security. Since 2012 the AIRC has been based at the FOCAS Research Institute which has provided much greater opportunities to collaborate with colleagues across DIT.

Examples of real world problems that have been addressed at the AIRC include spam filtering, sentiment analysis, dialogue management, custom search tools for language teachers, human-robot interaction, secure mobile financial transactions, engaging game characters, companion agents for mobile devices and the management and visualisation of large data collections.

Some particular highlights have been:

- Membership of the Centre for Applied Data Analytics Research (CeADAR) – an IDA/EI funded Technology Centre (www.ceadar.ie). Founded in 2012, CeADAR is a collaboration between DIT, UCD, and UCC. It performs industry-led data analytics research to promote the development, deployment and adoption of Data Analytics technology in Ireland.

- Developing machine learning and computational linguistics technology that was licensed to the spinout company LingleOnline (www.lingleonline.com). The technology developed at the AIRC analysed online newspaper and magazine articles to allow these to be used as the basis for teaching English as a foreign language.
- Winning the 1st Computer Cooking Contest held at ECCBR 2008 with the active learning based What's in the Fridge? system.
- Attracting international PhD students and visiting researchers from Brazil (through the Science Without Borders scheme), China and Tanzania.
- Securing research funding in excess of €2.5m since the foundation of the group.
- Dr Brian Mac Namee, the former director of the AIRC, received the DIT Fiosraigh Research Excellence award in 2013.
- Hosting national and international conferences such as the International Natural Language Generation conference, the Dublin Computational Linguistics Seminar series, the Irish Conference on Artificial Intelligence and Cognitive Science.
- Regularly presenting on robotics and artificial intelligence to school children as part of SFI's speakers for schools programme and Science Week.

www.ditairc.ie

e: airc@dit.ie

Rewarding Innovation

Three FOCAS centres were shortlisted for awards at the Intellectual Property Awards 2014. The Industrial & Engineering Optics Centre (IEO) was nominated jointly with DIT Hothouse for the 'Tech Transfer Award' which recognises a public research centre that has executed the most significant technology transfer of the year.

DIT Hothouse and the Centre for Research in Engineering Surface Technology (CREST) were shortlisted for an 'IP R&D Collaboration of the Year' award for their work with Smart Wall Paint and DIT Hothouse and the Communications Network Research Institute (CNRI) were also shortlisted for this award for their work with CNRI spin-out company Opti-Wifi.





Dr John Kelleher

John’s research focuses on artificial intelligence, language technology and machine learning. John has over 70 publications in international journals and at national and international conferences and is a co-author of a book on machine learning and

predictive data analytics that will be published by MIT Press in 2015.

He joined DIT in 2005 following work at the German Center for Artificial Intelligence (DFKI) as a senior researcher on the EU FP6 IST Cognitive Systems Integrated project Cognitive Systems for Cognitive Assistants – CoSy. He has a PhD in computer science from Dublin City University and a degree in computer science, also from Dublin City University.

John currently holds a number of research related posts. He is a funded researcher at the SFI Centre of Global Intelligent Content (www.cngl.ie), a research collaborator at the EI Centre for Applied Data Analytics Research (www.ucd.ie/ceadar), project manager and co-principal investigator on the EI funded CREAN commercialisation project, and an adjunct lecturer at the School of Computer Science and Statistics in Trinity College Dublin. John is also a funded researcher in the recently announced ADAPT SFI Research Center.

Dr Kelleher has also been involved in a number of commercialisation activities, applying the results of his research to industry. A highlight was developing the technology that led to the formation of the spin-out company Lingle Online Ltd (www.lingleonline.com).

e: john.d.kelleher@dit.ie



Dr Sarah-Jane Delaney

Dr Sarah Jane Delany is Assistant Head of School, School of Computing. She is a founder member of the Applied Intelligence Research Centre and a collaborator in the Enterprise Ireland and IDA funded Centre for Applied Data Analytics Research - CeADAR.

Her main research interests are in the field of machine learning, specifically in the areas of text analytics and information retrieval, concept drift, case-based reasoning and active learning. A recent area of interest is in emotional speech analysis. She has published widely in these areas and is a member of a number of international programme committees for conferences in these domains. She has been successful in getting over €500K in research funding from SFI, Enterprise Ireland and the NDRC.

e: sarahjane.delaney@dit.ie



Dr Eoghan O’Shea

Dr Eoghan O’Shea is a Senior Research Fellow in DIT’s School of Computing. His doctorate and previous research has been in the field of applied physics research (solar physics).

In FOCAS, however, he is working in the Centre for Applied Data Analytics Research (CeADAR) as part of the School of Computing’s Applied Intelligence Research Centre (AIRC). CeADAR is an industry-led research group, funded by Enterprise Ireland and IDA Ireland. Its teams in DIT, UCD and UCC, research and provide data analytics solutions to Irish industry.

e: eoghan.oshea@dit.ie

Communications Network Research Institute

The centre specialises in developing innovative technologies to support the delivery of real-time service such as VoIP and video streaming on wireless networks, specifically IEEE 802.11 or Wi-Fi networks. Recently, the CNRI has been addressing a number of the challenges for wireless mesh networks where it is investigating resource aware routing techniques, measurements of the characteristics of 802.11 wireless links, interference mitigation, multi-radio hardware platforms, rate selection, output power optimisation, and fragmentation threshold tuning.

e: cnri@cnri.dit.ie

w: www.cnri.dit.ie

Improving Wi-Fi Performance on the Streets of London

A start-up company OptiWi-fi is currently deploying technology developed in the CNRI in FOCAS to improve the performance of Wi-Fi in central London. Since March 2014, OptiWi-fi has been deploying its opticube technology on Oxford Street to improve the performance of the public Wi-Fi hotspots operated by O2 Wifi UK. Currently, over a dozen opticube devices have been installed on lamp posts along the length of Oxford Street in order to monitor and optimise the performance of O2 Wifi's network.

The opticube technology dates back to 2004 when it was originally developed under an EI Applied Technologies Research Programme (ARTP) and has since undergone much improvement and refinement under a number of SFI and EI projects. Essentially, the technology is based upon a mathematical framework that models the way in which the bandwidth is shared out among the users of a Wi-Fi network. The benefit of this framework is that it allows a network operator to monitor and to control how bandwidth is used. For example, it can allow an operator to allocate more bandwidth in order to support bandwidth intensive such as video streaming services or alternatively it could be used to provide a higher priority to servicing premium customers.

The technology underwent extensive testing under laboratory conditions in the CNRI and the impressive results resulted in a number of patents being filed. These filings resulted in two patents being granted and between 2005 and 2008, there was a number of trial licenses signed with leading industry players on the US west coast. In September 2010, the CNRI was introduced to an entrepreneur, Mark Burke, through the DIT Hothouse Technology to License initiative which resulted in the start-up company OptiWi-fi being incorporated in February 2011. OptiWi-Fi was co-founded by Dr Mark Davis (CNRI Manager) and Mark Burke to deliver next-generation monitoring and self-optimisation solutions to Wi-Fi providers, Mobile Network Operators and Wi-Fi equipment manufacturers.

In August 2012, OptiWi-fi competed in an initial field of 335 applicants, which were shortlisted to twenty finalists from which OptiWi-fi was selected as one of ten startup companies for the prestigious Telefonica/O2 Wayra Academy and resulted in an initial €50,000 investment in the company. The first live network trial of OptiWi-fi's solution took place in March 2013 in Twickenham Rugby stadium, during the England vs Italy RBS 6 Nations Championship game.

The trial was successful and has resulted in a deeper engagement... In February 2014 OptiWif signed a deal with O2 Wifi UK for the deployment of its network bandwidth optimisation solution across their UK & Ireland networks. The Oxford Street deployment represents the first phase of this deal.

The opticube technology has also enjoyed industry recognition when in November 2013, Dr Davis was awarded the Outstanding Academic Achievement of the Year 2013 by the Irish Software Association (ISA) for the development of OptiWi-fi's technology platform. After nearly 10 years of research and development in the CNRI, hopefully the streets of London will be paved with gold for OptiWi-fi.

w: www.optiwifi.com



Dr Mark Davis

Principal investigator and project director, Communications Network Research Institute (CNRI), DIT

DR MARK DAVIS HAS FOLLOWED AN EXTREMELY FOCUSED PATH, STARTING WITH HIS PRIMARY DEGREE IN ELECTRONIC ENGINEERING AND LEADING TO HIS CURRENT WORK, WHICH COMBINES BEING MANAGER OF DIT'S COMMUNICATIONS NETWORK RESEARCH INSTITUTE (CNRI), ASSISTANT HEAD OF THE SCHOOL OF ELECTRONIC AND COMMUNICATIONS ENGINEERING, AND CHIEF INNOVATION OFFICER AT OPTIWI-FI.

CNRI performs pure and applied research in all aspects of communications networks. It specialises in developing innovative technologies to support the delivery of real-time service such as VoIP and video streaming on wireless networks. It has been addressing challenges for wireless mesh networks, investigating issues such as resource-aware routing techniques, interference mitigation and output power optimisation.

Mark and colleagues have developed tools for estimating user satisfaction, as well as patented applications for managing the bandwidth on WLANs and measuring the quality of VOIP. OptiWi-fi is a company delivering products that enable Wi-Fi network providers to manage service quality on their networks.

FOCAS—10 years on

Mark, who helped to set up the National Satellite Services Centre in 1997, tells of a joint project with Eircom about fifteen years ago which involved “probably the first use of Wi-Fi in Ireland”. The wireless link ran from Herbert St to Kevin St. A performance anomaly observed on the wireless link raised the question: Where does all the bandwidth go? This resulted in a deeper investigation, funded by Enterprise Ireland, that led to the development of a very useful mathematical model of the Wi-Fi network operation.

Seeking to commercialise, Mark and colleagues showed the product to all the big players on the US west coast. They said: ‘Nice technology, but where’s the demand?’ We were ahead of things, so we put it on the shelf – and then in 2010 came the smartphone, and sudden exponential growth in data traffic!” Mark and colleague Mark Burke set up OptiWi-fi in 2011.

The technology was deployed, for example, for O2 Wifi UK on London’s Oxford Street, where it found that up to 25% of the bandwidth was not being fully used – and the operators had not known this. In brief, says Mark, Wi-Fi must be raised to a ‘carrier class’ technology.

A second company was recently incorporated. “We developed a tool for measuring the quality of VOIP calls, called EQUAL, and in early October set up VOPTI to commercialise the technology.”

Main research interests: WLANs, Radio Resource Management, QoS Provisioning for VoIP and Video Streaming

Over the next ten years, Mark is keen to develop technology roadmaps for both Wi-Fi and voice technology, focusing on Self-Optimising Networks and Web Real-Time Communication (RTC), and integrating EQUAL with WebRTC.

Mark’s early work to a great extent “kickstarted” CNRI, where his further research over the years led to OptiWi-fi and now VOPTI. He says that combining admin with business and research is “challenging”, but “it’s brilliant having dedicated research facilities, dedicated administrative support, on-tap IT support, a 24/7 building, etc. FOCAS is a fantastic facility.”

“**It’s brilliant having dedicated research facilities, dedicated administrative support, on-tap IT support, a 24/7 building, etc. FOCAS is a fantastic facility.”**

What drives him? “A puzzle – especially where I don’t even know the right question to ask!” From facing initial enigmas to asking the right questions, in collaboration with his colleagues he has found a number of great solutions. No doubt his puzzle-solving enthusiasm and intense focus – all nicely focused in FOCAS – means the coming decade, at least, will see a succession of further solutions, and their fruitful integration.

e: mark.davis@dit.ie

- **BE, MEngSc, PhD, Electronic Engineering, UCD, 1982-1992: PhD work in Optoelectronics: ‘Mathematical Modelling of Advanced Semiconductor Laser Structures’.**
- **Research Engineer, PTT Dr Neher Laboratories, The Hague, 1986-87**
- **Senior Research Engineer, BT Research Laboratories, Ipswich, UK, 1988-89**
- **Senior Research Fellow, Optronics Ireland, UCD, 1989-94**
- **Lecturer in Communications Engineering, DIT, 1994-2014**
- **Project Director, DIT, 2004–: Manager of DIT group researching QoS provisioning for real-time services on WLANs**
- **Assistant Head of School of Electronic and Communications Engineering**
- **Director, Communications Network Research Institute (CNRI)**
- **Chief Innovation Officer, OptiWiFi, 2012**

Centre for Research in Engineering Surface Technology

The CREST Centre is the only dedicated surface coatings laboratory on the Island of Ireland. It exists to serve the SMART economy by means of translating in-house fundamental knowledge from the bench-top to the market.

The CREST model relies on an expert and professional coatings consultancy service to front-face its activity. CREST recruits and develops industrial development scientists with a product development background operating within an ISO 9001 Quality Management System to guarantee consistent and reliable project delivery. Product development needs to be sustained, as secret know-how and craft can quickly become obsolete, therefore, robust intellectual property (IP) development that has sustained market value requires long-term focused strategic investment in fundamental research. CREST also recruits, trains and supervises scientists from undergraduate to postgraduate level.

e: brendan.duffy@dit.ie



CREST selected for EU Expo

Ireland was represented by CREST at the EU Innovation Expo in 2011. The Centre showcased its light-activated antibacterial surface coating, developed in collaboration with ceramic manufacturer VitrA Ireland with funding from Enterprise Ireland. Máire Geoghegan-Quinn, EU Commissioner for Innovation at the time, visited the stand to find out more about their work.

Opposite: EU Commissioner Máire Geoghegan-Quinn meets former CREST manager Dr John Colreavy at the stand in 2011.





Dr Brendan Duffy

CREST Centre Manager, PI in research projects

DR BRENDAN DUFFY, FROM CO KILDARE, GRADUATED FROM DIT KEVIN ST WITH A BSC IN APPLIED SCIENCES AND THEN COMPLETED A PHD—‘DEVELOPMENT OF NOVEL GAS SENSORS’ - AT THE NATIONAL CENTRE FOR SENSOR RESEARCH, DCU IN 2002, UNDER THE SUPERVISION OF PROFESSOR DERMOT DIAMOND.

He then worked as a Quality Officer in the food industry, before joining the Institute of Technology, Tallaght as a chemistry lecturer. Two years later, he joined CREST as a senior researcher in corrosion control on aluminium alloys and, from 2005, in hygiene control.

CREST has over sixty years of commercial surface coating experience (its precursor was the Institute for Industrial Research Standards, established in 1946).

Companies can avail of CREST’s expertise in four main areas: protective coatings, surface engineering of metal components, coatings for environmental and biomedical applications, and coatings for biomedical devices. It specialises in the early stages of product development, and can assist with product scale-up and transfer to manufacturing.

It works with many organisations, from start-ups to multinationals, providing a variety of services from testing and evaluation to product improvement. In the last decade, CREST has engaged in more than 400 projects with research and industrial partners at home, in the EU and the USA. Brendan says that “CREST also serves as a Gateway for industrial research into the wealth of expertise available in DIT”. The other Gateway staff are Dr Annaik Genson and Dr Michael Whelan. Brendan is currently PI on several active industrial projects, primarily funded through Enterprise Ireland and the EU, and with Dr Mohamed Oubaha manages the centre’s team of researchers. His work has been patented, licensed and published. He is also responsible for overseeing the implementation of the CREST ISO 9001 Quality Management System, working closely with CREST’s Quality Manager Dr Paddy Kane.

Research collaborations

Since 2005, funding secured for several projects worth over €6m directly for CREST through competitive funding (FP7, EI, SFI and DIT) and industrial projects.

Research partner with over 100 companies on the island, including ABB, Bombardier Aerospace, Borg Warner, C & F Automotive, Canon Hygiene, Galco Steel, General Paints, Graph Engineering, Henkel, Medtronic, Metal Improvement Company, Pfizer, and Smart Wall Paint. Academic partners include teams in DCU, ITTD, RCSI, TCD, UCD, UL and WIT. Dr Duffy has worked on research projects with overseas teams in Airbus (Ger & Fr), Alenia Aermacchia (It), EADS (Ger), Dassault (Fr), Fiat (It), Saab (Sw), VTT (Fin), Tecnalia (Esp) and FhG-ISC (Ger).

Brendan has worked with over 100 companies. He won Enterprise Ireland Commercialisation Awards in 2011 and 2012, and is co-winner of the DIT Inventors Award 2012, and the DIT Hothouse Award 2011.

“CREST also serves as a Gateway for industrial research into the wealth of expertise available in DIT.”

He engages in a wide range of activities; recent ones include industrially funded research, collaborative national research, commercialisation research, consultancy services, national and European project evaluations, patenting and exploitation of intellectual property, and joint coordination of FP7 submission.

Results for industry

Brendan puts particular emphasis on work that has “real-world” results, citing the example of corrosion protection for the aluminum trim of German and Scandinavian cars. A current project with Curtiss Wright (Galway) secured a manufacturing contract for five years with a leading medical device manufacturer. A recent 3½-year project with Airbus (Germany) involved the development of anti-ice coatings for aircraft wings.

Brendan clearly relishes seeing his work, and that of his collaborators, result in definite benefits out in the ‘real world’. In the coming ten years, he would like to see CREST expand to up to 40 researchers, and, more generally, to “help Irish companies innovate and lead”.

e: brendan.duffy@dit.ie

- BSc in Applied Science (Hon 1.1), DIT, 1997
- PhD, Analytical Science, DCU, 2002
- Chemistry lecturer, IT Tallaght, 2002-2004
- Senior Researcher, CREST, DIT, 2004-2008
- Senior Research Manager, CREST, 2008-2013
- CREST manager, 2013--: managing CREST Technology Gateway, maintaining CREST’s ISO Quality Management System, Developing business opportunities with industrial clients, Developing links and projects with companies and research centres, with the aid of Enterprise Ireland, IDA and Horizon 2020
- Secretary of Materials Ireland, a network of materials science researchers from industry and academia



Dr Annaik Genson

Dr Annaik Genson joined the CREST team in January 2014 as R&D Consultancy Manager.

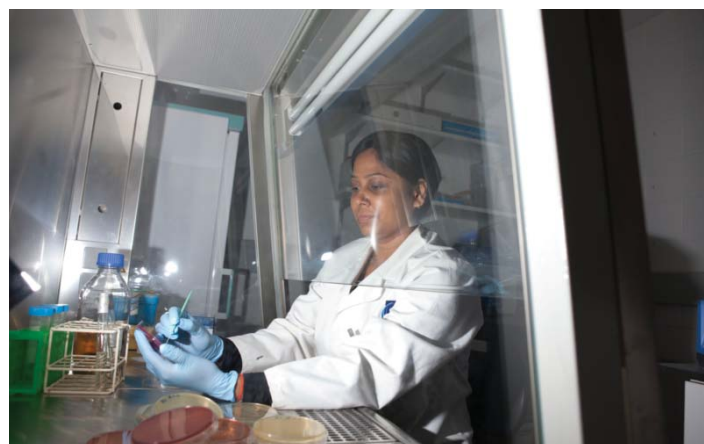
As a Senior Materials Engineer, she is currently responsible for research and development consulting services

for private companies as part of the Enterprise Ireland Technology Gateway Network. In 2001 Annaik completed two Masters degrees in Materials Science and Solid State and Inorganic Chemistry in the University of Rennes 1, in France, for which she was awarded an excellency scholarship, Annaik completed a PhD in Materials Science and Engineering with a specialisation in Electrochemistry from the Grenoble Institute of Technology, France in partnership with the Pechiney Centre of Research of Voreppe.

Her research was focused on the controlled corrosion of ultra-pure aluminium for high voltage capacitors. Annaik then moved into the Materials Surface Science Institute at the University of Limerick as a research officer on an SFI research project on oxyfluoronitrides glasses and ceramics for biomaterials applications. She did a previous work experience at the University of Limerick in 2000 at the Materials Ireland Research Centre on a phase change ink patented in 2001.

In 2008, Annaik joined the cultural and scientific section of the Embassy of France in Ireland, where she was in charge of the enhancement of the scientific cooperation between France and Ireland. She was responsible for the Ulysses programme for research visits between France and Ireland. She was pivotally involved in the creation of the Campus France office in Ireland in 2012. She was in charge of coordinating events during Dublin, European City of Science, 2012 which involved 2 French Nobel Prize winners and one French Fields Medallist and the Festival of Curiosity in 2013. Annaik has successfully secured research funding, actively collaborated and generated peer-reviewed publications and proceedings. She has reviewed papers for ATB Metallurgy, Powder Technology, Journal of Physics and Chemistry of Solids, and was editor in chief and redactor for the Bulletin Electronique Ireland between 2008 and 2013.

e: annaik.genson@dit.ie



Dr Swarna Jaiswal

Dr Swarna Jaiswal joined the CREST team in 2012 as a research scientist. She has worked on commercial and academic projects in the areas of medical microbiology, hygiene coating, biomaterial science and toxicology. Currently, she is working on bioabsorbable materials for potential applications in biomedical devices such as stent and bone fixation screws.

She obtained a Biotechnology (Hons) from BR Ambedkar Bihar University, India in 2005 and a Masters in Biotechnology from Bangalore University, India in 2007. After that, she worked for one year in the National Chemical Laboratory, India, investigating the impact of capping agents on nanomaterials functional properties. She was awarded a PhD by Dublin Institute of Technology in 2012 for her thesis “Synthesis, characterisation and biological assessment of some novel compounds, including inorganic metal nanoparticles, organic materials and metal doped sol-gel coatings”. She also has a diploma in Information Technology from India.

Dr Jaiswal has a number of peer reviewed publications in international journals and has delivered several talks and presented posters in national and international conferences. Recently she was awarded the “New Supervisory Fiosraigh award: 2014” by DIT.

e: swarna.jaiswal@dit.ie



Dr Paddy Kane

Dr Kane is a research scientist in CREST and Quality Manager in CREST. He joined the team in September 2013 as a Coatings Formulator on the Lazarus project. The aim of this project is to formulate paints with a relatively low pigment content, which could result in significant savings for paint manufacturers and suppliers.

Paddy has many years of experience in both industry and academia and graduated from Dublin Institute of Technology with a Diploma in Applied Chemistry and a Graduateship from the Royal Society of Chemistry before completing his PhD research in Dublin City University under the supervision of Professor Dermot Diamond. For his PhD he developed a novel method of analysing electrode selectivities and explained the results using computer-generated models of the interaction between the ligands used to construct the electrodes with primary and interfering ions. He has published several peer-reviewed papers in scientific journals.

From 1992 to 1995, Dr Kane lectured in Quality Assurance at DIT. As a lecturer in Analytical Science/Chemistry and Information Technology (both in DCU and in DIT from 2000 to 2005), he trained students in several analytical techniques, to analyse scientific data and to generate reports and presentations. In 2005-2006, Paddy wrote and reviewed eLearning courses for business applications while working for Source Skills. While working for Burgess Galvin & Co Ltd, from 2006 to 2013, he trained staff at all levels in a variety of techniques and subjects, from the handling of hazardous materials to good manufacturing practice in the manufacture of cosmetics.

Dr Kane has developed formulations for many types of products at commercial/manufacturing sites and has expertise in Quality Management, Environmental Management and Regulatory Affairs.

e: paddy.kane@dit.ie

FOCAS alumni making an impact on the world

Over the last 10 years many postgraduates and research staff have passed through the doors of FOCAS Research Institute. These graduates and research staff have then moved on to the next stages of their scientific careers and are based in industry and academia in Ireland and all over the world. Here, a selection of alumni tell us about their current roles and how they remember their time spent in FOCAS.

Dr Kunal Bhattacharya

Postdoctoral researcher 2008-2011

I am currently working as an Assistant Professor in Nanotoxicology at the Nanosafety & Nanomedicine Laboratory, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden. I am also researching the immunotoxicity and enzymatic bioremediation of carbon-based nanomaterials.

After I completed my PhD in Toxicology in the University of Duisburg-Essen, Germany, I started my first period of postdoctoral training in the FOCAS Research Institute in 2008 with Professor Hugh J Byrne. I worked in the HEA/PRTL 4-funded nanoscience research consortium 'Integrated NanoScience Platform for Ireland' (INSPIRE). My research involved the analysis of the respiratory toxicity of commercially important nanomaterials in mammalian cells under in vitro conditions.

For these studies I utilised the state of the art nanometrology, cell culture, microscopy and spectroscopy facilities available at the Institute. We created several successful national and international collaborations resulting in exciting research outcomes. During my time at the FOCAS Research Institute, we successfully published 8 peer-reviewed research publications and represented our research at several national and international conferences.

I was also awarded a research grant by Science Foundation Ireland under its UREKA program (2009) and a travel grant by the Health Research Board and National Cancer Institute (NCI), United States to attend a 'Molecular mechanism of cancer' course held at NCI, United States (2011). I also had the opportunity to co-supervise the research of undergraduate, graduate and doctoral students.

FOCAS Research Institute is a centre of excellence for multiple specialised scientific fields which provided me with the opportunity to learn and explore new techniques and theories in the field of science as well as in nanometrology and spectroscopy. My tenure at FOCAS Research Institute as a junior researcher helped me to develop my career in the field of bionanosciences which ultimately led me to my current scientific position.



**Dr Viswanath
Bavigadda**

**Postgraduate
student 2007-2011**

Currently working as
a Postdoctoral
Research Fellow at
SUTD-MIT

International Design Center, Singapore University of Technology and Design (SUTD) Dr Bavigadda was supervised by Professor Vincent Toal, Dr Raghavendra Jallapuram and Dr Emilia Mihaylova. His thesis was “A new versatile electronic speckle pattern interferometer for vibration measurements”.

FOCAS Research institute is one of the best places to carry out scientific and industrially relevant research. I really liked the work culture and people were always there to help one another. FOCAS has not only shaped my career but also contributed significantly to improving my personal development skills. The best part about FOCAS is that it is like a global village. I met colleagues from all over the world and got to know many different cultures!

At present I am working on developing a series of benchtop and prototype infrared medical imaging systems (micro-endoscopes) for reconstructing 3D information of tissue for cardiac procedures as part of my postdoctoral research.



**Dr Jallapuram
Raghavendra**

**Postgraduate
student and
postdoctoral
researcher
2002-2010**

I am currently working as a senior optical simulation engineer for Optical Sub-Assembly New Product Introduction (OSA NPI) - a telecommunication equipment manufacturer in Finisar Malaysia. I joined FOCAS Research Institute in April 2002 as a PhD student in the Centre for Industrial and Engineering Optics (IEO). The title of my thesis was “Optimisation of an acrylamide photopolymer for reflection holographic recording”. My supervisors were: Dr Robert Howard, Dr Suzanne Martin, Dr Izabela Naydenova, and Professor Vincent Toal.

As I was working with photosensitive materials, dark room facilities were essential and FOCAS Research institute provided us with excellent state of the art lab facilities including vibration isolated optical tables essential for holography. The core lab facilities are excellent with a wide range of equipment.

After I finished my PhD in 2005, I worked on multiple projects funded by Enterprise Ireland under proof of concept and technology development commercialisation programmes until September 2010, also in IEO and FOCAS.

The time I spent there is memorable. I thoroughly enjoyed working with excellent staff and facilities and with proactive support staff sharing their knowledge, expertise and always extending a helping hand when needed. FOCAS Research institute is truly multinational and cross-cultural and I cherish every moment of my career spent there. The experience and expertise I gained was immense and has helped me in many ways during my tenure at FOCAS and in my current work place.



Dr Sourav Prasanna Mukherjee

Postgraduate student 2008-2012

I am currently a Postdoctoral Fellow at the Molecular Toxicology Division,

Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden. My research involves the immunotoxicity and enzymatic bioremediation of carbon-based nanomaterials. After completing my PhD study in the FOCAS Research Institute, I worked as an NSERC Visiting Fellow, at Mechanistic Studies Division, Health Canada, Tunney's Pasture, Ottawa, Canada for a year on toxicogenomics of silica nanomaterials exposure for legislative/regulatory purpose.

The title of my PhD thesis was "Towards Structure Activity Relationships for in vitro Toxicity of Polyamidoamine Dendritic Nanoparticles" and my supervisor was Professor Hugh J Byrne. Professor Byrne is a fantastic supervisor and I enjoyed every moment I spent in FOCAS. During my PhD study he provided me with all the resources I needed and also taught me directly or indirectly so many skills that are required to find success in the scientific world. He also provided me the opportunity to attend different conferences around the world to showcase my research. The multi-national environment of FOCAS helped me to find many good friends from different corners of the world. This has not only extended my professional contacts, but also contributed significantly to improve my personal development skills.



Dr Sourabhi Debnath

Postgraduate student 2006-2010

I am an Assistant Professor, Department of Applied Physics and

Electronic Engineering, at Rajshahi University, Bangladesh. I spend most of my time lecturing BSc and MSc level students. My current research interest is Thin Films. But I also have a plan to engage in research work in nano-science in the future.

During my PhD studies I had a great time in FOCAS Research Institute. The working environment was very comfortable. People were very helpful and cooperative. The laboratories were also well equipped and hence I did not need to go to any other research institute for experimentation purposes. My thesis "Selective Solubilisation of Single Walled Carbon Nanotubes using Polycyclic Aromatic Hydrocarbons" was completed under the supervision of Professor Hugh J Byrne & Dr Theresa Hedderman.

I feel fortunate to have pursued my PhD study under their supervision. Their valuable suggestions, guidance, constant support, and encouragement helped me to successfully complete my PhD research. I have learnt how to deal with students and encourage positive attitudes in them. This knowledge helps me a lot to motivate my pupils, especially the research students under my supervision. I wish to see FOCAS at the TOP of all research institutions all over the world!

Dr Brian Keegan

Postgraduate researcher 2004-2010

I am a lecturer in the School of Computing, DIT. My thesis "Improving Multicast Communications over Wireless Mesh Networks" was completed under the supervision of Dr Mark Davis in the Communications Network Research Institute (CNRI) in FOCAS Research Institute

My research housed within FOCAS included topology based optimisation of multicasting in wireless mesh networks. Extensive hardware research and test bed configurations were carried out on a variety of platforms which covered a wide range of routing and networking protocols. During my time there, Professor Hugh J Byrne made extensive resources and building access available to me which were crucial to deploying and testing prototype scalable wireless networks. Since leaving FOCAS I went on to work as a software engineer with Oracle before returning to DIT. FOCAS is a fun place to work and study. The variety of research groups leads to a culture of learning with a good balance of social interaction.



Dr Aoife Power

Postgraduate student 2008-2011

I am currently a Postdoctoral Researcher at Dublin City University. My thesis “The

Preparation and Characterisation of Silver Nanomaterials and their application in Sensing Techniques” was supervised by Dr Anthony Betts and Professor John Cassidy and I worked in the Applied Electrochemistry Group (AEG). I found FOCAS Research Institute to be a great place to study and work, not just because of the great facilities and access to instrumentation, but because of the invaluable asset that was the ever present encouragement to cooperate and collaborate with my fellow researchers.

This promoted a truly interdisciplinary working environment where knowledge and experience were freely shared and, in my opinion, this enhanced greatly our academic output.

I was actively encouraged to participate, not only through publishing in academic journals and presenting at both national and international conferences but also through mentoring others, particularly undergraduate students, including those from other institutions, such as Singapore Polytechnic and KaHo Sint – Lieven. This was especially significant as it gave me invaluable teaching, project management and problem solving experience that I believe has enhanced my overall skillset as a researcher. Finally, but most importantly, FOCAS Research Institute supplied me with not only a network of colleagues but also some true friends.

Dr Niall Ó Claonadh

Postgraduate student 2007-2012

Currently working as a Photolithography Engineer in Intel Corporation, Dr Ó Claonadh’s thesis “Nano enhanced food contact materials: An approach to determine cytotoxicity” was supervised by Dr Alan Casey and Dr Gordon Chambers.

FOCAS supplied me with every facility I could have hoped to have available while pursuing a multidisciplinary PhD which encompassed nanomaterials, materials science and toxicology. Instrumentation is state of the art and it’s all very much available to every researcher, giving the opportunity for real hands on experience, something which I and employers have found invaluable.

I found the knowledge base in FOCAS to be wide ranging but also very in-depth. The research staff is hugely talented and dedicated. It was truly an international research facility and the people I met and connections I’ve made will no doubt benefit me long into the future. I could not have asked for a better environment for my studies.

Dr Jennifer Dorney

Postgraduate student 2008-2013

I am currently working as an Associate Research Fellow in Biomedical Physics at the School of Physics, University of Exeter. My first experience of working in FOCAS Research Institute was during the summer of 2006 when I took part in the Eureka Summer Programme for undergraduates. I spent a summer looking at the ability of various organic solvents to disperse carbon nanotubes under the supervision of Prof Hugh J Byrne.

During these 3 months I extremely enjoyed the friendly and helpful atmosphere of the Institute and met many people, some of whom would become lifelong friends.

When considering the PhD route after my undergraduate studies, FOCAS Research Institute was the natural place for me to look for excellent opportunities. Not only does the vast array of instruments and techniques make it a world class research facility, but also the helpful, friendly and talented staff made it a place where it was a pleasure to study, work and grow as a scientist.

The equipment and knowledge that are housed within the Institute have provided me with lifelong skills that I need to continue my career in academia. The freedom and encouragement to experience as many experimental procedures and techniques as possible, gave me the confidence to carry out scientific research to an extremely high standard. My thesis “Polystyrene: A Potential Standard for Developing In Vitro Cellular Tracking Methods for Nanotoxicology” was completed under the supervision of Professor Hugh J Byrne and Dr Gordon Chambers.



Dr Eoghan Ó Faoláin

Postgraduate student and postdoctoral researcher 2001-2008

Now a Senior Executive in the Irish

Software Association at Ibec (Ireland's leading business representative organisation), Dr Ó Faoláin's thesis "Potential of vibrational spectroscopy in the diagnosis of human tumours" was supervised by Professor Hugh J Byrne and Professor Fiona Lyng.

Eoghan joined the FOCAS Research Institute in June 2001 as a Research Assistant with the Radiation and Environmental Science Centre (RESC). In 2002, he embarked on his PhD research in novel methods for cervical cancer screening, which he successfully defended in 2006. Eoghan continued as a Postdoctoral Researcher and in collaboration with key partners at the National Maternity Hospital and the Coombe Women and Infants Hospital, the team began the process of commercialising the technology with support from Enterprise Ireland, resulting in a global patent for the technology developed.

In 2012, the technology was licensed to Raman Diagnostics, an innovative life sciences company based in Ireland.

Since leaving FOCAS, Eoghan has had a variety of roles among the high-tech sectors within Ibec. These include the Irish Medical Devices Association (IMDA), and more recently the Irish Software Association (ISA) and ICT Ireland.

Having been with the FOCAS Research Institute for almost 7 years, as both a post-graduate researcher and staff member, I can testify to the Institute's position as a unique facility, with dedicated support staff, internationally recognised researchers, and an unrivalled suite of instrumentation. FOCAS has a long track record in promoting interdisciplinary collaborations both within the Institute and with other national and international bodies.

FOCAS has positioned itself at the forefront of convergent technologies and has built up a rich network of industry links, across many established and emerging sectors of the Irish economy, ranging from biomedical, pharmaceutical & biotechnology to nanotechnology, environmental technology and green-tech.

This dynamic and co-operative approach has ensured the Institute continues to carry out responsive, industry relevant research, and prepares students and graduates well for a career in Ireland's high tech economy.



Dr Pratap C Naha

Postgraduate student 2008-2012

Now working as a Postdoctoral fellow at Perelman School of Medicine, University of

Pennsylvania, Philadelphia, Dr Naha's thesis "Eco and In vitro mammalian toxicological assessment of Polymeric nanomaterials" was supervised by Professor Hugh J Byrne.

I joined the FOCAS Research Institute as a postgraduate researcher in 2008, under the PRTL Cycle 4 INSPIRE (Integrated Nanoscience Platform for Ireland) Programme. During my PhD training at FOCAS, I found the Institute to be a multinational environment and I received the opportunity to learn many things in the area of science as well as personal development.

My PhD project was in the field of Nanotoxicology, which is a developing area of Nanomedicine. Scientific skills and knowledge learned during my PhD training at FOCAS Research Institute gave me the opportunity to get a postdoc position in Perelman School of Medicine, University of Pennsylvania, USA. My ongoing postdoctoral research at University of Pennsylvania is developing novel biocompatible nanomaterials as CT and MRI contrast agents as well as surface functionalised nanoparticles for gene therapy.

Dr Patrick Enright

Postgraduate student 2005-2009

Dr Enright is working as a Chemical Regulatory Affairs Manager in H2 Compliance. His thesis "Novel Photoelectrochemical Cell for the Remediation of Organic Compounds in Water" was supervised by Professor John Cassidy and Dr Tony Betts.

I completed a PhD with the Applied Electrochemistry Group (AEG) in FOCAS Research Institute in January 2009 under the tutelage of Professor John Cassidy and Dr Anthony Betts.

The project involved construction of a fuel cell with a titania catalyst illuminated with sunlight. The fuel cell was used to remediate waste water, creating a useful current. The project gave me an opportunity to pursue my dream!



Dr Garrett Farrell

Postgraduate student 2000-2005

Currently working as a Lecturer in Letterkenny Institute of Technology,

Dr Farrell's thesis "Investigation of the electronic properties of organic systems using electroabsorption spectroscopy" was supervised by Professor Hugh J Byrne and Dr Gordon Chambers. Garrett undertook his PhD work within the Physics of Molecular Materials group (POMM) part-time, while employed as Research Technical Support within the FOCAS Research Institute. FOCAS was a great place to study and work, and it really opened up a new career direction for me. Undertaking research in FOCAS gave me the chance to present work at both national and international conferences and it allowed me to work alongside and gain expert tuition from some exceptionally gifted researchers both in Ireland and abroad. The extended number of professional contacts that I have formed through friendships made while studying in FOCAS has also greatly aided my current role.

FOCAS has a talented, culturally diverse, knowledgebase which I found to be freely accessible to anyone who asked. The research environment was friendly and inviting and it was certainly as exciting and dynamic as any of the bigger institutions. Researchers were actively encouraged to be expressive and to think for themselves, resulting in a more independent postgraduate student capable of applying themselves.

Amaya Garcia MSc

Research Engineer 2008-2011

From 2008 until 2011 I worked as a Fluorescence Imaging Research Engineer in the Radiation and Environmental Science Centre where I was responsible for running the Flow Cytometry and Confocal Microscopy Facility, supporting projects specific to these technologies and also providing administrative support. As part of my role I provided training in sample preparation and use of the instrumentation. I made sure the core technology instrumentation was calibrated, maintained and used correctly according to standard procedures. I also wrote and maintained Standard Operating Procedures as well as training records for all the facility equipment. I had the great experience of lecturing flow cytometry to 3rd and 4th year students of Biomedical Sciences in DIT.

In 2011 I had the opportunity of joining Systems Biology Ireland (SBI) in University College Dublin (UCD) working as a Wet Lab Manager providing technical, administrative and operational support. Our research focuses on elucidating basic principles of the design and function of biological signal transduction networks. Our aim is to design new therapeutic approaches to cancer, degenerative and inflammatory diseases based on a systems level, mechanistic understanding of biomolecular networks. to a variety of problems.



Dr Peter Knief

Postgraduate student 2005-2010

I am working as a Postdoctoral Researcher at the Royal College of Surgeons in Ireland.

My thesis “Interaction of Carbon nanotubes with biological systems—assessed by Raman Spectroscopy” was supervised by Professor Hugh J Byrne, Professor Fiona Lyng and Dr Aidan Meade.

Working at FOCAS Research Institute with colleagues and friends helped me to initiate a scientific career that I once doubted was even possible. Its multidisciplinary and multicultural environment produced a great place to work and study.

Dr Qiaohuan Cheng

Postgraduate student 2006-2010

Currently working as a Lecturer in Henan University of Technology, China, Dr Cheng’s thesis “Dispersion of Single-Walled Carbon Nanotubes in Organic Solvents” was supervised by Professor Hugh J Byrne and Dr Elizabeth Gregan.

I was very lucky to get the opportunity to finish my PhD study in FOCAS under the supervision of Professor Hugh J Byrne. It provided me with scientific training in research and a great chance of communicating with scientists working in different fields.

During my PhD study I had 6 peer-reviewed papers published and, as a result, I won the Chinese Government Award For Outstanding self-Financed Students Abroad in 2009. FOCAS Research Institute is a great place to work and study!

Dr Kishore Kumar Jella

Postgraduate student 2008-2012

I am currently a postdoctoral Fellow at Emory University, Atlanta, GA USA. I was very happy during my PhD at FOCAS Research Institute especially with the multicultural environment and the friendly people there. A multicultural social environment influences individuals in creative thinking and performance at their work.

Presently I am in the United States as a Postdoctoral Fellow but I miss the happiness that I got from FOCAS. During my PhD, I worked under the supervision of both Professor Fiona M. Lyng and Professor Hugh J Byrne, very good and supportive mentors. They were very helpful and I appreciated their suggestions during my PhD tenure.

The title of my thesis was “Radiation Induced Bystander Signaling in Human Keratinocyte Cell Line”. All my colleagues provided valuable information and helped me a lot for the successful completion of my PhD work. I would like to come back to FOCAS Research Institute someday!

Nanolab

The Centre team has hosted 20 PhD and 4 MPhil graduates to completion, delivered over 100 conference presentations and published 50 papers - almost 2000 citations have been attributed to Nanolab. In addition, the Centre has hosted 8 international conferences and workshops in nanotechnology and bio-interactions.

Nanolab has been awarded more than €8m in European (FP6 and FP7 Programme) and National funding (Higher Education Authority, Science Foundation Ireland, Enterprise Ireland, Environmental Protection Agency and DIT) since 2005. This funding has allowed Nanolab to build up an impressive array of instrumentation. The lab houses a fully equipped mammalian cell culture facility, a dedicated microbiological and a materials characterisation laboratory. Nanolab also has access to equipment in other FOCAS research centres and the core instrumentation suite in the FOCAS Research Institute.

Expertise

The Nanolab team explore standards and methods for the characterisation of nanomaterials with respect to physical, chemical and biological properties. This includes the toxicity and biocompatibility of a variety of nanomaterials such as carbonaceous, polymeric, metallic and composite nano material systems.

The Centre focuses on establishing structure activity relationships governing particle or compound uptake, trafficking, fate and organism response. Model systems are employed to improve fundamental understanding, to validate current and develop new biological testing protocols for nanomaterials, while real life exposure scenarios are explored to assess risk.

Impact

Dr Gordon Chambers promotes awareness of the impacts of nanotechnology among stakeholders by consulting with regulatory bodies on policy documentation, delivering national and international workshops and undertaking pedagogical research for the advancement of education in nano sciences. Professor Hugh Byrne, Dr Gordon Chamber and Dr Alan Casey have contributed to EU policy formulation through the FP7 - funded NanoImpactNet project www.nanoimpactnet.eu.



This project led to the publication of the following co-authored reports; 'Minimal analytical characterisation of engineered nanomaterials need for hazard assessment in biological matrices'; 'First approaches to standard protocols and reference materials for the assessment of potential hazards associated with nanomaterials'; 'Protocols for assessment of biological hazards of engineered nanomaterials'.

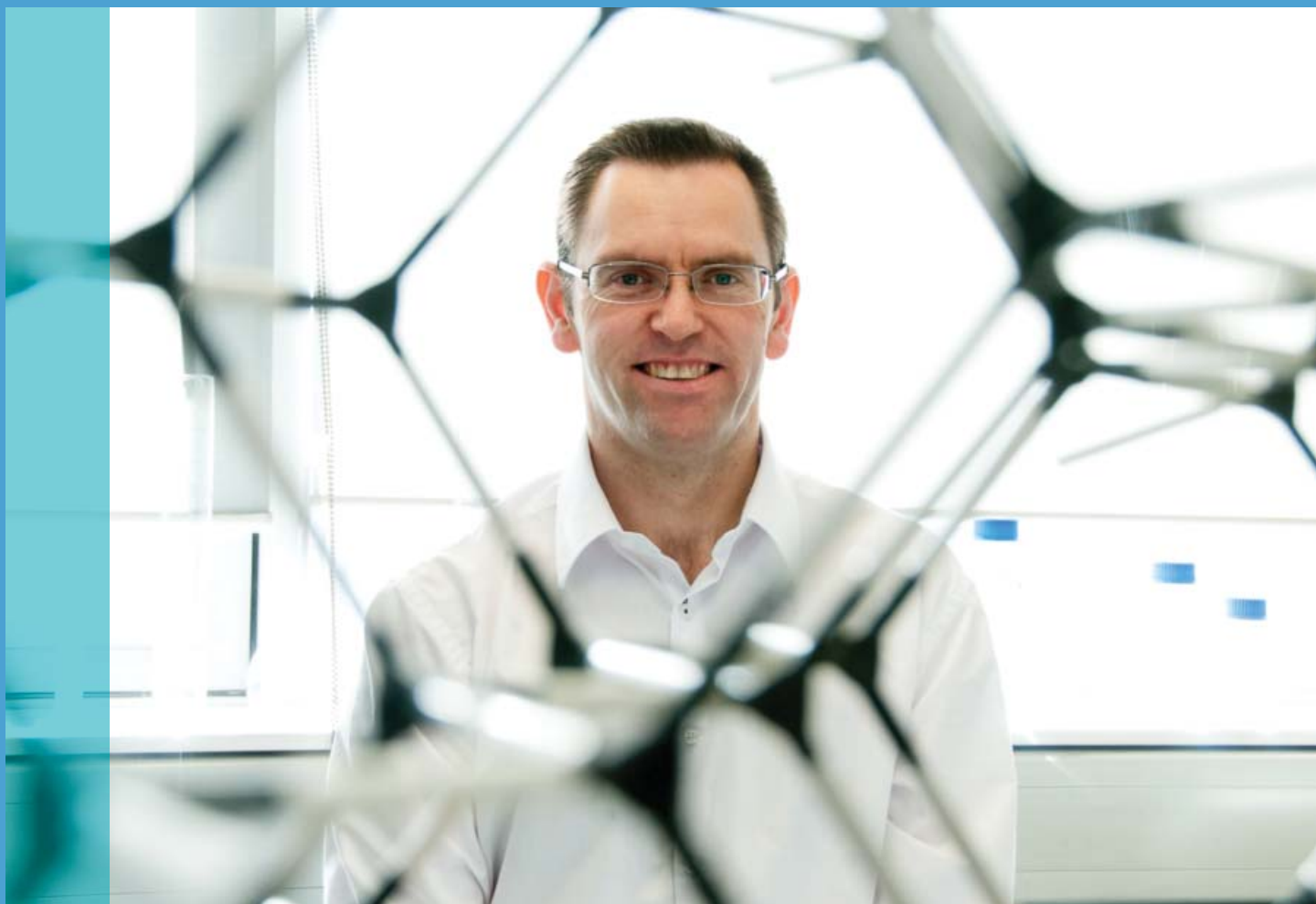
Nationally NanoLab researchers have contributed to the Health and Safety Authority of Ireland's (HSAI) ad-hoc working group on Nanotechnology (Dr Alan Casey), and co-authored the HSAI's policy document on the safe use of nanotechnology in the workplace (Dr Gordon Chambers). It has also contributed to the Food Safety Authority of Ireland's report 'The Relevance for Food Safety of Applications of Nanotechnology in the Food and Feed Industries'. NanoLab provided expertise as part of the National Advisory Committee to the EU presidency showcase event EuroNanoForum.

Industry links

Nanolab has collaborated with several industrial partners ranging from large multinational companies such as Intel and HP to SMEs. Some of the graduate students complete their projects in collaboration with industry partners such as Intel and others are funded under the Irish Research Council's employment-based postgraduate program with a partnership with Sigmoid Pharma.

e: alan.casey@dit.ie

www.dit.ie/nanolab



Dr Gordon Chambers

PI DIT Nanolab Research Centre/Lecturer at Dublin Institute of Technology

GORDON CHAMBERS, FROM WALKINSTOWN, KNEW EXACTLY WHAT HE WANTED TO BE WHEN ASKED IN PRIMARY SCHOOL. “I’M GOING TO BE A FORENSIC SCIENTIST,” HE REVEALED. JOHNNY BALL’S BBC SCIENCE PROGRAMMES HAD STIRRED HIS INTEREST, WHILE FORENSIC SCIENTIST BARRY ALLEN PROVIDED A “FLASH” OF INSPIRATION.

Gordon soon wrote to State Forensic Laboratory director Dr Jim Donovan (who survived two car-bomb attacks planned by Martin ‘the General’ Cahill), who kindly provided him with advice about the best path to take. Gordon did not come from an ‘automatic third-level’ background, but sailed through his BSc studies at TCD while also getting a Diploma in Applied Science at DIT. His PhD concerned the electronic and optical properties of buckminsterfullerene (C₆₀), one of the largest objects discovered to exhibit wave-particle duality.

After a stint researching with Media Lab Europe (which was working on developing a lollipop that would release nanosensors around a child to assist A&E doctors), he returned to DIT in 2001, as a physics lecturer. He joined the Physics of Molecular Materials group (its acronym POMM hinting at an Australian link) and held a Research Associate position in TCD working with the Functional Materials Group.

Since 2001, he has been strongly engaged in research and development at DIT. In 2005 he co-founded the DIT Nanolab Research Centre. At the time, it was one of the few centres in the world focusing on nanotoxicity, a major issue for nanotechnology. "In a sense," he says, "this opened up a can of worms!", involving "strange anomalies, interferences, and so on". "But ten years on, we've got a handle now on how to assess toxicity.

We've contributed to policy documents on nanotechnology for the EU's NanoImpactNet, the HSE and the Food Safety Authority of Ireland. But there's still no internationally agreed standard for assessing the toxicity of nanomaterials and no regulation."

Principal research interests: Nanostructures and composite fabrication and characterisation; Nanostructures and composite application development; Optical and spectroscopy techniques for rapid throughput analysis; Nanotoxicology; Integrating nanoscience and society. Other research activities: National Advisory Committee of EuroNano Forum 2013; Participant on Integrated NanoScience Platform for Ireland (INSPIRE); Consultancy work for industry and state bodies concerning nanoparticle safety; Collaborated on both EU-FP7 and EU-FP6 consortia; Member of DIT FOCAS management board 2004-present. Total number of publications >60. Citations ~1000.

Gordon was involved in establishing Ireland's first BSc in Science with Nanotechnology, co-run by DIT's School of Physics and School of Chemical and Pharmaceutical Sciences. He is currently course chair and lectures on nanotoxicology, nanocharacterisation, nanoelectronics and nanophotonics. He also teaches modules on acoustics, radiation and the integration of science and technology into society, for other degree programmes in DIT.

Huge benefits

Gordon has a special interest in the nano food area, and nano regulation and communication. He estimates that nanotechnology is applied to 60-70% of our food. "I would not take some food supplements, but overall I think that the big benefits outweigh the risks." Nanoparticle use has huge benefits (eg, in 2008, 10% of approx. €150bn in goods and services exported by Ireland was nano-enabled) but also raises many concerns. As Gordon has said, "We thus have happy academics, unhappy regulators and nervous industries" – not to mention consumers in so far as they are aware. "We need to be cautious," he stresses.

“Nanoparticle use has huge benefits (eg, in 2008, 10% of approx. €150bn in goods and services exported by Ireland was nano-enabled) but also raises many concerns.

Since the days when he was inspired by Barry 'The Flash' Allen and the buchminsterfullerene, Gordon has engaged in a huge amount of research work. While the matter he's investigating is of decidedly restricted growth (nanos is Greek for 'dwarf'), there's a gigantic amount of research waiting to be done, of crucial relevance to us all. Gordon is clearly fascinated by his chosen field, and, given his focus on investigating nanotoxicity, the former schoolboy did indeed become a forensic scientist.

e: gordon.chambers@dit.ie

- **Diploma in Applied Science (Physics and Chemistry), DIT, 1997**
- **BSc (1st class hon) in Physics and Chemistry, TCD, 1997**
- **PhD, DIT, 2001: 'In situ spectroscopic monitoring of the electronic transport properties of fullerene thin films'**
- **Senior Research Fellow, Nanostructures group, Media Lab Europe (MIT research partner), working on development of molecular electronics and nanosensor technology**
- **Postdoctoral Researcher, Physics of Molecular Materials group, DIT, and Research Associate, Functional Materials Group, TCD**
- **Lecturer in School of Physics, DIT; PI, DIT Nanolab Research Centre**
- **Consults on implementation and societal impacts of nanotechnology to private industry and government bodies**



Dr Alan Casey

Dr Alan Casey holds a BSc in physics and was awarded his PhD by Dublin Institute of Technology for his thesis “Physiochemical Indicators of Single Walled Carbon Nanotube Toxicity”.

He joined Nanolab within the FOCAS Research Institute as a researcher in 2007. He successfully achieved designation for Nanolab as a DIT Research Centre in 2010 and since then has managed the Centre.

He has supervised three PhD students to completion and is currently co-supervising three more and is advisor to a fourth. He is a member of the Irish Society of Toxicology, the Health and Safety Authority of Ireland’s (HSAI) ad-hoc working group on Nanotechnology, and a co-author of the HSAI’s initial draft of a policy document on the safe usage of nanotechnology in the workplace.

Dr Casey was one of two nationally nominated Irish representatives to attend a Workshop on “Enabling Standards for Nanomaterial Characterization” in NIST, Maryland, Washington. He is actively involved in the development of taught modules for the Graduate Research Education Program (GREP) within DIT. His current research interests include materials toxicity, nano-bio interactions, novel drug screening, cellular growth substrate design, particle uptake mechanisms and programmed cell death pathways.

e: alan.casey@dit.ie



Humza Khalid

Humza Khalid is a postgraduate student in Nanolab.

His journey began in University College Dublin (UCD) where he successfully completed a BSc in Biochemistry. In 2009, my 3rd year at UCD, he was offered a summer internship under the UREKA programme at the FOCAS Research Institute, DIT.

My experience at FOCAS shaped my future, as I was introduced to some great people. It was my first experience as a researcher and working with fellow researchers.

I continued on to the National University of Galway where I embarked on an MSc in Neuropharmacology, not knowing which direction to take, research or industry. I came across the position for a PhD in the FOCAS Research Institute funded by INSPIRE and it reminded me of the great experience I had there as an undergraduate.

I was accepted to the position and being familiar with the research institute helped me to integrate. The atmosphere that encourages collaboration and learning made it like a second home. Now, nearly in my final year researching in the field of nanotoxicology, I have learned many skills and qualities that will benefit me in the work place such as team work and problem solving.

Techniques that have been alien to me, such as confocal microscopy and AFM are great skills to take with me when I leave FOCAS. I have learnt a lot through my peers and supervisors which will benefit me in all aspects of life, which is a success.

e: humza.khalid@dit.ie

Radiation and Environmental Science Centre

Although it has been located in the FOCAS Research Institute for the last 10 years, the Radiation & Environmental Science Centre (RESC) was originally established in 1990 by Dr Carmel Mothersill (now at McMaster University, Canada). RESC researchers were part of the team that developed the original HEA PRTL Cycle 1 research proposal that led to the construction of FOCAS in 2004. The Centre has three main areas of research focus: radiation biology; environmental toxicology and testing of new materials; and biophotonics and imaging.

DIT research in radiation biology started in the 1970s. The main goals are to understand the risks associated with radiation exposure and to identify ways of optimising patient response to radiotherapy. Non-targeted (non-DNA) effects such as bystander effects (effects in cells not hit by a radiation track), genomic instability (effects in the progeny of irradiated cells) and adaptive responses (in cells exposed to a high challenging dose after pretreatment with a low adapting dose) have been the main focus over the last 10-15 years.

Translational radiation research, involving the correlation of patient radiosensitivity with radiotherapy response and the investigation of biomarkers of radiosensitivity, is also a key focus. RESC is part of the EU FP7 funded Network of Excellence on Low Dose Radiation Research, DoReMi.

The RESC has longstanding expertise in the toxicological assessment of contaminants of environmental concern on established cell lines and primary cell culture systems developed in the Centre. A multi-trophic battery of freshwater and marine test species, comprising the Microtox® test system and several algal, copepod, and amphipod cultures is routinely employed for ecotoxicity tests. In recent years this experience has been extended to include toxicity screening of many novel therapeutic agents such as chemotherapeutic drugs and nanomaterials by incorporating cytotoxicity and genotoxicity screening and further molecular mechanistic work to elucidate the modes of action of novel compounds/materials.

More recently, as a result of collaboration with Professor Hugh Byrne and integration into the FOCAS Research Institute, RESC's research focus has broadened to include Biophotonics and Imaging. Access to state-of-the-art Raman and FTIR spectroscopy facilities has enabled us to pioneer the use of spectroscopy for the development of technologies for cancer diagnostics, particularly in the area of cervical cancer, and latterly for applications in radiotherapy and chemotherapy. RESC is part of the PRTL Cycle 4 funded National Biophotonics and Imaging Platform and is part of the recently funded COST Action Raman4Clinics. RESC collaborates nationally with researchers in TCD, UCD, DCU, UCC, NUIG and with St Luke's Hospital, St James' Hospital and the Coombe Women and Infants University Hospital.

Achievements

Over the last 10 years, RESC researchers have published over 100 peer reviewed journal articles (see published items and citations below) and have filed 5 invention disclosures, 2 patent applications and completed 1 licence to an Irish company, Raman Diagnostics. RESC researchers have successfully won over €4 million in research funding and have supervised 24 PhD students to completion.

RESC Staff

Professor Fiona Lyng, Centre Manager, leads the research team of 15 researchers: Dr Aidan Meade and Dr Orla Howe, Senior researchers; 1 postdoctoral researcher, 2 research assistants and 9 postgraduate students.





Professor Fiona Lyng

Head of Radiation and Environmental Science Centre, DIT

PROFESSOR FIONA LYNQ ALWAYS LIKED MATHS AND “WORKING THINGS OUT”. IN HER ALL-GIRLS SECONDARY SCHOOL, SHE AND THREE OTHER GIRLS WERE INTERESTED IN STUDYING PHYSICS, BUT THERE WAS NO PHYSICS TEACHER. THE SCHOOL FOUND ONE – AND FIONA FOUND HER VOCATION.

She started off in DIT (BSc in physics and chemistry) and then went to UCD (PhD on cell reaction to low-dose radiation), working at Michigan State University as part of her studies.

She was awarded a postdoctoral fellowship by the Ernst Schering Research Foundation, at the Synchrotron Radiation Department, Daresbury Laboratory, UK (1995-1998). She then moved to the Cellular Physiology Research Unit, University College Cork (1998-1999). In 1999 she was awarded a FOCAS postdoctoral fellowship and an Arnold Graves Fellowship in 2000. She accumulated wide-ranging experience at the three centres and also made many contacts with people in her field.

So, having completed her undergraduate degree in DIT she came back to do postdoc research, “so I came round full circle”. When doing her primary degree, she liked the DIT stress on applied science and the amount of hands-on lab work. “Unlike many university students, we did not just witness an experiment, but actually got to do it.”

Since 2003, she has headed the DIT Centre for Radiation and Environmental Science (RESC), which specialises in radiation biology and environmental toxicology. She began as acting centre manager shortly after giving birth to her first child, taking over from Professor Carmel Mothersill who moved to McMaster University. “It was rather a shock to the system – but I survived.”

The centre’s main focus is on radiation biology. “We investigate the effects of radiation on cells and tissues, and try to work out how patients might respond to radiotherapy and how to improve it.”

A more recent research area is biospectroscopy. “We’re looking at the use of Raman and infrared spectroscopy for biomedical applications. We’re also working on identifying novel biomarkers of how cells respond to radiation, chemotherapeutic drugs and nanomaterials.”

Rewarding

As well as managing the centre, she supervises up to eight students at any one time. “People often don’t realise that full-time researchers also teach, although it’s one-to-one teaching. I enjoy that a lot. And it’s very rewarding to see how students develop.”

FOCAS houses RESC’s purpose-built laboratory, which has excellent facilities for cell and tissue culture, an aquarium room to house specimens and research projects, and facilities for molecular biology and proteomics. Fiona says that FOCAS is a great facility, but that it’s much more than that in so far as it promotes lots of collaboration and cross-fertilisation; for example, in the PRTL 4-funded INSPIRE and NBIP programmes on nanotechnology and biophotonics. The RESC itself collaborates with many partners in Ireland and internationally with radiation labs round Europe, including the FP7-funded Network of Excellence, DoReMi.

In the last ten years, Fiona has had responsibility for about a dozen postgraduate students and four postdoctoral researchers. Currently she is PI on five grants and has authored over 80 peer-reviewed publications.

Main research interests: Non-targeted effects of ionising radiation: bystander effects (release of signal by irradiated cells that can affect unexposed cells) and out-of-field effects (effects in cells/tissues outside the primary treatment beam). Vibrational spectroscopy for disease diagnosis.

Does she spend a lot of time seeking funding? “A huge amount, yes! There are funding calls throughout the year. Some proposals involve a massive amount of paperwork and admin. And in the impact statements, you have to go a little beyond the sober scientific text, but be realistic, which is demanding.” On the commercialisation side, Fiona has had to extend her capabilities and learn a new language. “It was quite a learning curve at first! You have to think in a businesslike way, project many years ahead, think of impact on the economy and jobs, and so on.”

“**Professor Lyng’s system has the potential to revolutionise the diagnosis of cervical cancer. The work is an excellent example of the positive social and economic impact of research outputs.**

Minister Sean Sherlock

In terms of impact, however, it’s clear that the centre’s work has strong potential benefits out in ‘the real world’. An example is the development by Professor Lyng and her colleagues of a new system to diagnose cervical cancer, which led to her Enterprise Ireland One to Watch award in 2011. In June that year, Research and Innovation Minister Sean Sherlock presented the award to her in front of 250 academic researchers gathered to look at ways to increase the amount of commercially valuable research transferred from third-level institutions into Irish industry.

Professor Lyng said she was “delighted to accept this award on behalf of the team at DIT... and our colleagues at the Coombe Women and Infants University Hospital”.

Enterprise Ireland, which she says has been “fantastic”, funded the development of this technology for five years, and the team, with business partner Paul Hands, have now set up a spin-out company, Raman Diagnostics, to develop and commercialise the technology: a diagnostic system for screening cervical cancer that is highly objective, specific and sensitive.

FOCAS—10 years on

Work on automating the system is continuing, and Fiona speaks of extending the technology to oral cancer. Fiona's work combines two extremes: methodical, painstaking and rigorous scientific work, and exciting potential – to the point of actually saving lives. “Yes, the potential benefits are hugely motivating, which means that I often work late into the evening!” Fantastic...

What about the next ten years?

Regarding the cervical-cancer technology, “there's much work still to be done, but it would be fantastic to see it in use in labs around the world”. She is keen to develop the oral-cancer work and other biomedical applications of Raman spectroscopy. She would also like to develop more clinical projects in the radiation biology area, looking at individual patient radiosensitivity.

A further aim is to see more of the centre's emerging ideas and technology bearing fruit, as well as “more commercial work similar to what we've been doing”. “There's less funding available now, so the times are challenging.” And she is strongly aware of the obligation to use the funding on what is “going to make a difference”.

Meanwhile, Fiona also seeks to ensure that the centre's basic research is never neglected. And this entails many unknowns. As Einstein said, “If we knew what it was we were doing, it would not be called research, would it?” She has to keep an eye open for projects that, with the necessary development, have great potential – while also staying alert to what is topical at any time (eg, nanomaterials).

Fiona is a scientist to her fingertips, and very much a hands-on one. No doubt she finds all the management, admin and commercialisation work takes her away from her main love, but at the same time the results must be rewarding. It looks as if all this work may bring massive benefits to the world outside the lab.

e: fiona.lyng@dit.ie

- **PhD, Radiation Biology/Electron Microscopy, UCD, 1995**
- **Postdoctoral research, Daresbury Laboratory UK, UCC, DIT**
- **Head of Radiation and Environmental Science Centre (RESC), DIT, 2003–**
- **Leads a team of 15 researchers**
- **80+ peer-reviewed research papers published, 3 patents filed, technology licensed to Irish start-up company**
- **2 MSc/MPhil and 21 PhD students supervised to completion**
- **Research funding: €2.5m+ attained as PI plus €20m as partner**
- **Enterprise Ireland One to Watch Award, 2011**
- **Honorary Professorship, DIT, 2012**

One to watch!

In 2011, Professor Fiona Lyng, Manager of the Radiation and Environmental Science Centre (RESC) was presented with the Enterprise Ireland 'One to Watch' award. It recognised the commercial potential of the research team that has led to the development of a new technology to diagnose cervical cancer. Developed with a team of colleagues in the FOCAS Research Institute, the work has been successfully benchmarked against standard tests from two Irish hospitals (Coombe Women and Infants University Hospital, Dublin, and Altnagelvin Hospital, Derry) and research on additional applications and manifestations is ongoing with funding from Enterprise Ireland and Science Foundation Ireland.

Opposite: From L to R; Professor Fiona Lyng, DIT, Sean Sherlock TD, Minister for Research and Innovation, Fergal O'Moráin, Director of Research, Innovation and Commercialisation, Enterprise Ireland.)



Dr Aidan D Meade

Dr Aidan D Meade is a Senior Researcher at RESC and a lecturer in the School of Physics since 2002.

He holds a Bachelors degree in Physics from University College Dublin (1997), a Masters degree in Medical Physics from Trinity College Dublin (2000) and a PhD in Physics from Dublin Institute of Technology (2010). His research interests are generally in the applications of photonic and computational methods in physics and biology, particularly in radiobiology and radiation oncology. He has over 40 peer reviewed publications and has attracted over €0.5million in competitive funding as PI since 2011.

e: aidan.meade@dit.ie



Dr Orla Howe

Orla Howe is a Senior Researcher at RESC and a lecturer in the School of Biological Sciences since 2009.

Orla was awarded a PhD from Trinity College Dublin (2004) for research on radiosensitivity conducted with the Queensland Institute of Medical Research in Brisbane, Australia. Her research interests are in the area of translational radiation research and more recently in the cytotoxicity and genotoxicity testing of novel compounds and materials. She has over 20 peer reviewed publications.

e: orla.howe@dit.ie

tPOT Research Group

The tPOT Research Group is based in the FOCAS Research Institute. The group was established in May 2007 and brings together all those conducting research into technology that interacts with humans or with the human body - People Oriented Technology (POT). The group's activities include research and teaching in biomedical signal engineering, human-machine interfaces, assistive technology and health informatics. tPOT is led by Dr Damon Berry and Dr Ted Burke.



Dr Damon Berry

Interests: Health Informatics, Electronic Health Record, Biomedical Engineering, Information Quality, Assistive Technology. Damon teaches Industrial Computing and Networking, Engineering Computation and the Engineering Design Module which led to the development of DIT's RoboSumo challenge.

He has a BSc in Control Systems and Electrical Engineering (Dublin Institute of Technology) and an MSc from Dublin City University for a project involving simulation and control of climate. From 1995 to 2000 he worked as a developer and team leader on various EU-funded medical informatics projects at DIT and arising out of that work, completed a PhD in health informatics at the University of Dublin (TCD). He has represented DIT at OMG meetings and in the ISO TC215 and CEN TC 251 standardisation organisations where he was involved in the work of PT 36 Clinical analyser interface project team and is now Ireland's representative on TC 251 WG1.

Damon's research interests span health informatics and biomedical engineering: instrument interfacing; electronic patient records; automated clinical guidelines; mobile health monitoring; applied digital signal processing.

e: damon.berry@dit.ie

e: ted.burke@dit.ie

Dr Ted Burke

Interests: Human-machine interaction, assistive technology, biomedical signal processing, embedded systems, music technology and toys.

Ted Burke completed his undergraduate and postgraduate studies in UCD. He was awarded a BE in Electronic Engineering in 1998, an MEngSc in 2001, and a PhD in 2005. The title of his MEngSc thesis was Rehabilitation applications of musical human-computer interfaces and the title of his PhD thesis was Accessible human-computer interfaces for communication and creative expression.

From 2001 to 2005, Ted managed UCD's Rehabilitation Engineering Laboratory (situated in the National Rehabilitation Hospital in Dun Laoghaire, Co Dublin), where he conducted and coordinated research in a wide range of rehabilitation and assistive technology projects. He subsequently spent several months as a post-doctoral researcher in UCD's Multimodal Signal Processing Laboratory. Since 2005, Ted has been a Lecturer in DIT's School of Electrical Engineering Systems, where he teaches a range of subjects including Robotics, Engineering Design, Engineering Computing and Bioelectromagnetism. His primary research interest is human-machine interaction, with an emphasis on facilitating communication and control. His other research interests include biomedical signal processing, embedded systems, music technology, robotics and toys.

Changing of the guard

The first group of postdocs and PhD students at the tPOT research group have either successfully completed their work (Dr James Condrón, Dr Fabrice Camous), defended their theses (Dr Mark Nolan, Dr Brian Madden and Dr Sheng Yu) or are currently writing up (Johnalan Keegan). The first of the next group of researchers, Paul Stacey, has just started as a part-time postgraduate student. Paul works full-time in IT Blanchardstown and is a graduate of DIT where he was awarded his MPhil. There are other graduate students in the pipeline.

RoboSlam workshops promoting STEM education

For the past 18 months, Ted Burke and Damon Berry have been developing a new Science, Technology, Engineering and Mathematics (STEM) promotion resource called RoboSlam. This is a robot building workshop for beginners - a quick introduction to building robots using real electronic components.

The workshop builds on tPOT's focus on embedded systems development and was inspired by the highly successful RoboSumo module that will be delivered this year to up to 140 undergraduate engineers. The RoboSlam work-shop format teaches participants to design and build a sumo bot—a wheeled robot that can seek out and push their opponent off a table.

Professor Shannon Chance, a Marie klodowska Curie Research Fellow based in the College of Engineering & Built Environment, has a particular research interest in new learning approaches and STEM education and she has worked on both RoboSumo and RoboSlam. The workshops are evolving and gaining in popularity and an interview with Ted Burke was featured in an RTE news bulletin in late July.

roboslam.wordpress.com



Industrial & Engineering Optics

The Centre for Industrial & Engineering Optics (IEO) specialises in holographic techniques, photosensitive materials and ultrasound. It has developed a number of innovative technologies with applications in product security, optical devices, testing, sensing and surface measurement. Based in the School of Physics and located in the basement of the FOCAS Research Institute, IEO was established over 15 years ago. Its research is carried out in well-equipped optical research laboratories and it benefits from access to the world class microscopy and spectroscopic analysis and materials preparation facilities in FOCAS.

The IEO research team includes postdoctoral fellows, research assistants and PhD students. Academic staff with expertise in Physics, Biology, Maths and Engineering are also involved in IEO projects in related areas. The Centre collaborates with a number of commercial companies including the recent DIT spin out Optrace Ltd, which employs three of the Centre's former staff.



Holographic And Optical Expertise

The current staff researchers have more than 70 man years experience in the areas of holography and optics. One of the founders of IEO, Professor Vincent Toal, still plays an active role in the Centre and recently published a textbook on holography 'Introduction to Holography' (published by CRC Press), which has been very well received around the world. The Centre's core competence areas are :

Photosensitive materials

IEO has developed a range of photosensitive materials that change refractive index, with very high resolution (several thousand lines/mm)

Key achievements:

- Improved the refractive index modulation making brighter holograms and more efficient devices.
- Improved the resolution allowing for smaller features making reflection holograms possible, visible in normal room light.
- Increased range of the materials now available so that we now have holograms and devices that are pressure sensitive, humidity sensitive, humidity resistant, laminatable, printable and flexible.

Optical setups for holography and interference

IEO has developed a range of holographic techniques that enable the creation and recording of high spatial frequency optical interference patterns. These techniques are used to test photosensitive materials and create diffractive devices (see Main applications). The use of CMOS cameras and appropriate software enable small changes in the displacement of surfaces to be measured.

Key achievements:

- Development of holographic lenses made from thin photopolymer layers—by adjusting the spatial frequencies and combining elements we have improved the acceptance angle of these lenses (usually low in diffractive devices).
- Construction of interferometric systems to measure vibrations of very low amplitude.
- Fabrication of efficient diffractive devices which are used to change the direction of light beams.

Specialised printing for optical devices

IEO has developed methods that allow optical materials to be selectively patterned by a printing process as well as an optical/light exposure process. The same technique can be used to deposit nanoparticles which add functionality such as sensing, or to produce photonic effects

Key achievements:

- Proof of concept for a new production process for individualised security holograms. IP successfully licensed.
- Successful printing of nanoparticles of various types on a range of substrates including photopolymer.
- Development of printed diffractive devices (with a minimum feature size 10 -15 microns).

Medical Ultrasound Physics and Technology sub group

The Medical Ultrasound Physics and Technology group is part of the IEO centre. It has developed novel tissue mimicking materials for use in quality assurance and clinical training test devices for medical ultrasound. These test devices have also been used to characterise new ultrasound technology such as contrast agent imaging as well as emerging imaging techniques such as microwave imaging.

Key achievements:

- Proof of concept for a new production process for anatomically realistic clinical training test devices, such as breast and renal arteries. The anatomical breast test device is currently being investigated for its commercial potential.
- Proof of concept of new clinical training and competency procedure for trainee breast ultrasound registrars. IP successfully licensed.
- Development of a range of novel test devices for evaluating the capability of medical ultrasound imaging and Doppler techniques.

Main applications

Applications for these technologies include sensing for packaging, light focussing and re-direction with thin polymer optics, vibration and surface measurement and product security and traceability as well as quality assurance and medical ultrasound imaging training and assessment.

Academic outputs

In the last decade IEO has produced:

- 45 peer reviewed journal papers
- 9 PhD and 5 MPhil theses
- > 30 conference papers and SPIE proceedings
- 4 Books and 2 book chapters
- > 500 Citations

Recent PhD graduates are now working in a range of optics-related industries in different locations around the world including Singapore, India and the Netherlands. IEO postgraduate students have been very successful in presenting their research at both European and International Conferences and have contributed to the IEO's portfolio of 30 peer reviewed journal papers published within the past 5 years (see www.arrow.dit.ie).

Collaboration

Within DIT, IEO is working with the Dublin Energy Lab on holographic optical elements for applications in solar collectors; the School of Manufacturing and Design Engineering on optical system design; and Antenna & High Frequency Research Centre on tissue mimick and calibration test device development for microwave imaging.

Nationally, the IEO is working with the Centre for Advanced Medical Imaging, St James's Hospital/TCD, BreastCheck and Mater Private Hospital. Internationally, the team is working with the University of Caen, France, the University of Patras, Greece, the Bulgarian Academy of Science and the University of Edinburgh. We have also had a number of joint projects with the University of Limerick.

IEO also engages in partnerships with industry for externally funded research projects and works closely with the DIT spinout company Optrace Ltd. Short-term design or measurement consulting projects are also carried out for industrial clients needing optical surface profiling, defect studies or optical system design.

IEO is also a partner in the Enterprise Ireland and IDA-funded National Pharmaceutical Manufacturing Technology Centre.



Emeritus Professor Vincent Toal

Emeritus Professor Vincent Toal is a former head of Physics in DIT and Director of the Centre for Industrial and Optical Engineering (IEO) since 1998. He is Co-Founder and Director of DIT spin-out company Optrace developed from research carried

out in IEO. He has 40 years research in applied optics and spent 30 years teaching at certificate, diploma, degree and postgraduate level in DIT. He has supervised 8 PhD and 11 MSc and MPhil students to completion and has published more than 60 journal publications, has made 6 patent applications, published 3 book chapters and 1 textbook. He has been awarded Funding as PI under the Proof of Concept programme (Enterprise Ireland) 2005 (€113,000), Science Foundation Ireland 2006 (€160,000) and Commercialisation Fund (Enterprise Ireland) (2007) €369,000.

He was Vice-Chair COST P8 Materials and Systems for Optical Data Storage and Processing, Manager STSM programme in COST MP0604 Optical Micro-Manipulation by Nonlinear Nanophotonics and of STSM programme in COST advances in Optofluidics: Integration of Optical Control and Photonics with Microfluidics. Professor Toal and his colleague Dr Suzanne Martin won the DIT 2013 Best Researcher Invention Award for their Novel Diffractive Optics invention. In 2009 Professor Toal and his colleagues Dr Suzanne Martin, Dr Izabela Naydenova and Denis Bade won the DIT Overall Best Invention award.

e: vincent.toal@dit.ie



Dr Izabela Naydenova

Dr Izabela Naydenova is a Lecturer in the School of Physics. She holds a PhD in Physics from the Bulgarian Academy of Sciences. She is a Principal Investigator in the Centre for Industrial & Engineering Optics (IEO).

After postdoctoral work at the Institute for Physical and Theoretical Chemistry, Technical University of Munich (1999-2002) and the IEO Centre (2002-2008) she took up her current academic position in the School of Physics, in 2008. Dr Naydenova has published more than 85 papers and 4 book chapters on holographic recording materials and applications and is co-author of 10 patent applications. She is the editor of two books on holography, holographic recording materials and applications.

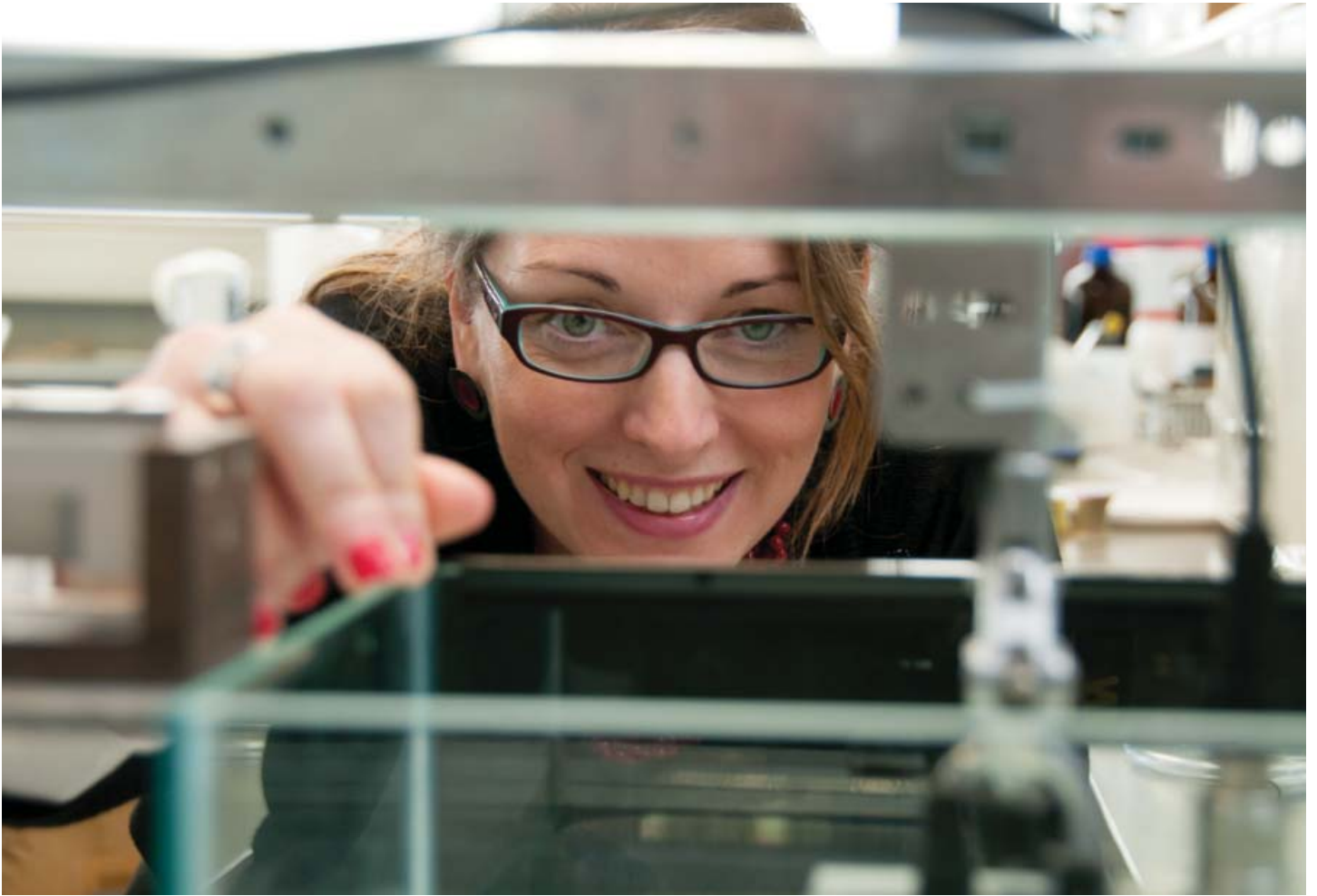
Dr Naydenova was the Principal Investigator of the Enterprise Ireland funded project that led to the establishment of OPTRACE Ltd, a DIT spin-out company for production of serialised holographic security labels. She is one of the co-founders and technical advisors of the company.

She has been awarded national funding of €400k as principal investigator and €580,000 as co-investigator from Enterprise Ireland, HEA, & IRCSET, SFI. She has supervised seven PhD, four MPhil and twenty three BSc students to their completion and has mentored six postdoctoral researchers.

She is currently supervising five postgraduate students. Dr Naydenova was awarded an Arnold F. Graves scholarship in 2002 and was joint winner of the DIT invention competition 2009 - Overall Best Invention. For her commercialisation work she was nominated for an award from Knowledge Transfer Ireland.

Current research interests are in the development of holographic recording materials and their applications in holographic sensing, fabrication of diffractive optical devices by digital printing, optical micro-patterning and micro-manipulation, and the development of holographic actuators.

e: izabela.naydenova@dit.ie



Dr Jacinta Browne

Dr Jacinta Browne, lecturer in the School of Physics, established the Medical Ultrasound Physics and Technology Group in 2005. It is based in the Centre for Industrial and Engineering Optics since 2013. She leads research in the characterisation of disease progression in the renal vascular system; the development of contrast resolution phantoms and anthropomorphic breast phantoms; and the development of novel Doppler test phantoms for cardiology.

Ultrasound imaging is a powerful tool that is used routinely in hospitals to diagnose a range of pathologies throughout the body, from cancers to cysts to calcifications. However, it can take a while to master the technique due partly to the complex physics underpinning it which makes it difficult to interpret the image features, but also because of the complexity of the scanner itself. Dr Browne's team has developed a physical simulation device which mimics the complexity of breast tissue. When it is scanned it produces images which bear a remarkable resemblance to real images from patient breast tissue.

The researchers have also mimicked a range of pathologies (tumours, cysts and calcifications) of varying sizes and appearances, and located them randomly in the device, mimicking their occurrence in real patients. The device will be used to train medical staff to diagnose a range of pathologies and is being validated in St James' Hospital. The training and assessment protocol associated with this medical device has been licensed to a US multinational.

Dr Browne is currently responsible for the supervision of 1 postdoctoral researcher and 1 Research Assistant and co-supervising 1 PhD student registered in TCD. Dr Browne has published 1 invited book chapter and 28 peer reviewed publications, 25 published conference abstracts, given ten invited presentations and over 100 conference presentations. She has to date, attracted funding of approximately €520K for research, new equipment and consultancy in collaboration with her colleagues.

e: jacinta.browne@dit.ie



Dr Suzanne Martin

Manager of the Centre and PI for research projects in holographic materials and devices

AS MANAGER OF THE CENTRE FOR INDUSTRIAL & ENGINEERING OPTICS (IEO), SUZANNE EMPHASISES SHE IS “VERY MUCH PART OF A TEAM”. A DUBLINER WHOSE FATHER WAS A FAMILIAR FACE AT DIT KEVIN ST, (HE WORKED AS A GATEMAN), SHE WAS AWARDED HER PHD BY TCD WHERE SHE RESEARCHED THE OPTIMISATION AND CHARACTERISATION OF A NEW POLYMERIC HOLOGRAPHIC RECORDING MATERIAL.

When Professor Vincent Toal set up the Centre for Industrial and Engineering Optics, Suzanne (above right) became the manager. A key collaborator in the centre, who has been part of the team for over ten years, is Dr Izabela Naydenova, (above left).

The Centre, which specialises in holographic and interferometric techniques, has developed novel technologies with applications in product authentication, sensing, vibration measurement, ultrasound and optical device fabrication.

These can be used by industry for leading-edge systems development and R&D. Other activities are applied research, contract R&D, and developing Intellectual Property for licensing. IEO also provides problem-solving, design, measurement and consultation services.

Suzanne herself has authored 29 articles in peer-reviewed journals, on the subject of holographic materials and devices. Several new technologies, of which Suzanne was a co-inventor, have been developed in IEO, and three patents have been granted to date. As principal investigator, she has been awarded external research funding of €845,000, and as a co-investigator a total of €555,000.

As IEO manager, she was one of the original contributors to the successful application for PRTL-Cycle 1 in 1999, which funded FOCAS.

Best invention

In 2009 Suzanne and her colleagues, Professor Vincent Toal, Dr Izabela Naydenova and Denis Bade won the DIT Overall Best Invention award. Also in 2009 she was nominated for the Enterprise Ireland One to Watch award. Then, in 2013, Suzanne and Vincent Toal won the Best Researcher Invention award for their Novel Diffractive Optics invention.

She is currently working on holographic diffractive devices with applications in light manipulation and distribution, and investigating moisture-sensitive systems.

Principal research interests: Holographic recording materials (recording processes, diffusion through polymer, holographic characterisation) and interferometric techniques for surface metrology (ESPI, white light interferometry, holographic interferometry).

Suzanne is a co-inventor and co-founder of Optrace. It produces holographic labels that improve security and branding on packaging and labelling. Each label, she says, is “unique as a fingerprint”. Only Optrace Ltd can manufacture these, using a patented process.

With her colleagues in IEO, Suzanne supported Optrace in its successful progress through the NDRC Venture Lab programme for technology-based companies.

“**Optrace produces holographic labels that improve security and branding on packaging and labelling. Each label is ‘unique as a fingerprint’.**”

In Optrace, Suzanne and her colleagues have the satisfaction of seeing their research work leading to specific and concrete benefits. It’s thus not surprising that, as regards the next 10 years, Suzanne is keen to learn from the Optrace experience and help to commercialise other IEO technologies.

Dr Martin has already achieved much as manager and as a researcher, but stresses that she’s done it alongside her colleagues, “as part of a team”.

e: suzanne.martin@dit.ie

- BSc, Physics & Chemistry, DIT/TCD, 1991
- PhD: Optimisation and characterisation of a new polymeric holographic recording material; TCD, 1995
- Author of 29 articles in peer-reviewed journals as well as posters and conference presentations
- Co-inventor of several new technologies developed in IEO
- Awarded external research funding of €845,000 as PI, and €555,000 as a co-investigator
- Co-founder of DIT spin-out Optrace Ltd
- Co-winner of 2013 DIT Best Researcher Invention Award and 2009 Overall Best Invention Award
- Nominated for Enterprise Ireland One to Watch award, 2009

Dervil Cody

Dervil is a postgraduate student in IEO. She completed her BSc degree in Physics with Astrophysics at the National University of Ireland, Maynooth in 2010.

In the summer of 2009 before my final year, I was accepted for an internship in the FOCAS Research Institute, funded by the Science Foundation Ireland's UREKA Programme.

I spent three months in the Centre for Industrial and Engineering Optics (IEO) working in a holography laboratory. This was a fantastic experience; it gave me an insight into the world of academic research and definitely helped me to make the decision to continue my studies to postgraduate level. After completing my BSc degree, I came back to IEO and FOCAS, this time as a PhD student funded by the Irish Research Council's EMBARK Initiative. I think that the research experience gained from the UREKA programme was of great benefit to me when applying for PhD funding.

I'm now nearing the end of my PhD studies, which focuses on the development of novel low-toxicity photopolymers for holographic sensing applications. I think that FOCAS is a great environment for researchers; the close proximity of research groups with such varied interests and skills really encourages interdisciplinary collaboration.

One of the highlights of my PhD was getting the opportunity to carry out in-vitro cytotoxicity studies by working with researchers from the Nanolab group, a field which I had never worked in before. FOCAS also has a great support system for core instrumentation such as the UV-Vis and Raman spectrometers, and it's been really helpful to receive training in this area.

e: dervil.cody@dit.ie



Hoda Akbari

Hoda Akbari is a postgraduate student in IEO. She is originally from Iran and moved to Dublin in October 2005 as an international student.

I received my BSc (Ord) in Industrial & Environmental Physics from Dublin

Institute of Technology in 2008 and in my final year I won the Joe Guy prize for the best final year project in the School of Physics. After this I continued my studies and graduated again from DIT with a BSc (Hons) in Physics Technology in 2010. During my degree, I was one of the 16 successful candidates to win a three month scholarship under Science Foundation Ireland's UREKA Site scheme here in FOCAS Research Institute in 2009. I conducted a 12-week research project in parallel with the postgraduate researchers, supported by a programme of technical tutorials and seminars, presentations in professional skills and a series of seminars in topical issues in science. I undertook my project within the Centre for Industrial and Engineering Optics (IEO) on the development of materials and devices for holographic applications.

The title of my project in UREKA was 'Photopolymerisable nanocomposites for development of irreversible holographic humidity sensors'. The project was under the supervision of Dr Izabela Naydenova and Dr Suzanne Martin. Over the period of the UREKA programme, we gave a number of oral presentations and written reports which provided me with invaluable experience in the research environment and inspired me to undertake a PhD.

In October 2011, I began my postgraduate project "Exploring the development of Holographic Optical Elements for application in solar collectors" in FOCAS with the Centre for Industrial and Engineering Optics group under the supervision of Dr Suzanne Martin and Dr Izabela Naydenova once again. Through my time as a postgraduate, I have published two journal papers/book chapters and presented at three international conferences. The FOCAS Research Institute includes a number of interdisciplinary research groups in many different fields and this encourages the postgraduate students and researchers to collaborate with each other. FOCAS has a range of facilities available for all postgraduates and researchers, has a very friendly atmosphere and is an enjoyable place to work.

e: hoda.akbari@dit.ie

Dublin Energy Lab



Dublin Energy Lab (DEL) has a research team of 60 postgrads, postdocs and academics. It has attracted funding of over €6m from a range of sources in the last six years. The centre has published over 100 journal and 200 conference papers as well as licences and patents and collaborates closely with industry partners and universities such as: ESB, Electric Ireland, Gael Electric, Bord Gais, United Technologies, Eirgrid, SEAI, Airtricity, Fraunhofer Institute, Universidad Politécnica de Madrid, University of Bath, Acciona Energia, University of Ulster and NREL.

It is focussed on serving the Island's institutional, industrial and academic needs. This is achieved through basic and applied research collaborations closely linked with national and international targets for carbon reduction and growth of a knowledge economy.

This makes Dublin Energy Lab a leader in science and engineering energy research in Ireland. Based in the FOCAS Research Institute, it conducts research across a range of disciplines with key efforts organised into four themes of solar energy, low carbon buildings, electrical power and energy policy.

Core Competencies

DEL's core competencies include:

- new technology development, validation and licensing and new company start-ups in the fields of energy efficiency and renewable energy;
- an interdisciplinary research capability which addresses scientific, engineering, design, behavioural and marketing challenges in the residential, commercial, manufacturing, transport and public sectors;
- a proven ability to work with industry and commercialise research output;
- a practical approach to research involving academic and research staff with extensive industrial experience and connections and an apprentice-to-PhD learning and award structure;
- the ability to generate internationally-recognised research outputs in the fields of energy efficiency and renewable energy supply.

Core research themes and projects

Solar Energy

- PV Crops - PhotoVoltaic Cost reduction, Reliability, Operational performance, Prediction and Simulation.
- CEMBAT - Using solar energy stored in cement batteries to power cathodic protection of reinforced concrete structures.
- EPHOCELL - Photovoltaic Surface Coatings - downshifting and up-conversion layers to increase PV cell efficiency.
- Non-imaging optical solar concentrators for solar thermal and PV absorbers.
- Photovoltaic Flat Plate Concentrators - Quantum Dot Solar Concentrator.
- PV temperature regulation through the use of phase-change materials.
- PV and low-temperature solar thermal energy and exergy system modelling including solar radiation simulation.

Low Carbon Buildings

- Microgeneration techno-economic modelling.
- Thermal Energy Storage - Phase Change Materials Based Spiral Heat Exchanger (PCM-SHE-TES)
- Energy demand profiling.
- Life-cycle assessment
- Embodied energy.

Electrical Power

- Power Quality - application of Unified Power Quality Conditioner (UPQC) to power quality enhancement analysis of fault contribution, transient stability, power flow, quality and losses with the objective of maximising levels of distributed generation penetration in urban networks.
- Double-Fed Induction Generators - involves long-term phase unbalance monitoring at 10kV network with simulation analysis of Double-Fed Induction Generator (DFIG) in presence of phase unbalance.
- The Quantum Greenway project is investigating how space heating systems can be used to remotely switch distributed populations of energy stores in response to an operational command.

Energy Policy

- International Energy Agency (IEA) Task 26 - Cost of Wind Energy
- ROKWOOD - Research and technological development activities in sustainable production and efficient use of wooden biomass
- Energy Training for Construction Workers for Low Energy Buildings
- SEA/AA in the Energy Sector - Towards Better Practice for the Preparation of Strategic Environmental Assessments (SEAs) and Appropriate Assessments (AAs) for the Energy Sector in Ireland
- Energy Training for Construction Workers for Low Energy Buildings (BUILD UP SKILLS QUALIBUILD)
- EFONET energy network foresight
- Embodied energy research in Irish buildings
- Energy policy in domestic buildings
- Greenhouse gas emissions and land use planning

Facilities and Equipment

The centre has the following facilities and equipment which allows it to carry out world class research:

- Thermal laboratory for monitoring of energy systems and prototypes.
- Microscopy and spectroscopy facilities for material characterisation.
- Outdoor lab for solar and wind device testing.
- Electric power lab for power quality analysis and simulation.

www.dit.ie/dublinenergylab



Professor Aidan Duffy

Lecturer & Centre Manager, Dublin Energy Lab

DURING HIS CHILDHOOD, PROFESSOR AIDAN DUFFY WENT, AS HE PUTS IT, “FROM POWERSTATION TO POWERSTATION” – IN COS KERRY, CORK AND DUBLIN. HIS FATHER, AFTER ALL, WAS AN ENGINEER IN THE ESB AND EVENTUALLY BECAME A DIRECTOR. IN A WAY, IT’S A METAPHOR FOR HIS CAREER SO FAR, EXCEPT THAT HE’S BRANCHED OUT PROLIFICALLY INTO NEW, THOUGH RELATED, FIELDS.

The final-year project of his Civil Engineering degree course at TCD related to historic buildings. Awarded a three-year PhD scholarship under the Science and Technology for Environmental Protection (STEP) programme funded by the European Commission, his PhD investigated urban atmospheric chemistry and materials. Among the buildings examined were the Parthenon and Trinity College Dublin. Between 1994 and 2005, he worked as a consultant. He founded and managed Carrig Consultancy, advising the construction sector on building materials conservation and façade design; founded and was managing director of Environmental Power Ltd (low-energy building design and CHP), and was managing director of Willis Risk Management (environmental and health & safety services).

FOCAS—10 years on

Then came his move to DIT's School of Civil & Building Services Engineering. He currently lectures in the Master's in Sustainable Infrastructure and Master's in Energy Management. As well as doing his own research – "I like the continuous challenge of research" – he supervises postgraduate and postdoctoral researchers. In 2010, he was one of a group of engineering researchers who set up the Dublin Energy Lab (DEL), of which he is (the elected) manager. DEL is a leader in science and engineering energy research in Ireland.

"DEL is highly interdisciplinary, involving physics, chemistry, all kinds of engineering, architecture, planning, etc, which makes the work very interesting," Aidan says.

DEL achieved a research income of around €10m in the last seven years or so, and, with 30 staff and postgrads, produces many publications, and seeks to engage strongly with industry.

Focus on interaction

One of Aidan's main aims is to persuade people to interact more, for example in the area of 'smart' cities (though he's not keen on the connotations of the term 'smart'). He'd like to see "more focus and development of interdisciplinary platforms on which we can collectively move forward, using our range of research expertise, involving industry".

As regards his own research, he's interested in how engineers and scientists can develop new devices and systems, work out how to embed them in house, car or network, and contribute more to policy debate. "We're the best people," he says, "for modelling how tech affects future policy environments."

Main research interests: Energy policy; Techno-economic modelling of energy systems; Life-cycle assessment; Carbon accounting; Cost-benefit analysis; Embodied energy and emissions

Aidan does not blow his own trumpet, so it's only by doing a little minor research that one finds out his many awards and honours. Winning the Collen Prize for best final-year project at TCD is outweighed by later recognition, though as an early honour it may well have been one of the most personally satisfying.

Since 2008, Aidan has been a reviewer for four international journals, including Energy Policy and the Journal of Environmental Policy. In 2008-2010 he was an invited lecturer on Energy Policy in a university with a fine engineering tradition, Queen's University, Belfast.

Being invited to present industry-relevant research findings to ESB board members and senior management in 2010 would no doubt have stirred paternal pride. He was also an invited chair at the Intelligent Energy Europe Universities and Students for Efficiency final conference in 2011, and an invited scientific committee member at the International Symposium on Life Cycle Assessment and Construction, Nantes, France in 2011.

In 2011, he won the DIT Hothouse Researcher Commercialisation Award for "licensing space heating and hot water energy demand forecasting tools to Bord Gáis". In 2012, he was the invited Irish representative at the Joint IRENA and IEA-RETD workshop on Levelised Costs of Renewable Energy in Bonn, Germany, and in 2012 an invited reviewer for the National Renewable Energy Laboratory 2011 Cost of Wind Energy Review in the United States.

Aidan has already accumulated an impressively wide range of knowledge and skills, straddling both academic research and the so-called 'real world'. He can thus be a key person in the development of interdisciplinary platforms, organisation of research expertise and collaboration with industry – to use a phrase he would probably reject, a smart person for the smart city. He's travelled a long way from the powerstations of his childhood to being himself a powerhouse of energy.

e: aidan.duffy@dit.ie

- **Primary Degree, Civil, Structural and Environmental Engineering, TCD, 1990**
- **PhD, Department of Civil, Structural and Environmental Engineering, TCD, 1995**
- **Master's in Business Administration, Open University, 2004**
- **Project manager/designer, low-energy building design and CHP design, 1994-2001**
- **Managing Director of Willis Risk Management, 2001-2005**
- **Lecturer in DIT School of Civil & Building Services Engineering, 2005-**
- **Centre Manager, Dublin Energy Lab, DIT, 2010-**



Dr Jimmy Devins, Minister of State for Science, Technology and Innovation (front row l) pictured with the partners at the official NBIP launch in 2009.

DIT expertise goes from strength to strength

In the 10 years since FOCAS opened the doors to its new facility it has been growing research, transferring knowledge and securing funding for research and education. Being a part of key national and European consortia has helped build its international reputation.

In 2007, FOCAS was invited to join two consortia making an application for funding under the HEA Programme for Research in Third Level Institutions Cycle 4. Both were funded and represented the biggest investment in research infrastructure in the state to date at that time.

The Integrated NanoScience Platform for Ireland (INSPIRE) was awarded €32million and the National Biophotonics and Imaging Platform, Ireland (NBIP) received €30million. The two Platforms consolidated and extended national capacity and capabilities in their respective areas and are landmarks in the development of the FOCAS Research Institute.

DIT received €4.5 million under INSPIRE and €3.5 million under NBIP, €8 million in total, to fund research costs and researchers - two PIs, five postdoctoral researchers, one technician and eight postgraduate students, over a period of 4 years, a substantial investment in the suite of core FOCAS equipment (€2.4million), and a full floor extension (-600m²-€1.6 million) to the building. The investment significantly enhanced and extended DIT's research activity and impact in these fields.

FOCAS—10 years on

The research focused on the health and environmental impacts of Nanomaterials (INSPIRE) and the development of biospectroscopic techniques for in vitro and ex vivo medical diagnostics (NBIPI).

INSPIRE

The eight partners in INSPIRE are: FOCAS, Dublin Institute of Technology; CRANN, Trinity College Dublin; Cork Institute of Technology; RINCE & NCPST, Dublin City University; Lighthouse, National University of Ireland Galway; Tyndall national Institute, University College Cork; University College Dublin and MSSl, University of Limerick.

FOCAS brought a unique blend of nanomaterials and toxicological expertise to the consortium. Nanolab's expertise in carbon based nanoparticles is internationally recognised as are its high throughput physico-chemical characterisation techniques for all materials.

The cyto and eco- nanotoxicology expertise in RESC is nationally unique and complements the bionanoscience activity. Through the consortium, protocols were established to characterise a range of nanomaterials, determine their potential human and environmental impacts and optimise knowledge transfer.

DIT was also invited into the EU FP7 Concerted Support Action, NanoImpactNet: European Network on the Health and Environmental Impact of Nanomaterials. This ran in parallel with the INSPIRE work programme. It was a pan-European network with 30 partners. It aimed to create a scientific basis to ensure the safe and responsible development of engineered nanoparticles and nanotechnology-based materials and products, and to support the definition of regulatory measures and implementation of legislation in Europe.

In 2011, INSPIRE was awarded a further €3.4million under PRTLl Cycle 5 to establish and consolidate the National Graduate Education Programme in Nanoscience and Nanotechnology. The structured PhD programme provides high-quality graduate training aligned to the INSPIRE vision. Fundamental nanoscience education is complemented by modules in electronics, photonics, and nanobioscience.

A significant component of the structured programme is the development of business, innovation and entrepreneurship skills for engineering and science students, while maintaining a focus on scientific and technical excellence to address strategic goals in "Building Ireland's Smart Economy".

National Biophotonics and Imaging Platform (NBIPI)

NBIPI supports and encourages the development and integration of centres of expertise in biophotonics and imaging nationally. The provision of adequate core technologies in advanced imaging greatly enhances the national research infrastructure and increases efficiency of usage to provide a solid foundation for the development of key research areas.

The partners in NBIPI are: Royal College of Surgeons in Ireland; Dublin City University; Dublin Institute of Technology; National University of Ireland Galway; University College Cork; National University of Ireland Maynooth; and University of Limerick. Although not funded, in the first year, the consortium was expanded to associate CNRS Montpellier, CNR -IBB Naples, Norforsk, Trinity College Dublin and Dundalk IT.

The key areas of focus are to: provide structured research and training in advanced imaging applied to the Life Sciences; establish a Graduate Training Programme in Cell Signaling and Imaging; bridge the Physical and Life Sciences interface; and through partnership with Industry enhance technology developments in BioPhotonics and Imaging.

FOCAS Research Institute provided nationally unique Spectroscopic Imaging facilities and expertise to the Molecular and Cellular Imaging Core. The associated expertise is based in Nanolab and RESC in the Biospectroscopy team. This team was the only group in Ireland using vibrational spectroscopy for cellular and tissue analysis.

Building on reputation

DIT's engagement with the NBIPI and its access to funding consolidated the group as national leaders in spectroscopic imaging. It strengthened DIT's reputation within the international community and facilitated the purchase of state of the art equipment and facilities and recruitment of staff. The team contributed the additional imaging dimension of spectroscopy and facilitated the development within the consortium of complementary imaging and hybrid techniques.



Professor Hugh J Byrne and Professor Fiona M Lyng were also part of an FP6 Special Support Action “Diagnostic Applications of Synchrotron Infrared Microscopy” (DASIM www.dasim.eu). This project led to the publication of a DASIM book, to which DIT researchers contributed two chapters.

The collaborative programme also led to a series of seminal papers which elucidate the origin of spectral artefacts in Infrared microscopy, and developed a data processing algorithm to remove them, now extensively used throughout the community, significantly progressing the confidence in the multispectral data gathered.

In 2009, the NBIPI programme was supplemented by a successful €2.4 million FP7 Marie Curie CoFund Programme (www.nbipireland.ie/education/cemp). The post-doctoral Career Enhancement and Mobility Programme (CEMP) enabled 15 postdoctoral researchers to collaborate with research organisations in the public and private sectors throughout Europe, supporting research fellows undertaking interdisciplinary research and training programmes in biophotonics and imaging applied to cancer, cardiovascular and neuro-degenerative diseases.

2009 also saw the launch of EuroBioImaging, a large scale pan-European research infrastructure project of the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap. EuBI aims to deploy a distributed biological and biomedical imaging infrastructure in Europe in a coordinated and harmonised manner. By providing access to and training in imaging technologies, and by sharing of best practice and image data, EuBI aims to become an engine that will drive European innovation in imaging research and technologies.

NBIPI is an Associated Partner of EuBI and the facilities of NBIPI at FOCAS were utilised as a Proof of Concept Pilot Access Site in 2012. In 2013, the FOCAS facilities were incorporated into the proposed NBIPI EuBI Advanced Light Microscopy Hub, also incorporating the NBIPI facilities of DCU, RCSI and UCD, which was Highly Recommended by the International Review panel.

In 2010, FOCAS co-organised the flagship biennial conference in the Biomedical applications of vibrational spectroscopy and imaging: SPEC: Shedding New Light on Disease, and since then Professor Hugh J Byrne has been appointed to the international Advisory Board. He was co-chair of SPEC 2014, held in Krakow, August 2014.

DIT’s international recognition as experts in the field of BioPhotonics and Imaging is evidenced by recent inclusions as international co-ordinators in the UK EPSRC Network Clinical Infrared and Raman Spectroscopy for Medical Diagnosis, (CLIRSPEC <http://clirspec.org/>) and the ESF COST Network Raman-based applications for clinical diagnostics (Raman4clinics www.cost.eu/domains_actions/bmbs/Actions/BM1401).

**Professors Byrne and Lyng have also been recognised nationally with their success in the SFI Principal Investigator programme.
e: hugh.byrne@dit.ie**

FOCAS encourages students to study science & engineering

The FOCAS Research Institute has been supporting undergraduate education since it was established and has organised many activities to encourage students to consider a career in research after graduation. The success of the programme is demonstrated by the number of attendees that went on to study for a PhD after they graduated.

In the early stages of its development (2001-2003), 25 undergraduate students worked on research projects in FOCAS during their summer break. This early programme was a great success and encouraged many of them to undertake a PhD when they graduated or to choose a scientific career. It also meant that FOCAS was in a very strong position to bid for funding under the UREKA programme launched by Science Foundation Ireland (SFI) in 2004. This programme aimed to encourage undergraduate students to consider research as a career option.

The SFI UREKA scheme provided funding for summer schools for outstanding undergraduate students from Ireland and abroad. The scheme was based on the American NSF Research Experiences for Undergraduates Programme, and in its first year was adjudicated by representatives of that programme.

The FOCAS summer school was one of only five funded nationally in the first round. "FOCAS on Education in Advanced Techniques and Undergraduate Research Expertise, FEATURE" was funded for three years from 2005 and then successfully competed for more funding to continue the programme until 2010.

FEATURE trained young scientists in experimental techniques in a range of fields within the centres based in FOCAS. There was a Core seminar programme on the underlying principles of the techniques, and a Group seminar programme on the versatility of the techniques for problem solving. Finally, a Support programme provided the students with workshops on topics such as ethics, intellectual property, health and safety and presentation skills.



As part of its remit to engage students in a "fun and engaging way" a number of social events were also organised including table quizzes, trips to the zoo (welcomed by the chief zoologist), paint balling and sports days.

At the end of the 12-week programme a FEATURE Symposium was organised. At this two-day event the 16 funded students presented their project results. Other summer students in FOCAS were also encouraged to attend seminars and workshops where possible with the result that more than 100 undergraduate students engaged in the programme between 2005 and 2010.

Over 120 applications to attend the summer school were received each year 33% from DIT students, 33% from elsewhere in Ireland, and 33% International, and successful international candidates came from Poland, France, Italy, US and Canada. The gender split was consistently 50:50, and the primary discipline ranged from Physics, Chemistry, and Biological Sciences, to Environmental Health Sciences and Zoology, reflecting the true interdisciplinary nature of the programme and FOCAS.

The programme was generally hailed as a huge success and 12 students returned to FOCAS to do a PhD, the first of whom graduated in 2012. Although it has not been possible to keep track of all FEATURE Alumni, regular feedback indicates that the programme significantly enhanced their future career development. The UREKA programme and FEATURE site enabled FOCAS to promote its activities, expertise and capacity to undergraduate students in DIT, nationally and internationally.

Although the UREKA scheme ended in 2010, FOCAS continues to support undergraduate students who complete research projects in FOCAS as part of their DIT degree programmes, Erasmus exchanges and the Research Brazil Ireland Initiative.

Reaching out to schools

Science, technology, engineering and mathematics (STEM) are strategically important subjects in both higher education and Ireland's economic recovery. More STEM graduates are needed to underpin growth and DIT is addressing this issue through STEM outreach programmes. Knowing that the student learning experience in STEM subjects in school is key to sustaining growth in their uptake at third level, the FOCAS Research Institute has introduced two programmes to help address this issue: Grasshopper and BORN.

The programmes were developed and are run by Dr Theresa Hedderman-Bowe, Research Technical Officer in FOCAS. Her main target audience is 7-15 year old primary and post-primary schoolchildren and in particular those who haven't yet chosen their Leaving certificate exam subjects. Her aim is to empower the pupils to make a more informed decision when choosing their third level courses and to encourage them to consider STEM subjects. Teachers are also encouraged to take part in the programmes as they have a significant influence over the subjects and careers chosen by their students, in particular female students.

The Grasshopper Programme is for primary schoolchildren from 7 to 12 years old. In a series of interactive science learning activities using structured inquiry based learning, the pupils are introduced to matter and its different phases and their unique characteristics. The programme is run as a roadshow during Science Foundation of Ireland's Science Week. Teachers and parents are encouraged to participate. In 2013, five schools were visited over five days and more than 2000 children attended the show.

The BORN project is a STEM secondary school junior cycle programme for 12-15 year olds. For this programme the students design a science show which they then present to their school. The aim is to give secondary school students an insight into scientific research. The students learn skills such as research techniques, project and time management and presentation skills.

In 2013, Fionn McNeill of Mount Temple Comprehensive School worked on a project with Dr Theresa Hedderman-Bowe in FOCAS Research Institute. First he wrote a science proposal that he thought would interest him and his classmates. Once it was finalised, he developed and refined it and then presented it to his class and teacher. As part of the presentation Fionn demonstrated an experiment and then invited his classmates to try the experiments for themselves. The project was met with great enthusiasm by all.

Fionn's experience in his own words: "Overall the preparation up to it was a great learning experience and lots of fun. It was great to see what the college was like and how kind everybody was. The science show went well and it was nice to see the students enjoying themselves and hopefully benefiting from the experience."



FOCAS—10 years on

His teacher was also happy — “I thought it was excellent, both in the way that Fionn presented and explained the demonstrations but in particular that the students were then allowed under supervision to try them out for themselves, hopefully reinforcing their understanding. The level of the subject matter was just right for the students and it was clear to see that they were thoroughly engaged from beginning to end.”

Dr Theresa Hedderman-Bowe is also a scientific advisor for primary school science competitions. In 2012 she worked with a Dublin school for the Discover Primary Science competition which they won at regional and national level. The competition was to promote green energy and the school proposed a lemon battery.

The children really enjoyed their exposure to research and the competition judges reported that they had excellent presentation skills and a deep understanding of scientific concepts. The pupils also presented this project at the Young Scientist competition 2012 and reached the final.

Fascinating light

The Fascination of Light exhibition was a European wide travelling exhibition, aimed at promoting science to primary and secondary school students and was a joint initiative funded by the European Union and Discover Science and Engineering. The exhibition was hosted by the School of Physics for two weeks in April 2008. More than 4000 school students attended. The exhibition had been hosted in numerous European cities over the preceding 3 years. It focussed on light and how it affects our lives using interactive installations, experiments, multimedia presentations and visual diagrams. Dr Theresa Hedderman-Bowe was actively involved in the exhibition as one of the tour guides.

e: theresa.hedderman@dit.ie



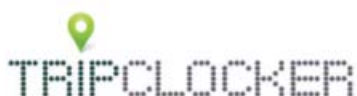


where business meets innovation

Irish Start-up Investment Opportunities



*Software design tool
to aid Architects*



*Traveller experience
booking platform*



*Platform for identifying
business tender opportunities*



**PURA LIGHT
LIMITED**

Improving Healthcare through Innovation

*Preventative Infection
Control through Innovation*



*A unique new bicycle that
"grows with your child"*



*Designing event
production software*



*Mobile Relationship
Management for Brands*



*Manufacturing Micro Hydro
turbine technologies*



*Enhancing user experience on
the world's Wi-Fi networks*



*Practice management
web application for self-
employed lawyers*



It's your world, Shape it

DIT Hothouse is the
award-winning Innovation
and Technology Transfer
Centre at Dublin Institute
of Technology, Ireland

Invest in exciting new Irish start-up businesses:
visit www.hothouse.ie or email hothouse@dit.ie

PhD Opportunities



Environment,
Energy and Health

Information,
Communication
and Media
Technologies

New Materials
and Devices

Society, Culture
and Enterprise

Invest in your future career
with a PhD at the
Joint Graduate Research School



Institute of Technology
Blanchardstown
Institiúid Teicneolaíochta
Baile Bhlainséir



Institute of Technology Tallaght
Institiúid Teicneolaíochta Tamlacht

www.dit.ie/phd