Irish Chemical News

The Journal of the Institute of Chemistry of Ireland

Feature Articles:- **Chemical Physics application of Prompt Gamma Activation Analysis (PGAA)**

Advances in Chemical Decontamination of the Eyes and Skin

Severe chemical injury

10 days after HF burn

EMIL ALPHONSE WERNER, ScD.
Professor of Applied Chemistry, 1904–1928
University Professor and Professor of General Chemistry, 1928–1946

The Dublin Professor Werner *

*A history of the university chemical laboratory, Trinity College, Dublin; 1711-1946, Wesley Cocker, *Hermathena,* Trinity College/JSTOR http://www.jstor.org/stable/23040384

Irish Chemical News

Originated 1922
Incorporated 1950

The Institute of Chemistry of Ireland

**PO Box 9322, Ravensdale Delivery Unit,
Ravensdale Road, Dublin D03 CY66.**

Web: www.instituteofchemistry.org

Email: info@instituteofchemistry.org

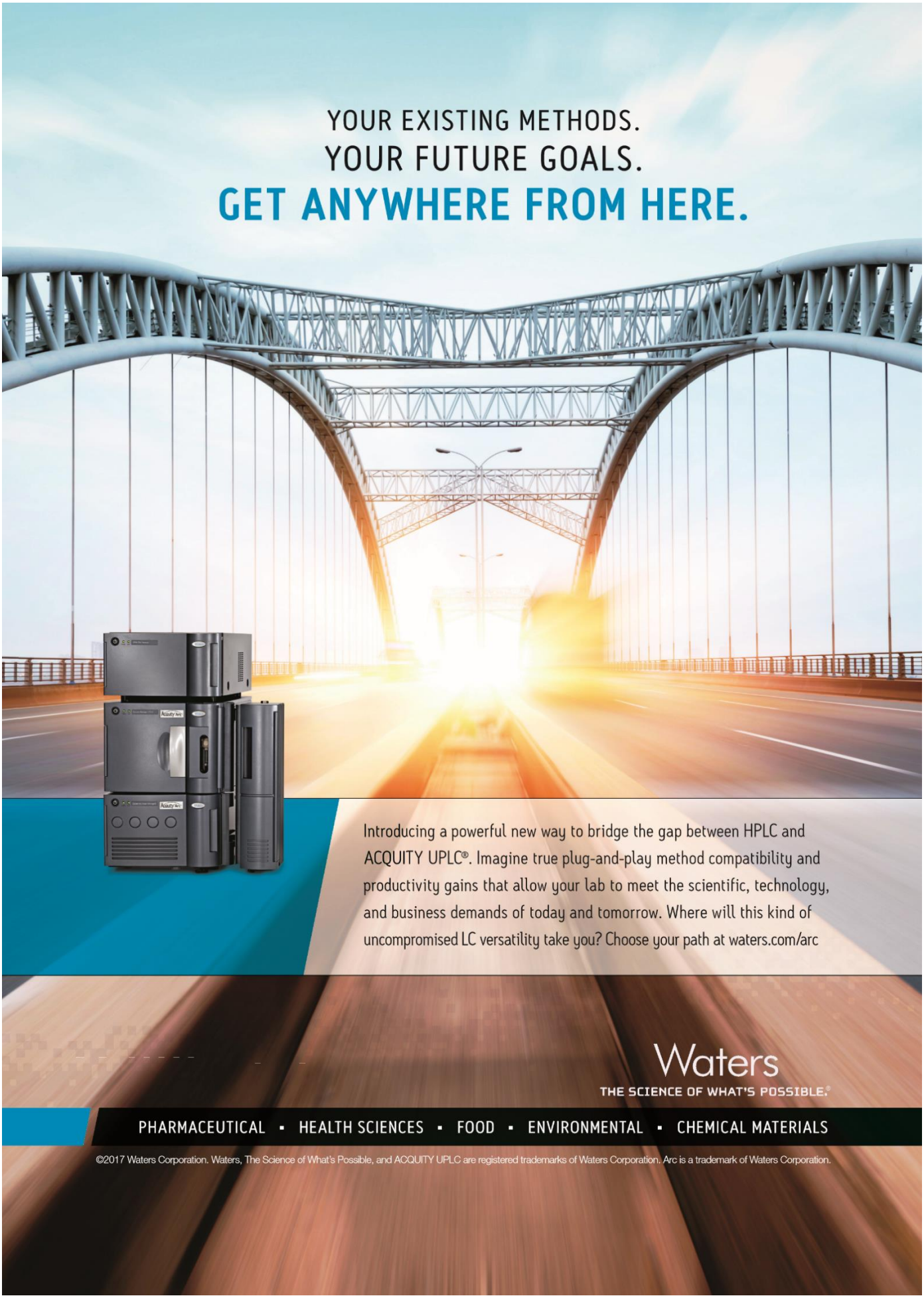
The Professional Body for Chemists in Ireland

Contents:-

Note:

Opinions expressed in this Journal are those of the authors and not necessarily those of the Institute.

Again we thank our Sponsors:-



Sponsors of the Institute of Chemistry of Ireland Annual Dairy

School of Chemical and Pharmaceutical Sciences

New President Inaugural Speech

First of all I would like to say how honoured I am to represent the Council and the members of the Institute of Chemistry of Ireland. I would like to commend Margaret Franklin on her accomplishments as President over the pasts two years.

In the last number of years the council has played an important role in the community of chemists in Ireland. This is through communication by means of the Voice, and the Institute publication: Irish Chemistry News. This is a primary instrument of communication to professional chemists in the State.

In addition the Institute has supported a number of congresses, in UCD in 2015 and GMIT in 2016 along with a long standing support of the Irish Universities Chemistry Colloquium, now in its 69th year. Furthermore ICI have sponsored a number of awards in the academic arena, through **The Boyle Higgins Gold Medal and Lecture Award** and the **The ICI Annual Award for Chemistry (Eva Philbin Public Lecture Series**) Award. Also there is a recently introduced **Industrial Chemistry Award** now entering its third year. The Institute has maintained and will preserve its close association with the Royal Society of Chemistry and the Society of Chemistry Industry.

There is a need, more than ever, for the evidence based science which can be communicated to the public. The Institute has played a role in this area through the Robert Boyle Summer School in Co Waterford and the street theatre Festival to bring science to the streets.

The future of the Institute relies on the continued close relationship with its members. The Institute needs to maintain its relevance to the community of chemists. In this regard the Institute will continue the use of communication through LinkedIn, Facebook and Twitter

I would hope to continue to lead the ICI in its mission: to promote Chemistry and represent the profession of Chemistry in Ireland.

LENNOX

The one source for all your chemical needs.

PH Buffers & Conductivity Standards

Lennox offers a comprehensive range of pH Buffers and Conductivity solutions for the calibration, monitoring and qualifying of pH and conductivity instruments. All of Lennox pH and Conductivity solutions are traceable against SRM of NIST.

Volumetric Solutions

Volumetric solutions from Lennox are ready-to-use solutions manufactured in large lots that will save you the time and expense of preparation and standardization. We offer a full range of Base and Acid solutions. Lennox ready-to-use volumetric solutions are manufactured to stringent specifications and utilise Quality Control procedures to reduce lot to lot variability, are labelled with expiration date and available in several packaging options.

Custom Manufacturing

Lennox offers a flexible custom manufacturing service to produce quality products. Our lab routinely manufactures solutions to meet research, pilot scale and full scale production requirements. We have extensive experience in this area and can manufacture from 100ml to 1000lt. Contact our sales team to discuss your chemical custom manufacturing needs now.

Ethanol

We can supply from stock a full range of Ethanol Absolute & Ethanol Denatured (IMS) in a large range of volumes and concentrations.

Contact us on 01455 2201 or email cs@lennox for more information on Lennox Chemicals.
www.lennox.ie

LENNOX

Editorial

This is a very active Issue of ICN reporting on a number of awards and events in the previous two months and happening throughout May and June. We had our Boyle Higgins Gold Medal Award and lecture on April 27 which was a well delivered and stimulating presentation from Prof Henry Curran, NUI Galway and I expect to have a paper based on his presentation explaining the chemistry of fuel combustion in the next Issue. Flyers for the upcoming chemistry events are presented in the following pages and throughout this Issue.

We had one of our prestigious members, Professor Dervilla Donnelly receiver the Cunningham Gold Medal at a presentation in the RIA on March 7th with a well-attended reception beforehand. The format was interview style with Professor Pat Guiry, UCD and this full interview has a link embedded in a short report on the event which you can watch.

Our AGM followed the Boyle Higgins Lecture and during the recess the Leaving Certificate Chemistry student, one of two student with highest marks was presented with the Institutes Leaving Cert Medal. Continuing with second level chemistry our winner of the Schools Chemistry Newsletter Competition, Hannah Fitzpatrick, The Institute of Education, Leeson Street, Dublin 2 has her Newsletter published in this Issue with some editing to Match the format of ICN.

It's a time of change for the Institute and following the AGM we had a change of President with Margaret having completed her two years at the helm. Professor John Cassidy, DIT is our new incumbent and I wish John many successes in driving the Institute forward.

On to the main papers in this Issue we have a second paper from Dr Mark Heaton this time on PGAA (Prompt Gamma Activation Analysis) which compliments his previous paper in Issue 5 December 2016 on Chemical Physics application of Small Angle Neutron Scattering (SANS). A short paper is presented on Advances in Chemical Decontamination of the Eyes and Skin, an ever present risk to anyone working with chemicals, showing the need for a rapid remedial intervention with appropriate treatment. Then we have an interesting historical paper on "The Dublin Chemist" Professor Emil Werner, TCD by Professor Brian McMurry, TCD. The final paper is about Carbon Trust a British organisation promoting sustainability and helping companies reduce waste and recycle. Examples of chemical companies as well as efforts Bord Bia at encouraging a sustainable future are presented.

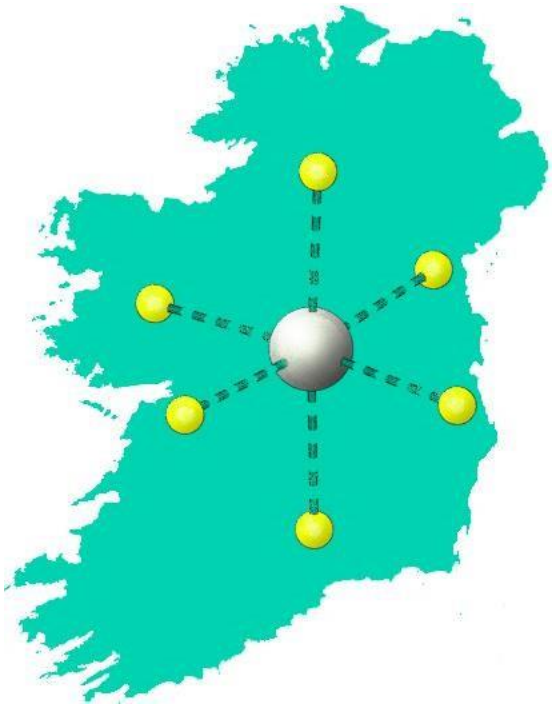
Last but by no means least, and this has come about from my past working life in the pharmachemical industry and publishing ICN. I was asked to be a judge for the Irish Laboratory Awards 2017 which I was honoured to accept. I am delighted to report that the standard is very high in all categories and the final decisions will be close calls. I am also extremely to say that the Institute is teaming up as "Trade Media Partners" with Event Strategies for this prestigious event. The winners will be announced at the Awards Event on May 25th at the Ballsbridge Hotel.

My best wishes to everyone involved.

info@instituteofchemistry.org

Patrick Hobbs
Editor
Irish Chemical News
Institute of Chemistry of Ireland

Inorganic Ireland 2017



Tuesday May 16 10:00-18:00

Albert Theatre

Royal College of Surgeons in Ireland

Professor Malachy McCann

David Brown Award Lecture (ICI)

Professor Dermot O'Hare

Tilden Award Lecture (RSC)

+ talks, flash & poster presentations from inorganic chemists all across Ireland.

The Irish Laboratory Awards 2017

WELCOME

The Institute of Chemistry Ireland

As Trade Media Partners

The Irish Laboratory Gala Luncheon Awards 2017 take place on the 25th of May 2017 in the Ballsbridge Hotel,

To book a seat at this prestigious event please visit our website at www.labawards.ie or call Glenn at 01 524 0588

The Irish Laboratory Awards 2017

Sponsors & Supporters

ENTERPRISE IRELAND where innovation means business

biopharmachem Ireland ibec

IRSA Irish Research Staff Association

Institute of Chemistry of Ireland

The Academy of Clinical Science and Laboratory Medicine

Molecular Medicine Ireland

Business River

We wish all entrants the best of luck with their entries.

The Irish Laboratory Awards 2017

2017 Irish Lab Awards Shortlisted Finalists

Laboratory Scientist of the Year

- Ahmad Bader Albadarin – Synthesis and Solid State Pharmaceutical Centre

Prof. Catherine Stanton – Moorepark Food Research Centre, Teagasc Fermoy

- Senad Bulja – Nokia Bell Labs

Laboratory Team of the Year

AS&T Novartis Ringaskiddy

BioClin Research Laboratories

FarmLab Diagnostics

Haematology Laboratory – Cork University Hospital HSE

Janssen Pharmaceutical Sciences

Laboratory Services – Jazz Pharmaceuticals

Manual Handling Team – School of Nursing & Midwifery, NUI Galway

The Labs Safety Team – Janssen Sciences Ireland

Laboratory Staff Member of the Year

Dr. Gerard Moloney – Department of Anatomy & Neuroscience, UCC

Fiona Crispie – Moorepark Food Research Centre, Teagasc Fermoy

Ollie Burns – Nokia Bell Labs

Young Leader of the Year

Dr. Colin Clarke – NIBRT

Frederick Sheedy – TB Immunology & Macrophage Homeostasis Groups

Melinda Halasz – Systems Biology Ireland

PJ Moloney – EireChrom

Pharmaceutical Laboratory of the Year

Alexion Quality Control Dublin

Bernal Process Engineering Lab – Bernal Institute, University of Limerick

BioClin Research Laboratories

Keytruda Bioassay Quality Laboratory – MSD Brinny

Laboratory Services – (a). Jazz Pharmaceuticals

__ (b). Microbiology Quality Laboratory – MSD Brinny

PDMS-AD – Janssen Sciences Ireland

Technical Operations Laboratory – Pfizer Ringaskiddy

Healthcare Laboratory of the Year

Diet & Microbes at the Extremes of Life, Research Laboratory – Teagasc Fermoy

Pathology Laboratory – Naas General Hospital

Think Biosolution

Chemical Laboratory of the Year

Alexion Quality Control Dublin

Bernal Process Engineering Lab – Bernal Institute, University of Limerick

Laboratory Services – Jazz Pharmaceuticals

Mass Spectrometry Group – CIT

Bio Science Laboratory of the Year

Alexion Quality Control Dublin

BioClin Research Laboratories

Macular Pigment Research Group – WIT

Food Laboratory of the Year

Central Laboratory – Dairygold Co-Operative Society

Diet & Microbes at the Extremes of Life, Research Laboratory – Teagasc Fermoy

Mass Spectrometry Group – CIT

Vision I Food Research Laboratory – Teagasc Fermoy

Agricultural Laboratory of the Year

Alltech European Bioscience Centre

Celignis Analytical

Crop Science Molecular Laboratories – Teagasc Oak Park

FarmLab Diagnostics

Irish Equine Centre

Vision I Food Research Laboratory – Teagasc Fermoy

Weatherbys DNA Laboratory Ireland

Engineering Laboratory of the Year

Bernal Process Engineering Lab – Bernal Institute, University of Limerick

Dynamical Systems and Risk Laboratory – University College Dublin

Veterinary Laboratory of the Year

FarmLab Diagnostics

Irish Equine Centre

Calibration or Testing Laboratory of the Year

Anecto

Celignis Analytical

ELS

LotusWorks

Metrology Systems & Services

Roscommon County Council

Research Laboratory of the Year

Bernal Process Engineering Lab – Bernal Institute, University of Limerick

Cork Centre for Vitamin D and Nutrition Research – UCC
Diet & Microbes at the Extremes of Life, Research Laboratory – Teagasc Fermoy
Macular Pigment Research Group – WIT
Mass Spectrometry Group – CIT
Thoracic Oncology Research Laboratory – St James's Hospital & Trinity College Dublin
Tissue Engineering Research Group – RCSI
Vision I Food Research Laboratory – Teagasc Fermoy

Education Laboratory of the Year

Girls Hack Ireland – Insight Centre for Data Analytics
Medical Device Decontamination Laboratory – School of Biological Sciences, DIT
Systems Biology Ireland

Start-up Laboratory of the Year

Alexion Quality Control Dublin
Bernal Process Engineering Lab – Bernal Institute, University of Limerick
Celignis Analytical
Laboratory Services – Jazz Pharmaceuticals
Think Biosolution
Translational Medical Device Lab

Laboratory Supplier of the Year

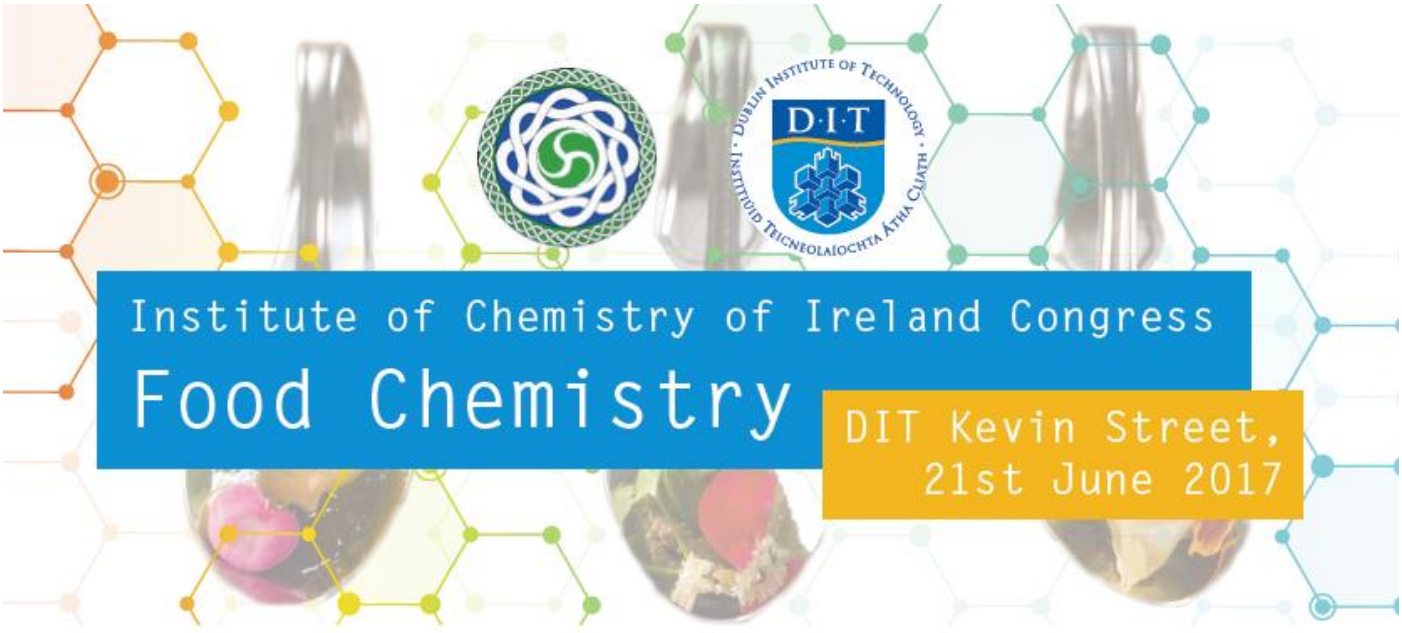
BioClin Research Laboratories
EireChrom
Roche Diagnostics Ireland

Innovation of the Year Award

Celignis Analytical
ELS
Enzyme Research and Development – Arran Chemical Company
Loctite 60 sec. Universal – Henkel Ireland
QuasaR™ – Think Biosolution

Collaboration Achievement

Draper Group, TCD Chemistry & Dalian University of Technology
ELS, Tyndall National Institute, Hahn Schickard & IK4-Ikerlan
Janssen Sciences Ireland
SFI-Pfizer BioMedicine Design Biotherapeutics Innovation Award
Systems Biology Ireland



A full day conference consisting of Oral and Poster Presentations.

Sensory Aspects of food - Overview ; flavours, taste, colour, culinary aspects. Aesthetics of food related to chemical components; how are these are related to chemical components.

Sampling and analysis- challenges of sampling and analysing a heterogeneous material, quantitation of components, residue analysis, novel means of food characterisation

Functional Ingredients- Recent developments in the area, formulations, treatment of food, freeze drying; adulteration, nutraceuticals.

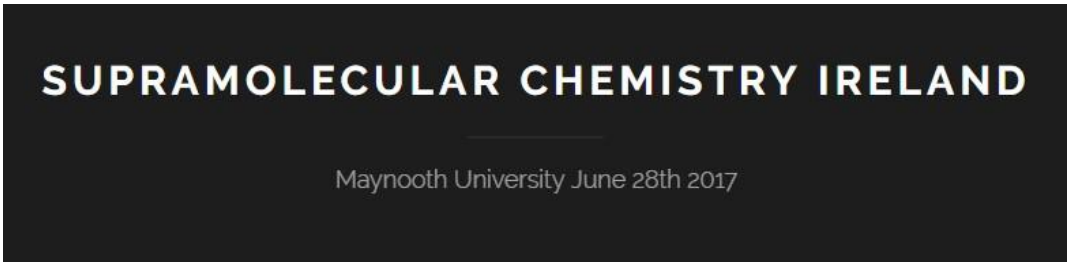
Oral presentations from

Dr. John Keegan (Public Analysts Laboratory)
Prof. Seamus O Mahony (UCC)
Prof.. Vitaly Buckin(UCD)
Dr. Maria Hayes (TEAGASC)
Prof. Jean-Christophe Jacquier (UCD)
Dr. Edward Malone (State Laboratory)
Dr Jesus Frias (DIT)
Ms. Charlene Connolly (Monaghan Mushrooms)
Mr. Tony McGorisk (Kerry Group) and plenary lecture from
Prof. Herve This (Institut National de la Recherche Agronomique)

Submission of poster titles to john.cassidy@dit.ie .

Organising Committee: Prof. John Cassidy,Dr.Jesus Frias (DIT), Dr. Catherine Barry Ryan (DIT), Dr.Eoghan McGarrigle (UCD), Dr. Paula Bourke (DIT) and Dr. Julie Dunne (DIT).

Congress 2017 Sponsors



The Supramolecular Chemistry Ireland (SCI) Symposium will be held in Renehan Hall at Maynooth University on Wednesday 28th June 2017 from 10am to 6.00 pm with a Poster and Wine Reception to finish.

SCI 2017 will bring together a host of world renowned participants including invited speakers and poster presentations covering a broad range of supramolecular topics.
Arranged to coincide with the International Symposium on Macrocyclic and Supramolecular Chemistry (ISMSC) taking place in Cambridge, SCI2017 will combine the best of Supramolecular Chemistry research from around the world opening lines of communication and collaboration worldwide.

The symposium is open to everyone and anyone wishing to present a poster can contact Dr. Rob Elmes (robert.elmes@nuim.ie).

10.00 am **Welcome address**

10.10 am **Prof. Leyong Wang** (Nanjing University, China)

10.30 am **Dr. Steve Butler** (Loughborough University, UK)

'Molecular probes for continuous monitoring of nucleoside polyphosphate anions'

10.50 am **Dr. Susan Quinn** (University College Dublin, Ireland)

11.10 am **Coffee**

11.50 pm **Flash Presentations** (3 x 10 mins)

12.20 pm **Dr. Miguel Martinez Calvo** (Universidad de Santiago de Compostela, Spain)

'Transition metal catalysis in living cells'

12.40 am **Dr. Fred Pfeffer** (Deakin University, Australia)

'Centrally functionalised [6]polynorbornane frameworks in supramolecular chemistry'

1.00 pm **Dr. Trinidad Velasco Torrijos** (Maynooth University, Ireland)

'Glycolipid mimetics: from soft materials to functional electrospun scaffolds'

1.20 pm **Lunch**

2.30 pm **Flash Presentations** (3 x 10 mins)

3.00 pm **Prof. Steve Bull** (University of Bath, UK)

'Boron based sensors for determining the enantiomeric excess of chiral analytes and for the detection of fluoride and peroxynitrite'

3.20 pm **Prof. Mike Watkinson** (Queen Mary University of London, UK)

'Imaging mobile zinc using click chemistry'

3.40 pm **Prof. Ognjen Miljanic** (University of Houston, USA)

'Supramolecular interactions in the construction of porous materials'

4.00 pm **Coffee**

4.30 pm **Prof. Thorri Gunnlaugsson** (Trinity College Dublin, Ireland)

'Engineering responsive soft-materials using supramolecular self-assembly processess '

4.50 pm **Prof. Steve Loeb** (University of Windsor, Ontario, Canada)

'Designing rigid molecular shuttles to function in the solid-state'

5.10 pm **Prof. Bruce Gibb** (Tulane University, New Orleans, USA)

'Guest packing and reactivity within containers assembled via the hydrophobic effect'

5.30 pm **Closing remarks** followed by **Poster Session** and **Wine Reception**.

Many thanks to our generous sponsors:

Maynooth University
National University of Ireland Maynooth

Institute of Chemistry of Ireland

Chem

ROYAL SOCIETY OF CHEMISTRY | REPUBLIC OF IRELAND LOCAL SECTION

Science Foundation Ireland sfi For what's next

Boyle Higgins Gold Medal Award Lecture 2017

Professor Henry Curran

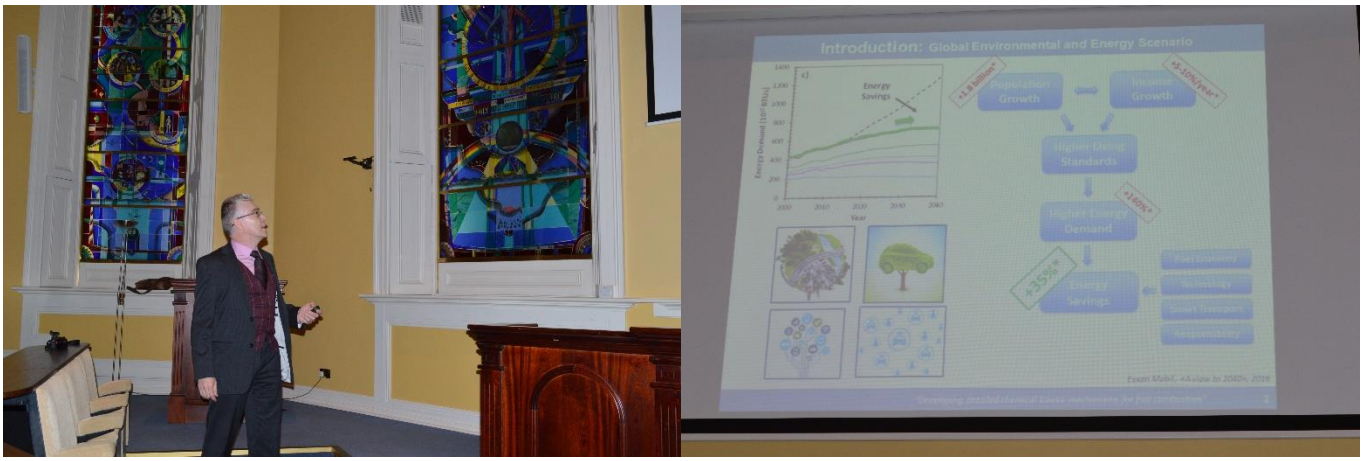
'Developing Detailed Chemical Kinetic Mechanisms for Fuel Combustion'

in the Royal College of Surgeons in Ireland, St Stephens Green, Dublin 2,
on Thursday 27 April 2017

Professor Henry Curran

Director of The Combustion Chemistry Centre, Department of Chemistry, NUI Galway

We had a very interesting and stimulating lecture from Henry on fuel combustion which triggered numerous questions from the floor. The medal was presented by President Margaret Franklin as one of her last duties before handing over the baton.



Henry during his lecture

I expect to have a paper from him based around his lecture in the next issue of ICN.

Below some more photos taking during and after the lecture.

During the reception after the lecture.

Margaret with Mark Kelada, our Young Chemist Representative and Dr Robert Elms both both from Maynooth University.

Best Leaving Cert Chemistry Student 2016

Margaret with Leaving Cert Chemistry Winner Paul McGoldrick and his mother.

At AGM transfer of Presidency and Honorary Fellow Presentation Photos.

Margaret handing over the Presidency To Prof John Cassidy, DIT

First duty of new President John Cassidy presenting Honorary Fellowship to former President Donal Carroll formerly of the IIRS/Enterprise Ireland

7th EuCheMS Chemistry Congress

Molecular frontiers & global challenges

ACC LIVERPOOL, UK
26–30 August 2018

REGISTER YOUR INTEREST

About the congress

With a theme of 'Molecular frontiers and global challenges', the 7th EuCheMS Chemistry Congress features five days of scientific and technical sessions, plenary lectures, oral and poster communications, keynote speakers and roundtable discussions, as well as exceptional networking opportunities, an exhibition and a unique social programme.

The EuCheMS Chemistry Congresses reflect the outstanding research being done in Europe and around the world by bringing together chemists from different countries and professional backgrounds to exchange ideas, advance knowledge and discuss key issues for chemistry and society. As such, the 7th EuCheMS Chemistry Congress offers you exceptional opportunities to network with chemists from across Europe and beyond.

Registration will open in late 2017, and will be via an online system; full payment is required to guarantee your booking.

http://www.rsc.org/events/euchems2018#

EuCheMS European Chemical Sciences

unsubscribe | update profile

Dear chemists, dear all interested in impact of chemistry on our daily life,

You are kindly invited to read about recent chemistry and related news in the second 2017 issue of the Chemistry in Europe Newsletter at

http://www.euchems.eu/newsletters/chemistry-in-europe-2017-2/

Best Regards,
CiE Editorial Board

Portable benchtop NMR spectrometer from GPE for Fluorine, Proton or Dual NMR

The spectrometer offers spectroscopic resolution at a fraction of the size and maintenance of current NMR instrumentation. The design brings analytical performance and point-of-need utility to the benchtop, fume hood or glovebox due to the compact size of the machine.

The NMReady was the first 60 MHz spectrometer available on the benchtop NMR market. Given its small footprint (Dimensions: 9.5 x 11x 17 inches) and light weight nature (only 45 lbs), the spectrometer is ideal for incorporation directly into the laboratory. The NMReady is compatible with all standard consumable 5mm NMR tubes, also available from GPE Scientific, so sample preparation is simple and fast.

The machine offers good sensitivity and the high resolution allows spectra to be measured quickly. The data can be processed directly (even while wearing safety gloves) through the built-in resistive touchscreen without connecting an external computer.

Contact Information:

GPE Scientific Ltd, Unit 5, Greaves Way Industrial Estate, Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4UB. UK.

Phone: +44(0)1525 382277

E-mail: info@gpescientific.co.uk

Website: http://www.gpescientific.co.uk/products/chemistry/nanalysis-nmready-benchtop-spectrometer

Company Information:

GPE Scientific Ltd was established in 1962 and is a leading distributor and manufacturer of laboratory equipment, glass blowing products and specialised glass components for the industrial, laboratory and research markets. There are many reasons to choose GPE Scientific above our competitors; we pride ourselves in stocking thousands of products from leading suppliers providing you with the best selection of laboratory equipment on the market. This includes being the exclusive distributors for Chemglass Life Sciences and Chemical Reactors, Norell NMR Tubes and Accessories and the portable Nanalysis NMReady Benchtop Spectrometer.

Acadamh Ríoga na hÉireann
Royal Irish Academy

Cunningham Medal Presentation

Professor Dervilla M.X. Donnelly, MRIA was presented with the Royal Irish Academy's premier award, The Cunningham Medal on 7 March 2017.

The Cunningham Medal is presented once every three years by the President and Council of the Royal Irish Academy. Mary E. Daly, the first female President of the Academy, made the presentation to this year's awardee in the Sciences Dervilla Donnelly, MRIA who is also the first female awardee of this medal. This year's awardee, Dervilla M.X. Donnelly was recognised for her outstanding contributions to scholarship and the objectives of the Academy.

Mary E. Daly, President Royal Irish Academy and Dervilla Donnelly, MRIA on the occasion. Photo John Ohle.

There was an engaging conversation between the Science Secretary of the Academy, Professor Pat Guiry, MRIA and Professor Dervilla Donnelly, MRIA. Pat Guiry moderated a warm and enlightening conversation about Dervilla's career with some questions and comments by guests in the audience which was made up of colleagues of Dervilla's from her wide and varied career. You can watch a high quality recording of the discussion embedded on the RIA Cunningham Web Page here:

https://www.ria.ie/news/grants-and-awards/cunningham-medal-presentation

Professor Dervilla M.X. Donnelly, MRIA

Professor Dervilla M.X. Donnelly MRIA is awarded the Cunningham Medal in the area of the Sciences. She has been a generous and enlightened leader in scholarship and the wider community, nationally and internationally. She has combined contributions in education and research of public service commitments. As Chair of Phytochemistry at UCD she supervised 85 PhD students to completion. She has been recognised by numerous honours and awards and holds honorary doctorates from the University of Nottingham, QUB, TCD, NUI and UCD. She has contributed extensively to the work of the Academy and served on Council and in Office.

69th Irish Universities Chemistry Research Colloquium June 22nd & 23rd, 2017.

2017 will see the School of Chemical Sciences at Dublin City University hosting the ***69th Irish Universities Colloquium*** **on June 22nd & 23rd.**

As always the Colloquium will highlight the outstanding research being conducted by the best and brightest of Ireland's young chemists across Ireland. As part of the programme, postgraduate students representing their institutions, will be invited to give oral presentations to showcase the range of exciting chemistry-based research being carried out in Ireland today. Each session of the programme will be opened with keynote presentations from leading Irish and international researchers. Invited poster and flash poster presentations will also feature on the programme. Prizes will be awarded to best presentations across a range of categories.

Outside the scientific programme, there promises to be a strong social programme to include an intervarsity's competition, a postgraduate fringe event, conference barbeque networking evening and lots more!

Register details to follow.

We look forward to seeing you there.

Meeting Chairs

Dr Emma Coyle (Organic)

Dr Andrew Kellett (Inorganic)

Dr Aoife Morrin (Analytical)

For all inquiries, please email Julie McArthur - Julie.mcarthur@dcu.ie

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION

Leaving Certificate 2016 2016 Chemistry Winners with Highest Marks

The State Examinations Commission advised the **Institute** that there were **two students** with top marks in **Chemistry** in **the 2016 Leaving Certificate Examination.**

Outgoing President Margaret Franklin presents the Institute's Leaving Certificate Chemistry Winners Medal to Paul McGoldrick, Coola Post Primary School, Riverstown, Via Boyle, Co Sligo after the Boyle Higgins Gold Medal Lecture in the RCSI, Dublin .

The second winner was David Gerald Murphy, St Fachtnas High School, North Street, Skibereen, Co Cork. The Institute will present the medal to Gerald who is studying in UCC at a later date.

Schools Chemistry Newsletter Results 2016/17

Topic: "The Chemistry of Climate Change"

First Place

Hannah Fitzpatrick, The Institute of Education, Leeson Street, Dublin 2.

Edited version follows. For Original visit www.chemistryireland.org

Runners-Up

Euan McDonnell, Moate Community School, Church Street, Moate, Co. Westmeath.

David Shanahan, St. Andrew's College, Booterstown Ave., Blackrock, Co. Dublin.

Highly Commended

Lance Licayan, Lusk Community College, Raheny Lane, Rathmore Road, Lusk, Co. Dublin.

Lia Murphy, Coláiste Muire, Réalt Na Mara, Crosshaven, Co. Cork.

They all get certificates and the winner gets €100 and the 2 Runners-Up get 50 each.

Chemistry of Climate Change

December 2016 Newsletter Competition

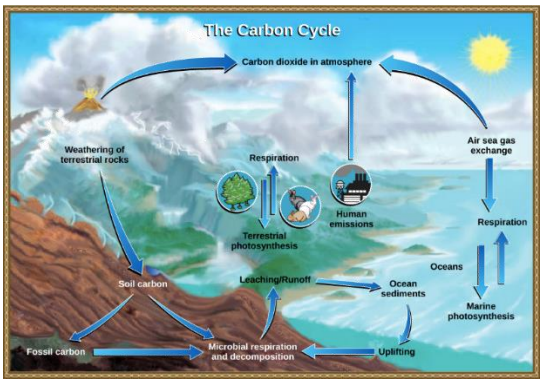
In a nutshell

There are unnatural levels of carbon dioxide and other greenhouse gases in the atmosphere. Greenhouse gases are now trapping more heat than is necessary, Causing the average temperature of Earth to rise. This Global Warming of the planet is playing host to a range of unfamiliar weather patterns. The climate is changing very rapidly.

Each species has spent millions of years evolving and adapting to certain conditions of their ecosystem. Said conditions are now altering at a rate faster than evolution can keep up. Many species are becoming extinct.
In fact, this is happening on such a major scale, that a great deal of scientists are even calling it the 6th Mass Extinction. (The same scale as the extinction of dinosaurs!)

The Carbon cycle

Carbon is the basis for all life on Earth. All living organisms are made of carbon, and need it as fuel to survive. Plants make their food by photosynthesis. A process which requires carbon dioxide to be carried out. Animals get their fuel by eating other organisms, which are largely made of carbon.



Carbon is exchanged between the atmosphere, the ocean, living organisms, soils and fossil fuels. Biological activity, such as photosynthesis causes carbon to be constantly converted among different forms and locations. These movements of carbon are referred to as the global carbon cycle.

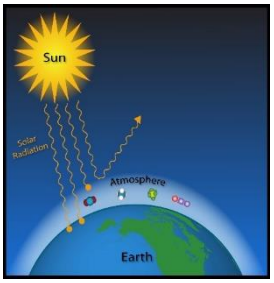
The Carbon Cycle is currently out of balance, as there is too much carbon being stored in the atmosphere. This is because we burn fossil fuels, an organic substance that reacts with oxygen to become carbon dioxide, a greenhouse gas.

Plants take carbon dioxide out of the atmosphere for photosynthesis. Areas with many plants and trees are called carbon sinks. Carbon sinks can be on land or under the sea. However, humans continue to clear carbon sinks by deforestation. We are disrupting the cycle at both ends.

The Greenhouse Effect

The Greenhouse Effect is the process by which a planet's atmosphere raises the temperature of the planet's surface. The Greenhouse Effect occurs by way of special heat-trapping gases in the atmosphere called greenhouse gases, Carbon dioxide being one of them. In the absence of the atmosphere, The Earth would not be able to hold onto the solar energy it absorbs. There would be no oceans, clouds, nor life. Earth would just be an icy cold, bare rock. Thanks to the Carbon Cycle, The Greenhouse effect has maintained an equilibrium for thousands of years.

Ultraviolet radiation from the sun (high energy, short wavelength) first penetrates the atmosphere to be absorbed by land and sea. The Earth emits much of this energy back as infrared radiation (low energy, long wavelength). About 10% escapes back into space. Greenhouse gases absorb the rest. Keeping a layer of heat just above the surface.

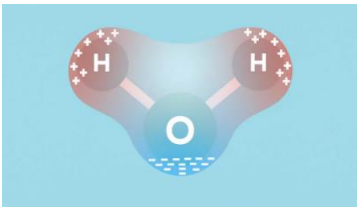


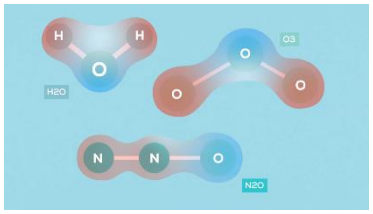
How does a Greenhouse Gas trap heat?

A greenhouse gas molecule consists of one or more different atoms bonded together loosely. They must have an electric charge. When in contact with electromagnetic radiation they vibrate. Vibrating allows them to absorb radiation.

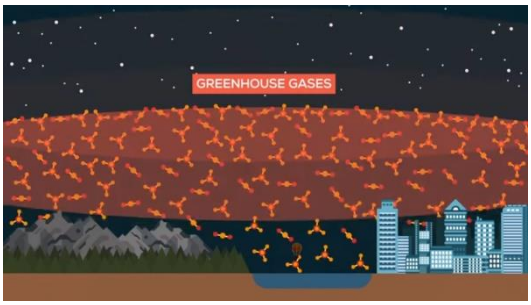
Two of the most common atmospheric gases; Oxygen and Nitrogen, do not absorb radiation as they do not have an electric charge, and are bonded together too rigidly to be able to vibrate.

Water, Ozone, Methane and Nitric oxide each have a non-linear arrangement of atoms. This is due to unequal sharing of electrons, resulting in slightly positive and slightly negative regions within the molecule. When radiation hits a greenhouse gas molecule, it will vibrate. Due to their loose, 'lopsided' arrangement. This allows the molecule to absorb infrared radiation that Is emitted from the earth's surface.





Carbon dioxide is arranged in a linear formation. Though collisions between other molecules, and contact with radiation can cause it to change its shape and vibrate. It behaves just like any other greenhouse gas.



The molecules constantly absorb and subsequently emit that radiation. When they emit radiation, it scatters in all directions. Approximately half of it will escape into space. The rest will likely be absorbed by another G.Gas molecule. A certain amount of radiation is constantly exchanged from particle to particle. This keeps the surface of the earth warm. At night, when we are turned away from the sun, we do not freeze because radiation from the daytime is still passed around between G.Gas molecules.

The Greenhouse Effect's role in climate change

Now that there is too much greenhouse gas, too much heat is being trapped. The temperature of the earth is rising, with no cool-off point in sight. This is having disastrous consequences on the climate. Ice caps are melting, sea levels are rising. Droughts are longer and more extreme. Forest fires and Bush fires are more common. There are too little of some creatures as they are going extinct, and too much of others who are benefitting from the gaps in the food chain. Tropical diseases such as malaria and Zika are becoming more global. Natural disasters are also on the rise. The UN estimate that 22.5 million have become climate refugees since 2008, and that figure is likely to be a lot higher. There is no end to the negative effects climate change is having and is continuing to have.

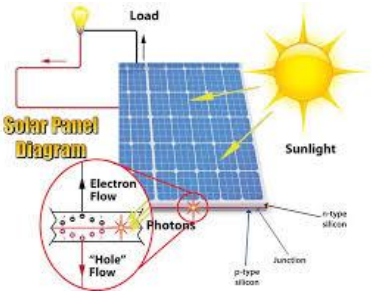
Everything is interconnected

I hope you are beginning to see that everything on earth is connected. This is what makes climate change such a complex issue. And at the same time such a simple one. If humans left earth today, the planet would naturally 'heal' itself. The climate would slowly but surely go back to the way it was. And endangered species would begin to flourish. But we aren't going to go, nor should we. Though we must change our lifestyles so they work in harmony with nature's rhythms, instead of disrupting them. We must learn to be natural again

Climate Change Solutions - The Science behind recent developments



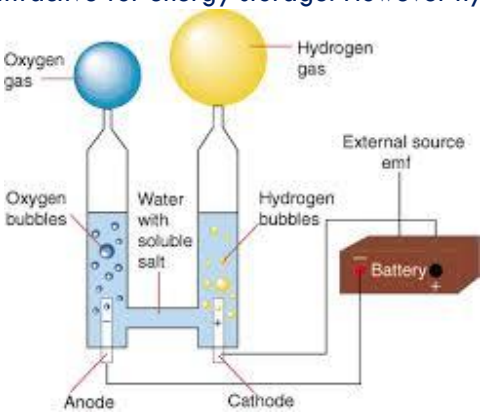

Solar Energy: The most promising of renewable energies



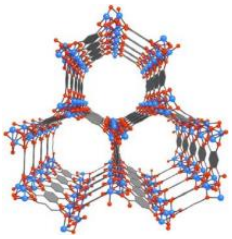
Solar panels are made up of units made of silicon, called solar cells. With a layer of special glass in between. In the cells, silicon atoms are bound together with strong bonds, preventing electrons moving. When sunlight hits the solar cell with enough energy (brightness, heat), it knocks an electron loose from its bond. Elect with the nucleus of the atom. Electrons are collected by a metal component at the top of the cell flow through an external circuit, powering anything from a battery to a city.

Alternative to natural gas: Hydrogen gas

Hydrogen is the most abundant element, and creates the cleanest fuel. Its only by-product is water. The chemical bonds between the atoms in hydrogen gas, can liberate a large amount of energy when broken, making this gas very attractive for energy storage. However hydrogen does not exist naturally on earth, so it must be manufactured. Water (H_2O) is split by sending electricity through it (Electrolysis). In this process energy from electricity is transferred into the chemical bonds of hydrogen bonds. However, electrolysis is expensive. Scientists are currently developing 'artificial leaves' in which photo catalysts harness the Sun's energy to split water into hydrogen and oxygen.



CO_2 Capture: Manually removing Carbon from emissions



This project involves the use of Metal Organic Frameworks. MOFs are molecular systems consisting of a metal oxide centre surrounded by organic "linker" molecules that form a highly porous three-dimensional crystal framework. This microporous structure enables MOFs to serve as storage vessels with a sponge-like capacity for capturing and containing greenhouse gases. They are applied to fumes coming out of factories and power plants. The carbon dioxide can then be stored in liquid or gas form. With plans for sequestering the carbon in an underground containment facility. (Possibly back to where it came from; empty reservoirs of oil, coal, peat and gas)

Algae as a Biofuel: A replacement to diesel and petrol for cars

It is claimed that algae can yield 60 times the amount of oil that present biofuels can. It is also carbon neutral, as the carbon it emits is equal to the amount it soaks up to grow. To extract the oil, algae is pressed (like olives) to extract lipids from it's cell walls. Supercritical carbon dioxide is then used to obtain lipids from the remaining biomass. A supercritical fluid is a substance at a temperature and pressure above its critical point, where distinct liquid and gas phases do not exist. It can effuse through solids with ease.


Give Trees a Chance!

How do we reduce deforestation?

Smarter Agriculture

Agriculture is the biggest contributor to deforestation. Forest is continuously cleared to make way for farmland. Most people would say this is necessary to feed our large population. However, It is possible that we have more than enough food to feed everybody. We are just bad at distributing it. The FAO estimate that we waste over **a third** of the food we produce annually. Also, the most grown crops: Sugar Cane, Maize and Palm, are predominately for oil, syrup and sugar production. These ingredients make nutrient-poor junk-food.

Smarter Consumption

42% of global wood harvest is used to make paper. Is it really worth cutting down trees for this product? We are transitioning into a digital age, you can get anything nowadays on electronic devices; books, newspapers, documents. Yet we continue to print all these things in paper form. Offices are notorious for paper waste, often printing reams of documents. Only to stow them away or throw them out later. Lessening of paper usage was predicted, perversely demand for paper is only expected to double by 2030.

Smarter Diets

Methane is 20 times more effective at trapping heat than carbon dioxide, making it one of the most potent greenhouse gases. And cows produce a lot of it. We need to reduce cattle cultivation to reduce emissions of methane, to do this we need to reduce demand for beef and dairy. Eating less meat and more vegetables is proven to be better for health all round, so it's a win-win!

Reducing greenhouse gas emissions while improving wellbeing

We mustn't forget that we are animals, our needs our practically identical to other mammals. We need to get enough nutrients, water and fibre to function at our best. We need regular exercise and enough sleep. Strong social connections are vital, As is time to play and time to relax. Our fossil fuel powered lifestyles are poisonous and it is clear to see. Disease is at an all-time highpoint. It seems like half of us are anxious and depressed. While the average amount of friends we have is dropping, floor space in private homes is rising. We are deluded if we think this lifestyle is something to latch onto. By transitioning to a sustainable world, we are saying 'YES, We do want to stick around!'. We do want to a **healthier, happier** society. By taking the leap to renewable energy and eating healthier diets we have much to gain. By working together in community, becoming less deluded by consumerism, and more invested in each other. Our world will be a far better place

Chemical Physics application of Prompt Gamma Activation Analysis (PGAA) for measuring the atomic element percentages for an SU-8 Polymer Nano-microscale turbine.

Mark Heaton obtained his Doctorate in Nanotech and microengineering from Imperial College London in 2013. This was part completed at The Budapest Neuron Centre, TNI-Cork and Carlow IT, where he obtained four of his nineteen publications.

In this PHD research he fabricated the first nanoscale Axial gas-flow turbines for measuring flow and generating power in confined/remote locations. Prior to this he progressed from Carlow IT to his Hons BSC in physics with electronics, and MSC in optics and holography from Salford and Manchester Uni.

He progressed from years of technician work to being a researcher in corrosion research for Tata Steel using his Physics BSC. His Doctoral engineering and research in environmental monitoring was put to use in his new go-gas-renewables business. Here he has international relationships with key players in the evolving nanotech sector including ANT advanced nanotechnology. He plans to partner with Unison in the US to produce autogas following feasibility discussions at Powerstown, Carlow and Wexford Co Co to start biofuel production. He is also involved in community renewable energy schemes and open to working with any interested parties. This is part of the EU 2Bn euro grant being made available to Ireland and given out on a merit basis to each locality.

1.1 Introduction

This article details the use of PGAA (Prompt Gamma Activation Analysis) for the measurement on the atomic scale of the material used for a nano-microscale turbine. The objective of the PGAA (Prompt Gamma Activation Analysis) experiment described in this article was to determine the nanoscale characteristics in terms of the percentages of the constituent atoms of SU-8 polymer of the turbine rotor before and after processing of the SU-8 polymer substrate [1.1, 1.2].

The microturbine is still the only such axial flow miniature turbine sensor generator working in the world. It was contoured to a smoothness of a few hundred nanometers. The benefit of the axial device is that it can detect low pressure air or gas flow. For example it could detect the flow of dopant gases for IC (integrated circuit) device fabrication. Also in generating its own power as part of a complete stacked unit with an electromagnetic stage it can operate in isolation without batteries in remote locations while monitoring wind speed. It has involved research work in London, Cork (Ireland), Civitanova Marche (Italy) and Budapest.

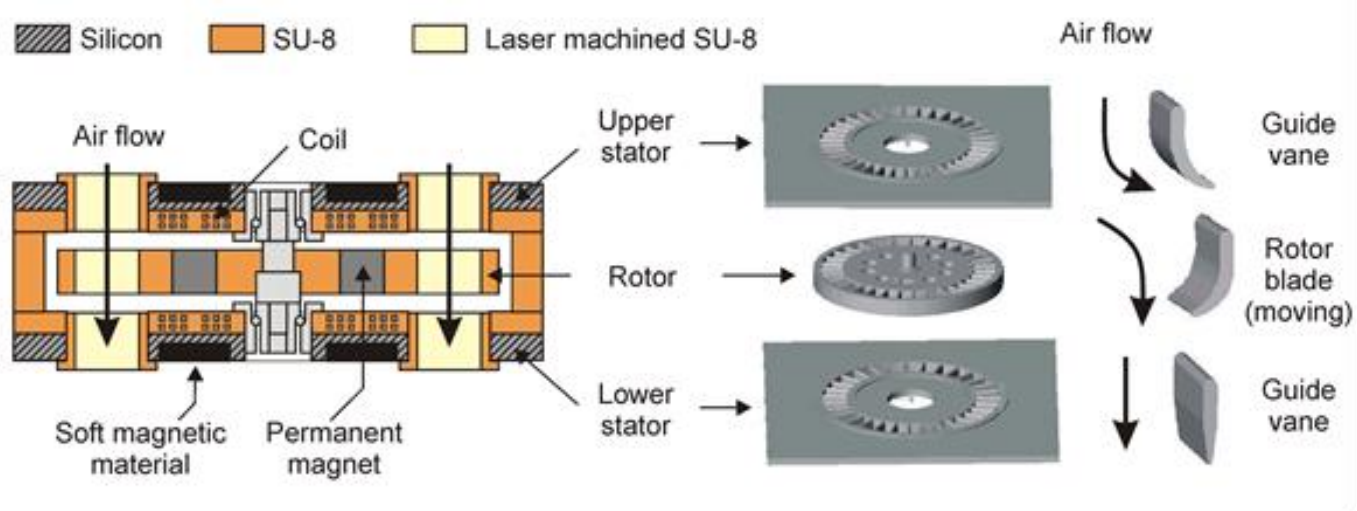
The nominal percentages of the different components in the starting material are 35-75% Epoxy Resin (CAS: 28906-96-9), 22-60% Gamma-Butyro-Lactone (CAS: 96-48-0), 1-5% Triarylsulfonia/Hexafluroantimonate Salt (CAS: 89452-37-9)-CAS: 71449-78-0) and Propylene Carbonate (CAS: 108-32-7) [1.3]. These are approximate and depend on processing condition, hence it was sought to find the actual count of the different atoms making up the resin.

Chemically SU-8 is a photopolymer containing an Epoxy Resin, together with Gamma-Butyro-Lactone (GBL) and small amounts of Triarylsulfonia and Hexafluroantimonate. This mixture forms a negative photoresist which is very popular in MEMS (microelectromechanical systems) fabrication. It can be processed in very thick layers due to its high optical transparency, and once cured it is both chemically and mechanically robust.

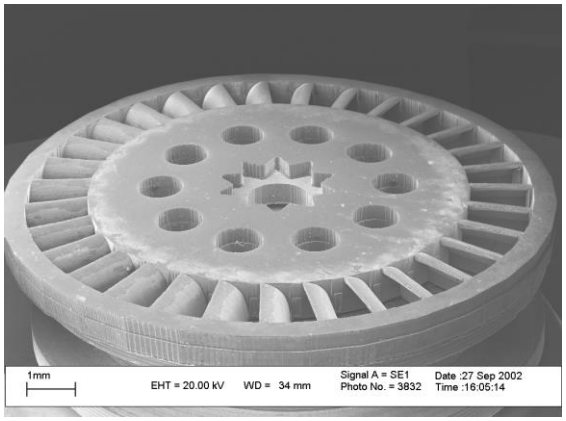
SU-8 is a mechanically robust photoresist when in the solid state and is thus well suited to fabrication of micromechanical devices [1.4]. The polymer will however have defects from UV curing and baking and, in the case of this work, transient heating during laser ablation. It may also suffer further mechanical degradation in its final application. Processing and other defects in the resin matrix will influence the material quality, and this may ultimately affect device performance.

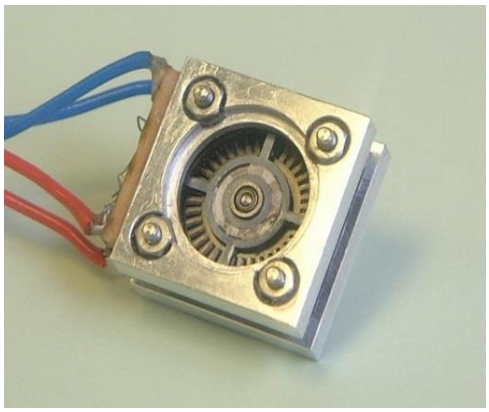
Material damage can occur in the SU-8 polymer as it is cured and shrunk using UV exposure and final post exposure heat baking from the liquid state to the solid cross-linked state. In the present work these steps were carried out during fabrication of the turbine rotor preforms. There is likely to be a higher density of defects near confined corners because the UV/heat curing process will be less even in such areas than over the general surface of the SU-8 material. This causes stress because the cured areas have not had time to normalise their stresses with the surrounding resin.

The laser ablation process used to shape the microturbine blades into 3-D curves will also generate stress in the cured SU-8. Laser ablation is always accompanied by a localised heat affected zone (HAZ), unless using Femtosecond lasers, and the associated heating can be excessive in confined corners and regions where the sample is thin. For the turbine rotors surface damage was found at the leading and trailing edges of the turbine blades, as seen in Figure 1.0 (a – f).

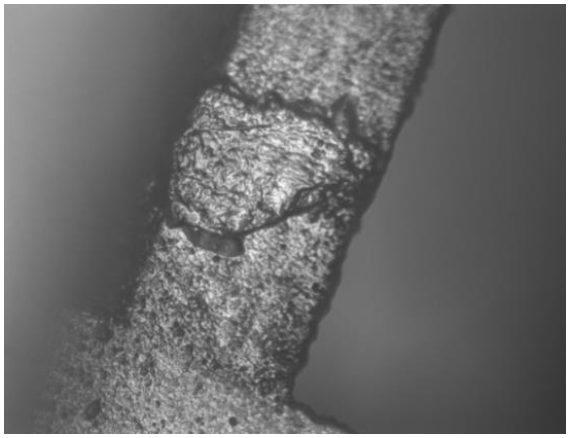


(a) (b)





(c) (d)



(e) (f)

Figure 1.0. Laser-induced damage in an SU-8 microturbine blade, showing (a) 50 µm-wide leading edge and (b) trailing edge of microturbine rotor (c) and (d). The leading edge has cracked during processing, and both edges show evidence of melting and reflow which will have induced stress.

Finding the distribution, type and relevance of the defects that accumulate during processing allows useful information to be obtained in order to better understand where improvements are needed in the fabrication process.

PGAA (Prompt Gamma Activation Analysis) was used to measure any changes in the percentages of the elements that made up the SU-8. Such compositional changes could occur during UV curing, baking or laser micromachining. The aim was to identify both systematic changes in composition due to processing and differences between samples subject to nominally similar processes. It was also of interest to examine how effective the PGAA technique was for investigating a polymer material like SU-8 [1.5, 1.7].

1.2 Prompt Gamma Activation Analysis (PGAA)

This area of investigation analysis providing quantitative data regarding the percentages of the constituents in the SU-8 samples on an atomic level. It was of interest to establish whether the percentages of the constituent elements were affected by processing. In particular, it was expected that the baking steps in

curing the SU-8 might change the Hydrogen or Oxygen element percentages. Laser machining is also expected to produce some compositional changes near the surfaces of the machined structure.

Two samples of SU-8 were subjected to the PGAA diagnostic study. These were in the form of microturbine rotor preforms which had been given different solidification pre-treatments, in particular different durations of baking and UV cross-linking. In addition to determining the major components of the analysed samples, some trace elements were also identified, and the compositions were compared.

1.3 PGAA Principle and Instrumentation

Neutron investigations have recently become an increasingly significant probe for materials across a wide range of disciplines, and can reveal significant properties about materials. Neutrons are becoming ever more useful in the non-destructive characterisation of materials and components of industrial interest. The industrial applications of neutron techniques are also being developed in many new industrial sectors [1.8].

PGAA is a relatively new non-destructive nuclear analytical method based on the detection of characteristic prompt gamma photons that originate in (n,γ) nuclear reactions. The principles of the method have been well known for decades, and industrial applications are currently in development. However, routine application of the method is not so frequent because of the relatively low number of available laboratories equipped with guided neutron beams. All atomic nuclei, apart from ^{4}He, can undergo (n,γ) reactions with different probabilities. The energies of the emitted gamma photons are characteristic for each given isotope, while the intensities of the gamma peaks are proportional to the amount of a given isotope. This phenomenon allows the use of a quantitative elemental (isotopic) analysis, and this is the basis of PGAA or PGNAA (Neutron) [1.9]. PGAA gives information on the sample as a whole. Neutrons can penetrate the surface and lower layers of the material so PGAA cannot distinguish between the bulk and surface composition of a sample.

The PGAA experiments reported here were a first attempt to apply PGAA to detect trace elements in an organic matrix, and an early example of applied research using PGAA [1.10]. The measurements were performed using the experimental station shown in Figure 1.1. This equipment was placed at the end of a 30 m-long horizontal guide. The neutrons, which exit the reactor core, are moderated by a liquid H cell, and are cooled down to 20 K. The "*1/v*" dependence of the neutron absorption cross-section makes the sensitivity of the method increase by a factor of twenty, compared to the thermal sensitivity of the beam. Prior to the author's experiments the thermal equivalent flux of the cold beam was increased from $5 \cdot 10^{7}$ $cm^{-2}s^{-1}$ to $1.2 \cdot 10^{8}$ $cm^{-2}s^{-1}$ by upgrading the neutron guides.

Figure 1.1. Prompt Gamma Activation Analysis station at the Institute of Isotopes, Budapest Research Reactor (BRR).

The test samples were mounted on an aluminium frame with Teflon strings, as seen in Figure 1.1, 1.2 starting with a sample having no voids. The sample holder chamber was evacuated in order to minimize the spectral background. A 2×2 cm^2 cold neutron beam was then applied for irradiation. The irradiation time was chosen to achieve the counting statistics of necessary confidence limits. In practice sample one was irradiated for about 14000 seconds, while sample two was irradiated for almost 20000 seconds. The background effects originating from (n,γ) reactions within the constituent materials (i.e., H, C, Cl, Al, Fe and Pb) were calculated, as listed later in Tables 1.1 and 1.2.

Parallel to the irradiation, the prompt gamma spectra were recorded with a specially designed detector system. This consisted of a 27% high purity Germanium detector surrounded with Bismuth Germanate scintillators which are dedicated to performing the Compton-suppressed measurement mode. The signals coming from the detectors are processed using a S100 multichannel analyser. All the spectra were evaluated using a Hypermet-PC. The element identification is based on a prompt-gamma library [1.7].

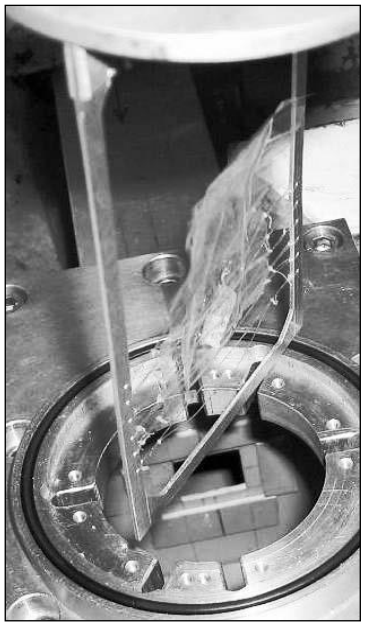


Figure 1.2. SU-8 microturbine sample fastened with Teflon strings onto an aluminium frame for introduction into the PGAA measurement chamber.

1.4 Data Analysis and Results

The total detector count N_P for a particular peak in a PGAA experiment is directly proportional to the mass m of the corresponding element, the analytical sensitivity S and the measurement time t, such that:

$$N_P = m \cdot S \cdot t \tag{1.1}$$

The count rate, dN_P/dt, is proportional to the number of nuclei emitting the gamma photons of a given energy, and may be expressed as:

$$\frac{dN_P}{dt} = \int_V \int_{E_n=0}^{\infty} \frac{\mu(\boldsymbol{r}) N_{Av}}{M} \sigma_\gamma(E_n) \Phi(E_n, \boldsymbol{r}) \varepsilon(E_\gamma, \boldsymbol{r}) dE_n d^3\boldsymbol{r} \tag{1.2}$$

where N_P is the peak area, $\mu(\boldsymbol{r})$ is the local density of the element of interest at position $\boldsymbol{r}$, N_{Av} is Avogadro's number, M is the atomic mass of the element, σ_γ is the partial gamma ray production cross section, $\Phi(E_n, \boldsymbol{r})$ is the local neutron flux and $\varepsilon(E_\gamma, \boldsymbol{r})$ is the detector efficiency.

In practice a few simplifications can be introduced. Firstly, the partial gamma ray production cross-section is assumed to take the form:

$$\sigma_\gamma = \theta \cdot \sigma \cdot I_\gamma \tag{1.3}$$

where σ is the thermal neutron absorption cross-section, I_γ is the probability of gamma ray emission and θ is the isotopic abundance. Secondly, if it is assumed that the sample is homogeneous, and sufficiently small that the spatial dependencies in $\Phi(E_n, \boldsymbol{r})$ and $\varepsilon(E_\gamma, \boldsymbol{r})$ can be neglected, Equation (1.2, 1.3) can be simplified to:

$$\frac{dN_P}{dt} = \int_{E_n=0}^{\infty} \frac{mN_{Av}}{M} \sigma_\gamma(E_n) \Phi(E_n) \varepsilon(E_\gamma) dE_n \tag{1.4}$$

A further simplification can be made by assuming that the detector efficiency does not vary over a given gamma peak. In this case the total count may be expressed as:

$$N_P = \frac{mN_{Av}}{M} \cdot \theta \cdot \sigma_0 \cdot I_\gamma \cdot \Phi_0 \cdot \varepsilon(E_\gamma) \cdot t \tag{1.5}$$

where Φ_0 is the thermal equivalent flux, defined such that:

$$\int_{E_n=0}^{\infty} \sigma(E_n)\Phi(E_n)dE_n = \sigma_0\Phi_0 \tag{1.6}$$

From Equation (1.5), the analytical sensitivity, typically expressed in units of counts·s^{-1}·g^{-1}, is obtained as:

$$S = \frac{N_P}{mt} = \frac{N_{Av}}{M} \cdot \theta \cdot \sigma_0 \cdot I_\gamma \cdot \Phi_0 \cdot \varepsilon(E_\gamma) \tag{1.7}$$

The analytical sensitivities for the most intensive prompt-gamma lines of all the chemical elements were determined by internal standardisation measurements at the BRR and collected in a new PGAA gamma-ray spectrum catalogue [1.7]. Using these published values, the relative abundances (weight-percentage ratios) of two arbitrary elements *X* and *Y* in a sample can be obtained simply from the corresponding N_P values since, from Equation (1.1):

$$\frac{wt\%(X)}{wt\%(Y)} = \frac{m_X}{m_Y} = \frac{N_{PX}/S_X}{N_{PY}/S_Y} = \frac{N_{PX}}{N_{PY}} \cdot \frac{S_Y}{S_X} \tag{1.8}$$

While Equation (1.8) yields only the relative abundances, if all the major components in the sample are identified the absolute wt% levels can be obtained by applying the following normalisation:

$$\sum_i wt\%(i) = 100 \tag{1.9}$$

This normalisation method was applied for the two SU-8 samples analysed in this work.

In calculating the element concentrations only the 25 most intensive gamma lines were used. During the calculations, gamma lines which suffered from peak interference (i.e. overlap with nearby peaks) were eliminated from the determination of the element concentrations. In Table 1.1 the most intensive gamma lines for the elements are reported. These resulted from all the lines that were identified in the samples. The symbols and atomic masses of the isotopes, the order of peak intensities, relative peak areas, the characteristic gamma energies and their uncertainties, the partial gamma ray production cross sections and the calculated sensitivities are listed.

The two SU-8 samples had been processed under the following conditions:

SU-8 sample one: Soft baked by heating at 90 °C for 158 hours

Final solidification using 10 min UV plus heat at 90 °C for 40 min

SU-8 sample two: Soft bake heated at 90 °C for 158 hours

Final solidification using 20 min UV and heat at 90 °C for 20 min

El.	A	No.	Rel. Area	E (keV)	dE (keV)	σ_γ	Sens. (cps/mg)
H	1	1	100	2223.3	0.019	0.333	3.4
C	12	1	100	1261.708	0.057	0.00127	0.0017
C	12	2	60.55	4945.302	0.067	0.0028	0.0011
C	12	3	38.02	3684.016	0.069	0.00121	0.00066
O	16	1	100	870.682	0.034	0.00018	0.00023
O	16	2	73.5	1087.714	0.031	0.00015	0.00016
O	16	3	50.79	2184.381	0.039	0.00015	0.000096
O	16	4	7.01	3272.109	0.069	0.000035	0.000015
F	19	1	100	1633.602	0.015	0.0093	0.0064
F	19	2	99.00	583.493	0.022	0.0034	0.005
F	19	3	51.14	655.942	0.022	0.0019	0.0025
S	32	1	100	841.013	0.014	0.36	0.236
S	32	2	27.53	2379.495	0.035	0.214	0.064
S	32	3	16.16	5420.241	0.1	0.32	0.038
Cl	35	1	100	517.077	0.008	7.4	6.28
Cl	35	2	66.79	1164.831	0.012	8.9	4.22
Cl	35	3	48.49	788.370	0.212	5	3.12
Fe	56	1	100	352.332	0.016	0.284	0.205
Fe	56	2	57.57	122.078	0.022	0.099	0.122
Fe	56	3	30.60	691.914	0.016	0.142	0.062
Sb	121	1	100	121.643	0.042	0.4	0.226
Sb	121	2	76.96	61.513	0.044	0.27	0.18
Sb	121	3	75.64	115.044	0.044	0.3	0.17
Pb	207	1	100	7367.833	0.118	0.137	0.00165

Table 1.1. List of the most intensive gamma line data for the elements identified in the samples, showing the symbols and atomic masses of the isotopes, the order of peak intensities, the relative peak areas, the characteristic gamma energies and their uncertainties, the partial gamma ray production cross sections and the calculated sensitivities.

Table 1.2 shows the measured compositions of the two samples in both atomic percentage and weight percentage. The major constituents identified were carbon (C), oxygen (O), hydrogen (H) and fluorine (F). In addition, small concentrations of several other elements were identified, including antimony (Sb), lead (Pb), sulphur (S), chlorine (Cl) and iron (Fe). Other trace contaminants, if there were any, fell under the

detection limits of PGAA. The two compositions are compared side-by-side in Figure 1.3, and it can be seen that there are only small differences between the two.

	SU-8 sample one					*SU-8 sample two*				
El.	*C % atom.*	*Unc. %*	*C % el/el*	*Rel.unc. %*	*Abs.unc.*	*C % atom.*	*Unc. %*	*C % el/el*	*Rel. unc. %*	*Abs. unc.*
H	45.6	2.3	6.0	4.4	0.3	44.7	3.1	5.7	6.0	0.3
C	42.6	2.6	67	3.8	2.6	39.9	3.5	61	5.8	3.5
O	9.9	15.9	21	14.1	2.9	13.7	17.6	28	14.8	4.1
F	1.6	8.5	4.1	9.1	0.4	1.5	9.2	3.5	10.4	0.4
S	0.091	3.5	0.38	5.0	0.02	0.090	4.1	0.37	6.6	0.02
Cl	0.035	4.5	0.16	5.8	0.01	0.034	5.0	0.15	7.2	0.01
Fe	0.0095	8.3	0.07	9.0	0.01	0.0073	12.4	0.05	13.4	0.01
Sb	0.064	3.6	1.0	5.1	0.1	0.065	4.2	1.0	6.6	0.1
Pb	0.029	14.9	0.8	15.2	0.1	0.029	16.9	0.8	17.6	0.1

Table 1.2. List of the elemental compositions of SU-8 polymer samples one and two having different solidification and hardening pre-treatments. *Rel. unc.* and *Abs. unc.* are relative and absolute uncertainties in the measured concentration levels.

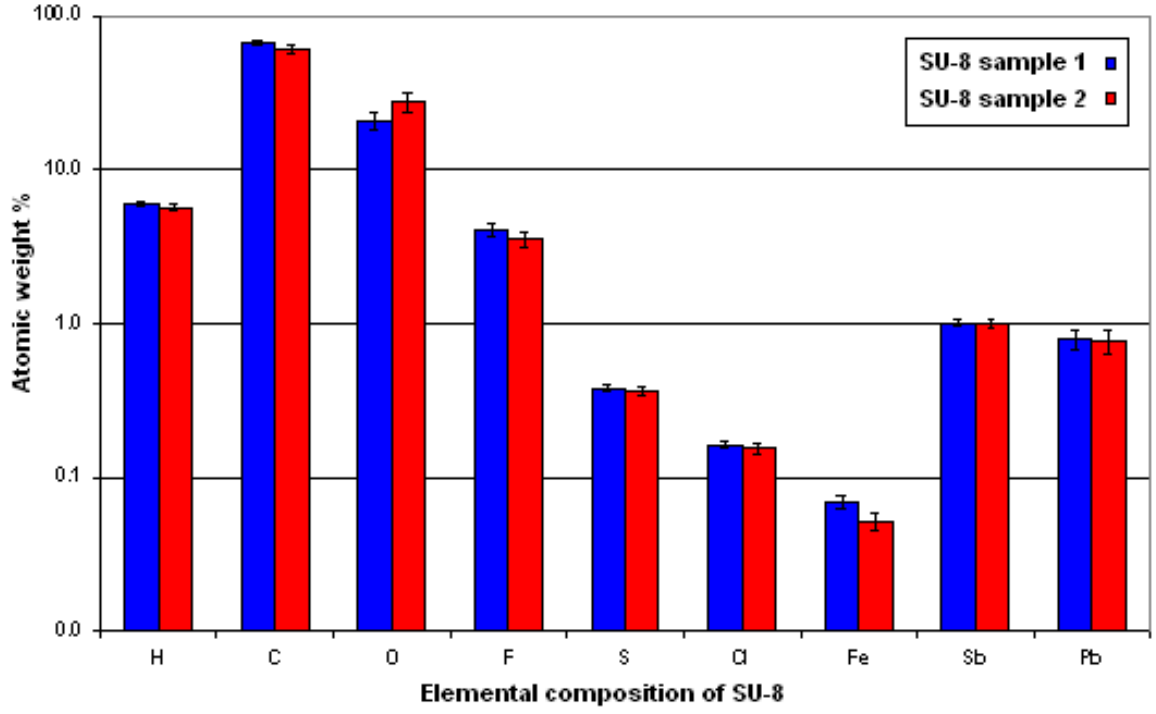


Figure 1.3. Atomic weight percentages of different elements in SU-8 samples 1 and 2, as determined by PGAA.

1.5 Conclusions from PGAA Experiments

The results obtained in this preliminary PGAA investigation suggest that differences in UV exposure and post-baking have little effect on the final elemental composition of SU-8. The two samples tested were exposed to different post baking and UV exposure durations but showed no significant differences in any elemental percentage. This is a positive result in the sense that significant differences in composition would be likely to be accompanied by differences in chemical or mechanical properties of the processed polymer. It is perhaps a somewhat surprising finding since changes in processing might be expected to affect at least the hydrogen and oxygen levels; however, if such effects occur predominantly at the material surface then this would have only a small effect on the PGAA result.

The results also demonstrate the application and usefulness of PGAA in the industrial field of polymer investigation. The results further confirm that PGAA is a useful industrial tool that is well suited to the investigation of other polymer materials. Applying PGAA to SU-8 polymer has demonstrated its potential for industrial applications, and will hopefully encourage its adoption in other polymer analysis sectors.

The above work was done with Massimo Rogante, Director of the Rogante Engineering Office (Italy), Adel Lén and Laszlo Rosta, Budapest Neutron Center (Hungary).

References

1.1 M.E. Heaton, M. Rogante, A. Len, D. Denieffe, “Investigation of the processing effects of UV, heat and laser ablation on SU-8 microturbines: a first approach by Small Angle Neutron Scattering”, Multidiscipline Modelling in Materials and Structures (Emerald), vol. 6 issue 3, pp. 364-372, 2010.

1.2 M. Rogante, L. Rosta, M.E. Heaton, “Neutron beam measurement of industrial polymer materials for composition and bulk integrity”, Measurement Science and Technology (IOP Publishing), vol. 24 n. 105601, pp. 8, 2013.

1.3 G. Hong, A.S. Holmes, M.E. Heaton, “SU-8 resist plasma etching and its optimization”, Microsystem Technologies, 10, pp. 357-359, 2004.

1.4 H. Lorenz, M. Despont, N. Fahmi, N. LaBianca, P. Renaud, P. Vettiger, “SU-8: a low-cost negative resist for MEMS”, J. Micromech. Microeng., 7, pp. 121-124, 1997.

1.5 M.E. Heaton, M. Rogante, Zs. Kasztovszky, D. Denieffe, “Prompt Gamma Activation Analysis of impurity and elemental stability for two SU-8 organic polymer samples having different solidification pre-treatment”, The Open Inorganic Chemistry Journal (Bentham Open), Vol. 3, pp.33-38, 2009.

1.6 Zs. Révay, T. Belgya, Zs. Kasztovszky, J.L. Weil, G.L. Molnár, “Cold neutron PGAA facility at Budapest”, Nucl. Instr. and Methods in Physics Research B, 213, pp. 385-388, 2004.

1.7 Zs. Révay, G.L. Molnar, T. Belgya, Zs. Kasztovszky, R.B. Firestone, “A new gamma-ray spectrum catalog and library for PGAA”, J. Radioanalytical and Nuclear Chemistry, 248 (2), pp. 395-399, 2001.

1.8 M. Rogante, “Applicazioni industriali delle tecniche neutroniche”, Proc. 1st Italian Workshop for Industry: Industrial Applications of Neutron Techniques. Rogante Engineering (Ed.), Civitanova Marche, Italy, 2008, pp. 40-120.

1.9 M. Rogante, “Industrial applications of neutron techniques: a recent overview related to materials and components of technological interest”, Proc. Int. Conf. MATRIB ‘03, Vela Luka, Croatia, 26-28/06/2003, K. Grilec (Ed.), Croatian Society for Materials and Tribology, Zagreb, Croatia, 2003, pp. 235-241.

1.10 M. Rogante, “Neutroni per l’investigazione di componenti e materiali industriali”, ICP 2/2008, Reedbusiness, Milano, 2008, pp. 72-75.

innovection
Innovation in Protection

Advances in Chemical Decontamination of the Eyes and Skin

Introduction:

A multitude of occupational and household compounds have the potential to induce chemical injury to the eye and skin. Prompt intervention is required to avoid irreversible disfigurement or loss of sight.

Chemical Injury:

Chemical agents (acids, alkalis, oxidising and reducing agents, chelating agents and solvents) can cause injury by producing a chemical interaction, resulting in extensive tissue damage and significant pain. Statistical information from the UK indicate these injuries account for only 3% of all burns but lead to approximately 30% of burn death. Chemical ocular burns account for between 7.7% and 18% of all eye trauma. Typically, young males working in industrial environments such as factories, chemical plants or laboratories are the commonest patient group, with more than 70% of eye burns occurring at work.

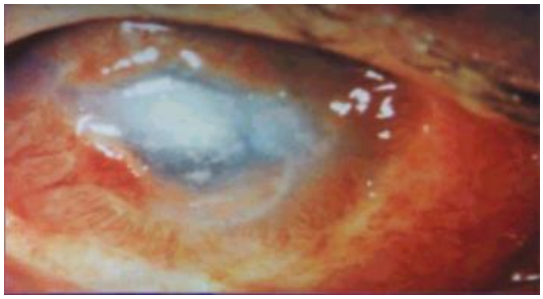
The main elements that determine the degree of injury are: type and concentration of the chemical, tissue exposed to the chemical (eyes are most easily damaged) and duration of exposure.

Alkaline agents, such as sodium hydroxide, typically penetrate more deeply than acids and through **liquefactive necrosis** cause saponification of fatty acids. In the eye, once the corneal epithelium is breached, alkaline solutions can lead to glaucoma. In contrast, acids cause a **coagulative necrosis** resulting in a mechanical barrier to limit further damage.

Traditional Decontamination:

Without prompt intervention, irreversible visual loss and disfigurement may occur. Immediate continuous irrigation with water (or saline) has been the usual first line treatment for chemical burns, regardless of the nature of the chemical involved.

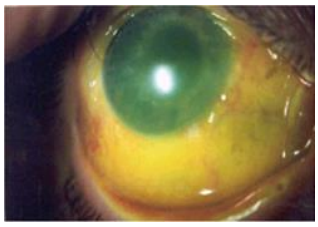
Water and saline, decontaminate by mechanically removing the chemical and diluting the chemical to reduce the aggressiveness on human tissue. Both are passive rinsing agents and need to be used for a minimum of 15 minutes. As you will know rinsing with these should ideally start within 10 seconds. The water must be of potable quality and should be tempered to between 15 and 20 degrees centigrade. To comply with current EN standards, water based showers must be capable of delivering 60 litres a minute thereby requiring 900 litres of water.



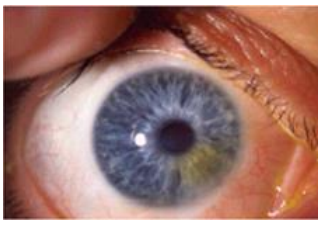
Hand and eye treated with water after a chemical splash

Active Rinsing Solutions (Diphoterine®):

The **Diphoterine®** solution is a First Aid Rinsing solution for decontamination of a chemical splash. It is a Class 2a Medical Device under European legislation and is safe to use on the skin, in the eyes and in the oral and nasal cavities. The **Diphoterine®** solution is an aqueous amphoteric chelating agent that will mechanically remove the chemical, will bind and encapsulate the aggressive part of the chemical (whether acid or base, solvent, oxidiser or reducing agent) and because of its higher osmotic pressure "suck" any chemical back out of the tissue that has penetrated beyond the outer layers of the skin or eye. Because of a combination of these features a portable **Diphoterine®** shower, which delivers 5 litres of solution, will fully decontaminate a casualty from head to toe with a 5minute dispensing time. The response time for the **Diphoterine®** solution is 60 seconds.



Ammonia splash to the eye,
visual acuity of 2/20 on arrival at hospital



After rinsing with Diphoterine® solution,
visual acuity of 14/20 restored

EN15154, the **European Standard** which governs the rules regarding emergency showers etc. indicates that **Diphoterine®** (and its sister product for HF contamination, **Hexafluorine®**) are compliant with these regulations. This may be of interest for your safety showers which, if not currently heated, will need to be upgraded. When compared to the cost of ownership of a compliant water-based system, the **Diphoterine®** solution offers a very cost effective alternative. This does not take into account the significantly better outcomes and lack of sequelae experienced when using the **Diphoterine®** solution in dealing with a chemical accident.

The product has been in use in Ireland for more than 20 years by companies such as; Rusal Aughinish Alumina, Pfizer, Novartis, Analog Devices, Amgen, Genzyme and many more. Indeed, the National Burns Unit in St James' Hospital, a number of Emergency Departments and Fire Brigade units use the product for chemical splash.

The latest Clinical **Practice Guidelines from PHECC** (Pre-Hospital Emergency Care Council - the governing body who cover from First Aid Responder through to Advanced Paramedic including Occupational First Aid) where they relate to Chemical Burns specifically allow the use of **Diphoterine®** and **Hexafluorine®** for the decontamination of chemical splash.

Diphoterine® Shower Unit

Diphoterine® Skin & Eyewash station

Recommendations:

A recent article in the UK is recommending the introduction **Diphoterine® Solution** to all emergency care facilities from Industrial First Aid through to hospital Emergency Departments.

Perhaps it is time for a change.

innovection
Innovation in Protection

Innovection Ltd, Unit 2 Santry Hall Industrial Estate, Swords Road, Dublin 9 D09 Y2F7

ROI Tel. 01 6424211

Innovection Ltd, 18 Enterprise House, Lisburn Enterprise Centre, 6 Ballinderry Road, Lisburn BT28 2BP

NI Tel. 028 203 60100

Fergus Cullen

Mobile 0876002228

Email: info@innovection.net

The Dublin Professor Werner

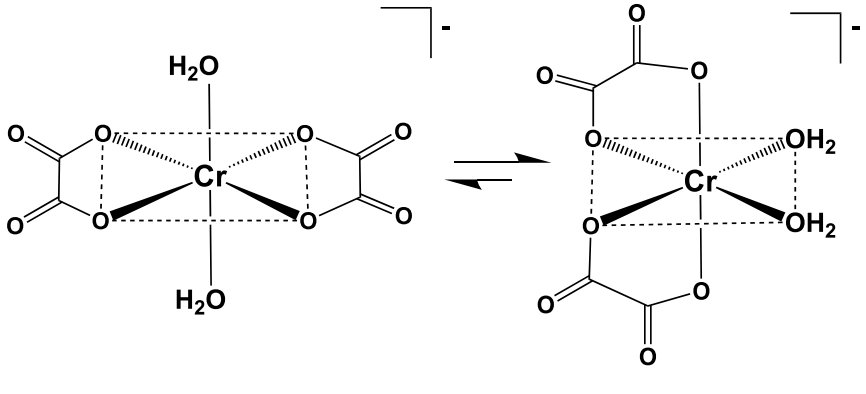
Prof Brian McMurry

Brian McMurry *graduated with 1st Class honors and Gold Medal in Experimental Science in 1953 (specialising in Chemistry) from Dublin University, and received his PhD in 1956. He joined the staff of the Chemistry Department in Trinity College in 1955, and was elected a Fellow of the College and a Member of the Royal Irish Academy in 1959. He went to Harvard for the year 1961-1962 where he worked with RB Woodward at the start of the synthesis of Vitamin B12. In 1964 he went to the University of Lagos, Nigeria as the first Professor of Chemistry as part of an exchange programme between the two Universities. Unfortunately a tribal conflict arose in the University, it closed, five of the six deans were sacked and there were mass resignations. Back in Trinity, he served as Dean of Graduate Studies and later Registrar, on the Board of the College as a Senior Fellow, and a Treasurer and Trustee of the Trinity Association and Trust. He served as Treasurer of the Royal Irish Academy, and on the Executive Committee of the Irish Council for International Students. He started as a natural product chemist, went over to organic photochemistry, and finished up as a medicinal chemist, when he was one of the leaders of a group that developed a drug that got into Phase-2 Trials against Melanoma. It proved too toxic at this level and was dropped. He retired in 2001.*

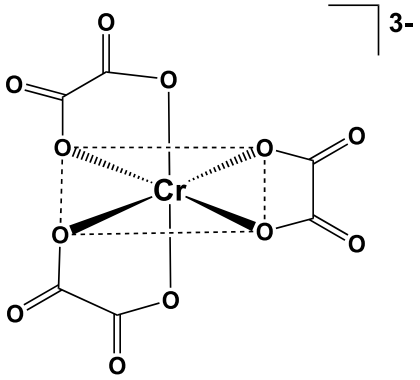
Every chemist has heard of Alfred Werner, Professor of Chemistry in the University of Zurich and a Nobel Laureate[1]. From an Alsace family, he is remembered for his brilliant study of the stereochemistry of metal coordination complexes. From the same family, Emil A Werner became University Professor of Chemistry in Trinity College; he had never acquired a primary degree in chemistry. His father was a portrait painter; he had come to Dublin in 1856 to ply his trade. His wife set up a photography business as a side line. Their first son became an ophthalmic surgeon; their second son joined the family business and became a successful photographer on Grafton Street. Their third son, Emil, as a teenager, became interested in the chemistry of the photographic process. He acquired a chemistry textbook and started experimenting with chemicals that he could acquire[2]. Small amounts of a wide range of chemicals were available from suppliers such as Lennox Chemicals in Lincoln Place. Working in his bedroom, Emil prepared beautiful crystals, both blue and red, by reduction of potassium dichromate with oxalic acid. They mystified him, as they gave no reactions characteristic of either chromium (III) or oxalate. He decided that he had to find out, and he brought the samples to show to Professor Emerson Reynolds FRS in the Chemistry Laboratory - the official address of the department – in Trinity College. Reynolds could not explain the chemistry either, but he was so impressed by the young man that he offered him a position as his private assistant. Reynolds himself never held a primary degree in chemistry but was a Licentiate of the Edinburgh College of Physicians and Surgeons, where chemistry would have constituted part of his studies[3]. Already in his teens, he had published several notes in *Chemical News*. He practiced as a medical doctor for some time to please the family, but, when his father died, he devoted himself to chemistry. This background would have made him sympathetic to the young Werner.

Initially Werner's position was unofficial; he helped Emerson Reynolds with his experiments, but he continued to use his bedroom to carry out his own experiments. From there, he published papers, the first one on the analysis of thallium in lead and the second describing two tests for the detection of impurities in ether. The latter was accepted by the *British Pharmacopeia* as the standard method of analysis, and it survived in six subsequent editions until 1932[2]. He sat an examination to qualify as a Fellow of the Institute of Chemistry. This was a qualification biased towards analytical chemistry.

After a few years, he was allowed to carry out his own experiments in the Laboratory. He was elected to the Chemical Society in 1888. He published the correct empirical chemical formulae of the oxalo-chromium complexes, clarified the conditions required to synthesise them, and how to convert the red to the blue compound[4]. The Medical School building housing the Chemistry Laboratory was started in 1885, and completed and officially opened in 1887[5] so his work, involving careful analysis of the samples, cannot have been carried out in the new building, but rather in the older building located behind the new. Certainly the papers were among the first to be published from the new site. His cousin, Alfred Werner provided the structures of the two compounds in 1914[6]. He showed that the red compound had a hydrated *trans*-bis (oxalato) diaquo chromium structure **1a**, though in solution the *cis*- isomer **1b** was the more stable, but much more soluble; the blue compound was a hydrated tris (oxalato) chromium complex **2** formed, of course, as a racemate.The crystal structures of the *trans*-bis(oxalato) compound[7] was solved in 1950, the *cis*- in 2012[8] the tris(oxalato) – compound in 1978[9].



1a **1b**



2

The academic staff in the Chemistry Laboratory at the turn of the century were listed as Professor and Assistant. Emerson Reynolds was not popular in College; he continually complained about his conditions and salary and this provoked his resignation in 1903. He was a martinet and kept his assistants to the grindstone in charge of practical classes[10] but Werner later probably gave lectures. Reynolds being difficult, Werner may have been a more friendly face in the Department. His name appeared in the College Calendar as Assistant in 1892. He gave his title as Assistant Lecturer in a paper published in 1890[11] and as Assistant in a paper with Reynolds in 1903[12]. He remained as an Assistant in the College Calendar until he was appointed Professor of Applied Chemistry when Emerson Reynolds left in 1903. He must have been well

known to, and respected by, the College community by that time. He later sent his son to a Catholic school, so he must have been one of the few Roman Catholics on the staff. The absence of a primary degree may have scuppered any chance of getting Fellowship, though it did not affect his nomination to the Chair – Fellows owned the College while Professors were employed merely to give lectures and carry out research! Once he held a Professorship, the chances of Fellowship receded, as it was not the custom to make Professors Fellows.

Professor of Applied Chemistry

Sydney Young from Bristol had been invited to apply for, and was appointed as Reynold's successor as the University Professor of Chemistry. He was the first non-medical to be appointed to the Chair. Working with the (later) Sir William Ramsay there, he already had a considerable reputation in the determination of boiling points of pure liquids and the exploration of azeotropic mixtures. His method using benzene to prepare dry ethanol is still with us[13]. Fearon[2] in the obituary of Werner states that he, Werner, did not apply for the post, as he felt that Young was much more distinguished. However he was a physical chemist, and somebody was required to teach organic chemistry, and in 1904 Werner was appointed Professor of Applied Chemistry to meet the need. He was given three Christian names, Alfred (after his cousin), Emil and Anthony (always known as Tony).

Young must have been a much easier colleague for Werner than Reynolds. Being already an FRS would have eased Young's way into Membership of the Royal Irish Academy, but he must have been sufficiently liked and respected to be elected President. During his time in the College, a new Professorship – of General Chemistry – was created, and Young was appointed to it. The University Chair was in the gift of the Royal College of Physicians and required re-advertising every seven years. The origins of chemistry in the College lay in the Medical School which was closely linked with the College of Physicians. The Chair of General Chemistry was created to give Trinity College complete control over it.

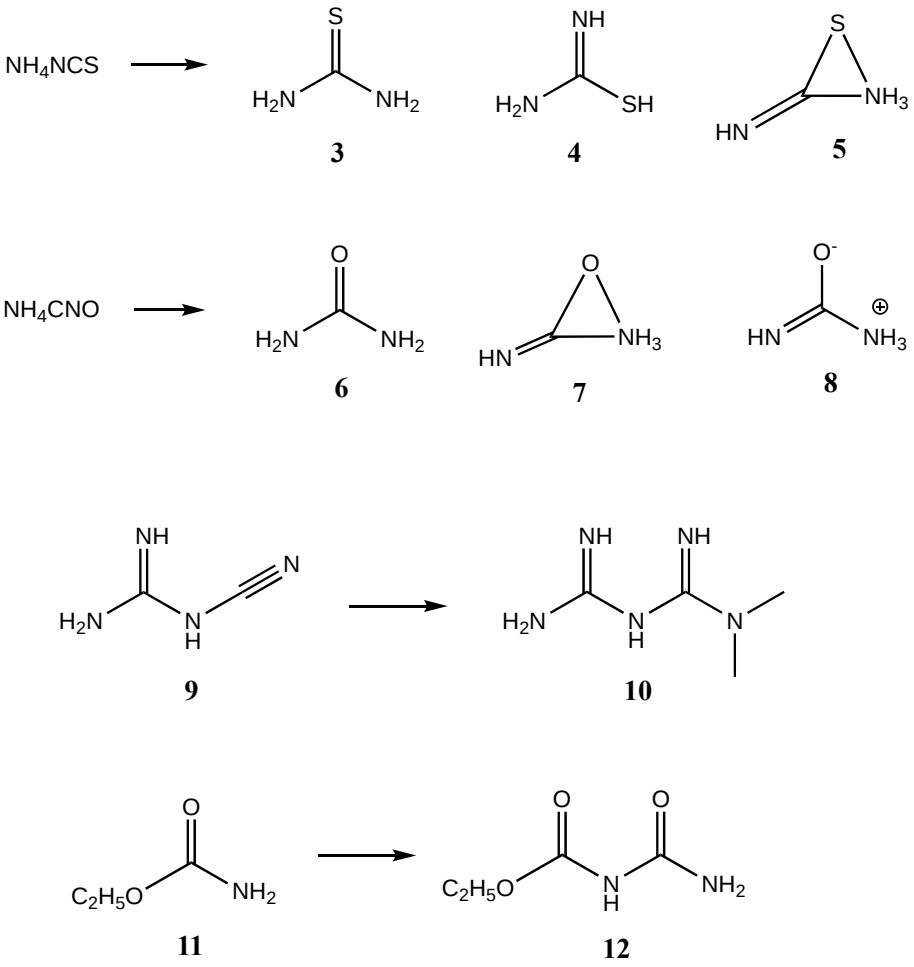
Reynolds had been the first person to synthesise thiourea **3**; the experiment was reported in 1869 when he held the position of Analyst in the Royal Dublin Society[14]. It caused quite a stir as the synthesis had eluded both Leibig and Hoffmann. The secret lay in the temperature required to establish the equilibrium between ammonium thiocyanate and thiourea. Ammonium cyanate converted to urea at 100^0C, but the thiocyanate required heating above its melting point (148^0C). Reynolds in 1891 favoured the isothiourea structure **4** for the molecule to account for its reactions[15] and Werner helped Reynolds establish the time and temperature needed to get the best yield of thiourea[12]. Reynolds abandoned the topic, and returned to his organosilicon interest but Werner continued to worry about its structure and suggested an alternative with a pentavalent nitrogen atom **5**[16]. It is easy for us to rubbish this formulation, but even ammonium chloride was written with a pentavalent nitrogen at the time.

Urea

With his background of work on thiourea, it was only natural that Werner should start working on the chemistry of urea. He prepared many derivatives of it and also of thiourea. There was a similar ambiguity about urea's structure. He suggested the cyclic structure **6** for it in 1913[17]. Following Lewis' pioneering work, Langmuir applied the 'eight electron rule' to nitrogen compounds; a pentavalent nitrogen atom was impossible. Langmuir in fact revised the structure proposed by Werner for urea and suggested that it should be represented as polar, with one positively charged tetravalent nitrogen and a negatively charged oxygen **8**[18]. The concept of resonance structures had not been developed at the time; it was promulgated in the '30s.

Werner stuck to his guns, and in his monograph, *'The Chemistry of urea'* (1922), he still stated his preference for his cyclic proposal[19]. He discussed Langmuir's paper but claimed that it did not explain the reactions of urea with nitrous acid and hypohalites. In the case of the former, he pointed out that the reaction did not take place in the presence of acetic acid, but required the presence of a mineral acid. This, he claimed, could not be explained by Langmuir's polar structure. Reading his book now, it is clear that he did

not really subscribe to the ‘eight electron rule,’ and, while he appreciated tautomeric structures, he did not realise how easily hydrogens could migrate from one atom to another. In his book, he argued that, in ammonium chloride, there were four hydrogen–nitrogen bonds, but there was the possibility of a ‘residual bond’ between nitrogen and chlorine! The book rambles over the mechanism of the synthesis of urea from ammonium cyanate, the structure of cyanic acid, the reactions of urea on heating and with reagents. He spends a chapter discussing the occurrence and origin of urea in nature. He was convinced that cyanic acid was a precursor. He gave details of various demonstration experiments, and methods for the detection and analysis of urea.



The year after it was published, Werner attended an International Congress of Physiology in Edinburgh. WR Fearon[2] who was the Professor of Biochemistry, in his obituary of Werner, records that “he failed to do justice to his beloved ‘cyclic urea,” and that the “chemists, suspicious of what looked like a quinquevalent nitrogen, refused to commit themselves.” I suspect that he had a rather hard time. Certainly his publication rate plummeted from that time on. Fearon states that the author was disappointed with his book. It did no go into a second edition. Gossip around the department when I was a student was that he had got the structure of urea wrong! I am afraid the gossip was right, but this view may not have circulated widely in College. McDowell and Webb[10] list his research as work on the structure of the molecule. Wesley Cocker[20] in his history of the department treats him gently, citing the fact that resonance theory had not been promulgated at the time.

During the First World War, Werner had engaged in war work, developing methods of making bulk samples of cyanamide, several aliphatic amines, and α-naphtholphthalein[2] He later prepared many compounds related to urea and thiourea; his samples were still present in the department until about twenty five years ago. He used ‘dicyanodiamide’ **9** - originally prepared by Bamberger[21] - to react with dimethylamine

hydrochloride to make dimethylaminodiguanide hydrochloride **10**[22]. Even here he got things wrong, as he did not accept that 'dicyanodiamide' was equivalent to 2-cyanoguanine[23]. Over the years, several reports had mentioned that dimethylaminodiguanide hydrochloride reduced blood glucose levels. These were either forgotten or ignored until J Sterne in 1957 demonstrated that it was effective in patients with Type-2 diabetes[24]. Metformin is still the leading drug to be prescribe if insulin is not required. At present, it is the subject of clinical trials to see if it can contribute to the treatment of cancer.

Head of Department

Sydney Young retired in 1928, and Werner, at the age of 64, was appointed to the two Chairs. Most people now would have retired or be contemplating retirement. Fearon in his obituary says that Werner gave up his research work to devote himself to running the Department[2] though the College Calendars show that he continued to publish. He is listed as reading several papers to the local section of the Institute of Chemistry.[25] In one, he describes the synthesis of urea from ammonium hydroxide and carbon dioxide on the surface of peat. A second one focusses on the usefulness of the reaction of nitrogen containing compounds with nitrous acid and with hypobromite as an analytical technique. The structure of urea was not mentioned in the accounts. He contributed to the investigation of the fact that urea is hygroscopic, and indeed deliquescent, in conditions of high humidity[26]. In a paper with his son, Tony (AEA) then a Lecturer in the Department, published in the *Scientific Proceedings of the Royal Dublin Society,* the conversion of ethyl urethane **11** to ethyl allophanate **12** using thionyl chloride is discussed. Reactions of urea feature in the paper, but no structure for the molecule itself is given[27]. Tony published several other papers in the same journal dealing with subjects related to urea and thiourea chemistry[28,29,30,31]. In one of them the correct formula for urea features[32].

College activities

Running the Department did not stop him playing a leading role in the Common Room, which can be regarded as the Trinity Academic Staff Club. He is recorded as being present at its AGM in 1923, was elected to the Committee in 1928, and Treasurer in 1929[33]. The post also covered the duties of a present-day Secretary; he threw himself into the job and served until 1938. He was back on the Committee in 1941. He was elected an Honorary Member in 1946 on his retirement from College and while still on the Committee. Fearon[2] says that he had intended to retire on reaching seventy five in 1939, but the start of World War-2 meant that he stayed on until 1945. He describes Werner as "most friendly and companionable" and McDowell and Webb[10] describe him as popular. The year after he became head of the Department, he was elected a member of the Royal Irish Academy (1929). The Certificate proposing him lists his interest in monograph on urea chemistry as among his accomplishments. The signatures of prominent Trinity academics on it confirm his popularity, though it was not signed by either Joly (Geology) or Dixon (Botany), the scientists who might have known most about Werner's research[34]. He had been an active 'Non-Fellow Professor' in 1908 when they were pushing for reform. Certainly he had been sufficiently liked and respected by 1903 to have been appointed to a Chair, and his elevation to the University Professorship in 1928 appears to have been seamless. He played no part in the department after he retired, but his successor, Wesley Cocker, paid him a tribute by naming the newly formed student Chemical Society after him.

I am grateful to Lisa McCaffrey Saris who allowed me to look at the Minutes of Common Room AGMs and to the Common Room Committee to quote them, to the Siobhan Fitzpatrick (Librarian in in the Royal Irish Academy) for sending me Emil Werner's Membership Certificate, and to Professor Wolfgang Schmitt for help in drawing the formulae.

References

1. *Nobel Lectures Chemistry, 1901-1921*, Elsevier Amsterdam, 1966, EP Thorpe, *Obituary Notices, J. Chem. Soc, Trans.*, 1920, **117**, 1639.

2. WR Fearon, Emil Alphonse Werner, 1864-1951. *J. Chem. Soc.*1952, 2947.
3. TE Thorpe, *Obituary Notices, J. Chem. Soc., Trans.,* 1920, **117**,1633; D Reilly, *J. Chem. Ed.*, **15**, 149
4. EA Werner, *J. Chem. Soc., Trans.*, 1887, **51,** 383; 1888, **53,** 404, 602.
5. D Coakley, *Medicine in Trinity College Dublin; an illustrated history*, Trinity College Dublin, Dublin.
6. A Werner, *Liebig's Annalen der Chemie*, **406,** 261.
7. JN van Niekerk,and FRL Schoening, Nature, 1950, **166**, 108
8. I Cherif, J Abdelhak, MF Zid, and A Driss, *Acta Crystallogr.E: StructRep.Online*, 1012, **68**, m824.
9. D Taylor, *Aust. J. Chem.*, 1978, **31**, 1455.
10. RB McDowell and DA Webb, *Trinity College, Dublin, 1592-1952, an academic history*, Cambridge University Press, 1982, Cambridge.
11. EA Werner, *J. Chem. Soc., Trans.*, 1890, **57**, 283.
12. J Emerson Reynolds and EA Werner, *J. Chem. Soc., Trans.*, 1903, **83**, 1.
13. WRG Atkins, *Obituary Notices, Royal Society, Sydney Young, 1857-1937*, 1974, 371.
14. J Emerson Reynolds, 1869, *J. Chem. Soc., Trans*, **7**, 1.
15. J Emerson Reynolds, 1891, *J. Chem. Soc., Trans.*, **71,** 383.
16. EA Werner, *J. Chem. Soc., Trans.*, 1912, **101**, 2180.
17. EA Werner, *J. Chem. Soc., Trans.*, 1913, **103**, 1010, 2275.
18. I Langmuir, *J. Amer. Chem. Soc.*, 1919, **41**, 274.
19. EA Werner, *The Chemistry of Urea*, 1923, Longmans, Green, London.
20. W Cocker, *Hermathena*, 1978, **124**, 58.
21. E Bamberger and W Dieckmann, *Chem. Ber*., 1892, **25**, 545.
22. EA Werner and J Bell, *J. Chem. Soc., Trans.*, 1922, **121**, 1790.
23. EA Werner and J Bell, *J. Chem. Soc., Trans.*, 1920, **117**, 1133.
24. J Sterne, *Maroc Med. J.*, 1957. **36**, 1295, cf. A Dronsfield and P. Ellis, *Education in Chemistry*, 2011, **48**, 185.
25. EA Werner, *J. Proc. Inst. Chem*., 1935, **59**, 165; 1937, **61**, 156.
26. EA Werner, *Nature*, 1937, **139**, 512.
27. EA Werner and AEA Werner, *Sci. Proc. RDS*., 1943, **32**, 137.
28. AEA Werner, *Sci. Proc. RDS*., 1943, **32**, 131.
29. AEA Werner and J Gray, *Sci. Proc. RDS*., 1944, **24**, 77.
30. AEA Werner *Sci. Proc. RDS*., 1944, **24**, 199.
31. AEA Werner and J Gray, *Sci. Proc. RDS*., 1944, **24**, 209.
32. AEA Werner and J Gray, *Sci. Proc. RDS*., 1944, **24**, 111.
33. Minutes of the Common Room Annual General Meetings.
34. Archives, Royal Irish Academy.

Institiúid Ceimice na hÉireann
Institute of Chemistry of Ireland

Henkel Excellence is our Passion

The Institute of Chemistry of Ireland
Industrial Chemistry Award 2017
Sponsored by Henkel Ireland Ltd

This award has been instituted to recognise the achievement of an individual chemist, or team of chemists, for making a significant contribution to the chemical or pharmaceutical industry in Ireland

1) **Eligibility (Membership):** FICI, MICI (applicant who is not a member can apply for membership at same time, but membership process including entry fee and payment for first year must be completed by closing date for award).

2) **Eligibility (Industry Award):**

a) Employees, a group or principals of the ***chemical, pharmaceutical industry, and related sectors on the island of Ireland, involving work substantially chemical in nature (consideration will be given to self-employed and service sector entries)*** that can clearly show support of industrial chemistry functions.

b) A **Group** or **Team** may be nominated provided at least one member of which is a Member or Fellow of the Institute or whose company/employer/organisation is a member of the Institute and who has played a principal role in the team. This Chemist will be nominated by the team to accept the award on behalf of the group.

c) Current members of Council are not eligible.

d) For former Council members to be eligible, a period of 3 years must have elapsed since the end of their term on Council.

e) Employees of Henkel Ireland and its subsidiaries are not eligible (while Henkel Ireland is sponsor).

3) Application must include:

a) 2-page general CV. Candidates may self-nominate or be nominated by their company or organisation.

b) List of publications (3 most significant to be at the top *i.e.* ones the applicant considers best supports their case for award or list of up to 5 significant contributions of the applicant(s) to his/her/their industry based in Ireland accompanied by confirmatory evidence. Such evidence might include technical documents, patents, journal articles, contribution to formulation of industrial standards etc.

c) Brief summary of research/investigational work/developmental work and its particular value (*i.e.* why applicant considers themselves worthy of award).

d) Brief summary (400 words) of article for ICN should applicant be successful (for consideration, *inter alia*, by editor of ICN).

e) Names of 2 referees prepared to support application (and their connection with/knowledge of applicant, including length of time they have known applicant), one of whom (at least) should be FICI/MICI or Fellow/Member of an EuCheMS chemical society (these referees should write a statement of support of 250-400 words to be submitted by the same deadline as applicant).

4) Confidentiality: Applicant should make clear any issues of confidentiality concerning their application, but are advised that any independent adjudicators will only be considering the material for the purpose of award adjudication, and such adjudicators will not be connected with the applicant's employer/organisation.

5) Adjudication: possible shortlisting by ICI sub-committee (depending on the number of applicants, with proviso that sub-committee members initially declare any conflict of interest with respect to applicants) … then an independent panel (2-4 persons) and should include a Council Member, an FICI with an industrial background and a senior representative of the sponsoring organisation. Each to be checked for conflict of interest with respect to group they are adjudicating on *i.e.* in respect of all applicants, or in respect of shortlist, as relevant; panel to carry out their work via correspondence, with tele- or video-conference if necessary.

6) Prize: **a) Award Certificate + b) Memorial Trophy + c) €1000**. The candidate will be required to give a Public Lecture and contribute an Article to ICN. The award will not be arranged until prospective Awardee has agreed date for the lecture and supplied the article for ICN. The Lecture would coincide with date for the formal ceremony for Award.

Awardee's organisation to get free company membership for 1 year (if not already a company member).

7) Publicity: Awardee to provide reasonable assistance to advance publicity for award ceremony, and publicity arising from it; sponsor to be consulted on format/timing and venue of Public Lecture & Award.

Closing Date for Nominations Friday 29th September 2017

Inquiries can be E-mailed to: - info@instituteofchemistry.org

Check website: - www.chemistryireland.org

The Carbon Trust is an independent, expert partner of leading organisations around the world, helping them contribute to and benefit from a more sustainable future through carbon reduction, resource efficiency strategies and commercialising low carbon technologies.

We believe in a future where economic prosperity and environmental sustainability go hand in hand

Building a sustainable future

Until now, natural resources such as energy, materials, water and land have been abundant and cheap. As a result, today's economy - from buildings and transport to food and clothing – is wasteful. The scarcity of resources, the impact of their use and the growth of emerging economies mean that the infrastructure, products and services of tomorrow will have to be radically different. The Carbon Trust works with organisations to address these challenges and deliver on our mission – to accelerate the move to a sustainable, low carbon economy.

Who we work with

Our partners and clients are leaders in this transition – governments and multilateral organisations, businesses and the public sector. We act as a catalyst, working closely with them to help them succeed. Our experts listen closely to their needs, understand their challenges and create bespoke solutions, often acting as a critical friend. With over 16 years' experience, we understand what does and doesn't work and most importantly – why.

What we do

We cut through uncertainty to provide insights that support better, often bolder, decisions. We design and manage complex projects and collaborations that overcome financial and behavioural barriers to deliver real results. And, when the time comes to celebrate success, we recognise achievement through assurance and certification of the outcomes.

Our services

World-leading and trusted

Created in 2001, we have developed into a world-leading and trusted expert in low carbon issues and sustainable strategies. We offer more than 16 years of unparalleled experience in the low carbon sector.

We are impartial and, our clients and partners tell us, rigorous and innovative too. We understand the need for unique solutions, which is why we think global but act local. Every day we work with new technologies, markets and business models yet, in a sector where much is open to opinion, we make the case for change based on evidence and facts. And as an organisation committed to our mission, we reinvest any surplus from our activities.

Our experts

All this needs great people and real expertise, fortunately we have both, with over 180 experts of 30 different nationalities, based in the UK, China, Mexico, Brazil, South Africa and the USA.

Our engineers, policy makers, financiers and entrepreneurs have experience from a wide range of sectors, and each is personally committed to delivering positive change to everyone we work with.

Our principles

Impact. We listen to our partners and clients and create solutions that meet their needs, drawing on our experience and know-how.

Resilience. In order to deliver our mission, grow, innovate and capture emerging opportunities we must be financially strong. Any surplus revenue is reinvested in our work.

Integrity. We insist on honesty, integrity and fairness in our work and expect the same from our partners, clients and contractors. The direct or indirect offer, payment, soliciting or acceptance of bribes in any form is unacceptable and we must avoid conflicts of interest.

Health, safety and the environment. We have a systematic approach to health, safety and environmental management. We work to have a positive impact on the environment and ensure the safety and well-being of our people.

People. We value diversity and provide an inclusive environment for our people. We recruit, reward and promote on merit and seek to develop skills and capabilities.

Learning. We learn from our experience, successes and failures, avoid blame and aim to continually improve.

Compliance. We comply with all applicable laws and regulations in the countries in which we operate and, where appropriate, go beyond compliance.

We are committed to continually improving our environmental performance, as set out in our **Environmental Policy (PDF)**.

How we can help you

We offer a range of **tailored services**, designed to meet the needs of businesses, governments and the public sector:

- We advise businesses, governments and the public sector on their opportunities in a sustainable, low carbon world
- We design and manage multi-year, multi-stakeholder projects, often in collaboration with expert partners, that overcome financial, behavioural and structural barriers to deliver real results
- We provide independent assurance and certification services that recognise real achievements in sustainability.

The Carbon Trust is proud to support the **United Nations Global Compact**

The Carbon Trust supports the **Global Goals for Sustainable Development**

Case Study 1

Bord Bia - Demonstrating resource competitiveness of Irish agriculture

Using carbon footprint models built with the Carbon Trust, Bord Bia has been able to demonstrate the relative resource competitiveness of Irish agriculture, with the Irish dairy industry being shown to have the joint lowest carbon footprint in Europe.

The footprint information allows further hotspots to be targeted to help maintain the industry's leading position.

Bord Bia – the Irish Food Board – acts as a link between Irish food, drink and horticultural producers and customers throughout the world. The food and drink sector accounts for 7% of Ireland's economic output, 11% of Ireland's exports and in 2013, exports increased by an estimated 9% to approach €10bn for the first time, with some 42% going to the UK.

Given the lack of traditional industrial activity in Ireland the sector accounts for 29% of overall greenhouse gas (GHG) emissions. In order to continue the growth of Irish food and drink exports, the sector is seeking to optimise their supply chain position by demonstrating and communicating that Ireland is a responsible and sustainable producer of food and drink products.

This ambition led Bord Bia to launch the Origin Green sustainability programme in 2012 to demonstrate internationally the commitment of Irish food and drink producers to operating sustainably – in terms of greenhouse gas emissions, energy conservation, water management, waste reduction, biodiversity, raw material sourcing, community initiatives, and health and nutrition.

Collaboration with the Carbon Trust

Collaboration with the Carbon Trust has allowed Bord Bia and Teagasc (The National Agricultural Research & Farm Advisory Body) to understand and model the complicated carbon emissions associated with agriculture through activities such as:

- Building **carbon footprint models** for the dairy, beef, poultry, pork, and lamb industries to better understand the relative resource competitiveness of Irish agriculture
- Publishing guidance to dairy and beef industries on how to calculate and reduce carbon emissions with the aim of helping farmers and processors identify carbon hotspots where efficiency improvements are possible
- Conducting sustainability audits for more than 38,000 Irish beef farms that are members of its Quality Assurance Scheme, collecting data from up to 500 farms per week
- Over 50,000 farm assessments have provided bespoke feedback to help farmers identify improvements that deliver financial and environmental improvements
- Extending its assurance scheme from carbon measurement to develop a framework that captures farm performance in relation to other sustainability measures including water, waste, biodiversity, and community engagement

Supply chain sustainability

Examining the processing and packaging stages of the supply chain and integrating this insight with farm-level data to build a complete picture of the agricultural supply chain. The Origin Green programme has attracted significant buy-in at industry and farm level. By end 2013, 297 food and drink companies had registered their interest in becoming members and already 60% of food and drink exports are supplied by companies who are verified members of Origin Green. The target is to increase this to 75% by end 2014.

In engaging with farmers, processors and manufacturers, Bord Bia discovered that demonstrating a sound business case was fundamental to getting participation. However, this business case frequently goes beyond efficiencies and cost reduction to include a perceived market return – whether it be a preferred supplier contract, a new customer or increased business with an existing customer.

Resource management

All this has led Bord Bia to recognise that the proper management of resources today matters and a better understanding of resource use will further enhance the Irish agri-food sector's green reputation, save resources, reduce costs and building a healthier bottom line for the sector both at farm and food manufacturing level.

Case Study 2

GlaxoSmithKline - value chain footprinting

GSK has set ambitious goals to reduce carbon, water and waste across its value chain – from the sourcing of raw materials and the impacts of its own labs and factories, to the use and disposal of its products by patients and consumers.

As a global healthcare company with a mission to help people do more, feel better and live longer, the rationale for an environmentally-conscious approach is clear. Environmental challenges like climate change and deforestation exacerbate health issues and undermine efforts to overcome inequalities around the world. To achieve its environmental objectives, GSK needed to measure, allocate and track emissions to isolate specific hotspot areas across the value chain.

GSK worked with the Carbon Trust in 2014 to estimate the full value chain greenhouse gas (GHG) footprint of its business. This took into account all emissions associated with the company's activities: from the production of raw materials through to the end-of-life impact of the products it sells.

Making it work

We worked with GSK to understand how to leverage data from their existing reports. The final output was an Excel-based tool which included:

- A hybrid approach to evaluating the impacts of purchased goods and services, combining existing life cycle assessment data for raw materials with economic input-output data for other areas of spend
- Allocation of emissions between GSK business units
- Grading the data quality of all activities and providing a summary of where better quality data is required
- Detailed analytics to show where carbon reduction opportunities exist across the supply chain

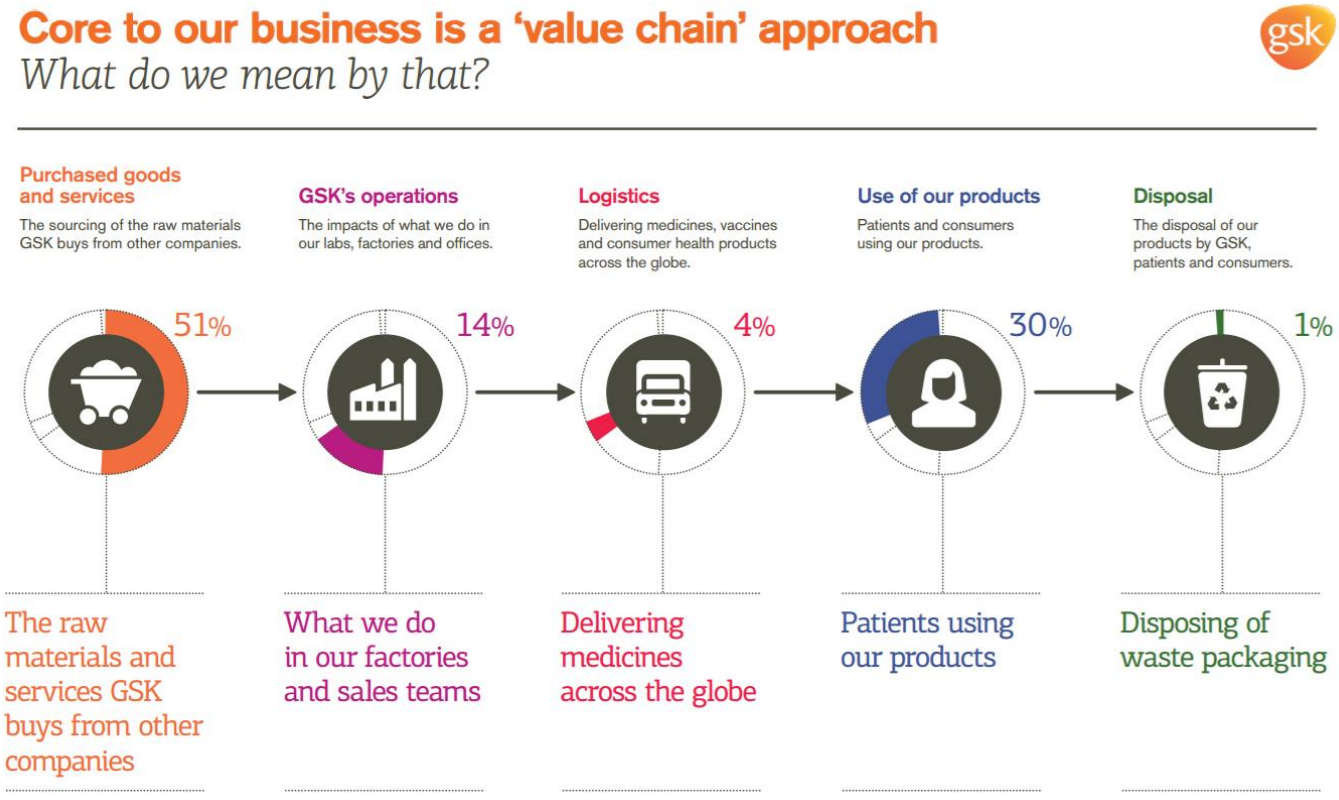
The Environmental Sustainability Centre of Excellence within GSK has worked with the Carbon Trust on numerous projects. We have found them focused, thorough and time-effective in their execution of the project briefs. Their breadth of knowledge enabled us to collaborate successfully to build an easy to use tool to evaluate our value chain carbon footprint and update it on an annual basis.

Richard Henderson, EHS Performance and Reporting Lead, GSK

Positive outcomes

Since the completion of our work, GSK has used the tool on an annual basis to calculate and update its value chain footprint. This has enabled GSK to report and track results with confidence, both internally and externally, against its corporate goals.

The model has given GSK the information and data to prioritise interventions in key areas throughout its value chain for carbon reduction. This has led to a series of targeted initiatives at different points across the value chain, working with suppliers, partners and employees to reduce their environmental impacts, to support existing sustainability efforts within GSK's own operations.



Case Study 3

AkzoNobel - Carbon Trust Standard for Water

UK decorative paints business successfully achieves certification to the Carbon Trust Standard for Water, demonstrating an absolute reduction in water use of 22.2%

AkzoNobel Decorative Paints UK is a part of AkzoNobel, the leading global paints and coatings company, and home to well-known brands such as Dulux, Cuprinol, Polycell and Hammerite. In July 2013 the UK decorative paints business successfully achieved certification to the **Carbon Trust Standard for Water**, demonstrating an absolute reduction in water use of 22.2%.

AkzoNobel recognises that a sustainable water supply is important to the long-term sustainability of its global business. The company relies on water for raw materials production, product formulation and manufacturing, power generation, cooling, cleaning, transporting and for effective use of some products. For this reason the business has announced its ambition to have sustainable fresh water management in place at all AkzoNobel manufacturing sites by 2015.

The UK Decorative Paints business put a particular focus on minimising freshwater use in operations. Over the certification period a reduction of 59.6m^3 was achieved through manufacturing initiatives. This included the implementation of various leading-edge technologies in production facilities to reduce water use while ensuring there would be no adverse impact on product quality.

Paint manufacture requires water as a key ingredient. At its Prudhoe manufacturing site, rainwater harvesting was implemented and captured water was used for new paint manufacture. It is filtered and is then sterilised using an ultraviolet filter, eliminating bugs without the use of biocides. The site has the capacity to harvest 1.7m litres of water per year. Wash water storage has also been increased on all sites across the UK to allow more water to be reused in new paint production where possible.

"We value the independence and reputation of the Carbon Trust, and having held the Carbon Trust Standard for many years, we were keen to be one of the first to also achieve the Carbon Trust Water Standard as recognition of our work to date in this important area".

Susan Kendall

UK & Ireland Sustainability Director at AkzoNobel Decorative Paints

Cleaning machinery in between different product or colour batches is a particularly water intensive area in paint manufacture. AkzoNobel's Slough plant made engineering improvements that allow pipe work to be washed out separately from the mixer. This means that in between similar water-based batches it is possible to wash just the pipe work, halving the amount of water required. In the company's Stowmarket plant similar paint products follow each other in the production schedule, requiring washing to be carried out less frequently.

AkzoNobel is currently investing in a new manufacturing facility in Ashington, due to open in 2014, which aims to be the most sustainable paint plant ever. All new water-saving processes and learnings have been incorporated into the design of this site, along with a series of other sustainability measures. It is intended that Ashington will replace the current Slough and Prudhoe manufacturing sites, with the capacity to produce 90 million litres of paint a year.

To ensure that the company is able to continue achieving year-on-year reductions, meeting its own ambitions for sustainability, it has set stretching targets have been set around reductions in energy, water and waste. For water the major targets are reducing total fresh water per tonne of production to a maximum of 155 litres, excluding product water content, and having zero process waste water.

"It is a core value of AkzoNobel to seek radical resource efficiencies wherever viable. We recognise that the UK will become increasing water scarce and that as a responsible manufacturer and a leader in sustainability in our sector we need to be pushing the boundaries and pioneering new processes for minimising water usage. We value the independence and reputation of the Carbon Trust, and having held the Carbon Trust Standard for many years, we were keen to be one of the first to also achieve the Carbon Trust Standard for Water as recognition of our work to date in this important area".

Susan Kendall, UK & Ireland Sustainability Director at AkzoNobel Decorative Paints

Read more on Akzonobel's **Planet Possible** series to encourage communities and businesses to do 'more with less' for the benefit of the environment.

Compiled by the editor with Carbon Trust from public material.

Carbon Trust Carbon Neutral Certification

Carbon Trust Certification is the world's leading independent certification body for carbon footprints and certifies organisations and products to PAS 2060.

A carbon neutral footprint is one where the sum of the greenhouse gas emissions (CO_2e) produced is offset by carbon credits. The Carbon Trust recognises any Gold Standard carbon credits. Carbon Neutral footprint certification enables you to gain an internationally recognised, fully independent measurement that can be used to communicate your product's resource efficiency, to drive sales, reduce costs and increase brand loyalty.

Certification process

Sustainability leaders

Many leading brands have had their product and organisational footprints independently certified by Carbon Trust Certification, including:

Kingsmill	Quorn
PHS	GSK
Portillo wines	Truvia

Certified product footprinting allows you to differentiate your brand and increase sales. The Carbon Trust has certified the carbon footprint of over 25,000 individual products to recognised international standards.

Universally recognised, the Carbon Neutral Footprint Label shows your customers, employees and stakeholders that you have taken steps to measure and offset the resource footprint of your product, thereby demonstrating clearly your commitment to environmental sustainability.

Certification offers real advantages

Delivering efficiencies

›› Identify carbon hotspots to improve embedded resource efficiency and save costs

›› Benchmark your environmental resource management performance against that of your portfolio and competitive offerings

Enhancing reputation

›› Enhance your green credentials and improve customer loyalty

›› Differentiate yourself as an environmentally responsible brand with an internationally recognised, independent assessment

Facilitating compliance

›› Demonstrate your commitment to resource reduction in the supply chain

›› Meet procurement requirements for more sustainable products with independently-verified environmental impact data

PAS 2060 Carbon Neutral

PAS 2060 is the internationally recognised specification for the demonstration of carbon neutrality and builds on the existing PAS 2050 environmental standard.

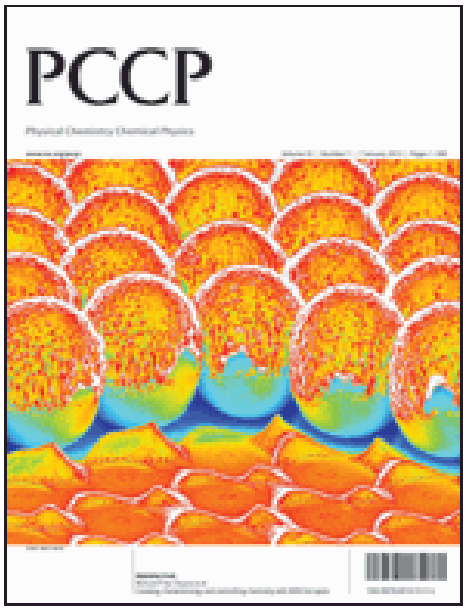
It sets the requirements to be met when seeking to achieve and demonstrate carbon neutrality through the quantification, reduction and offsetting of greenhouse gas (GHG) emissions from a uniquely identified subject or entity, be that an organisation or a product.

It requires robust measurement and a plan for achieving internal reductions and offsetting using high quality carbon credits.

Launched in 2010 by the British Standards Institute (BSI) PAS 2060 was developed with input from The Carbon Trus

For more information, please contact +44 (0)207 832 4655 or visit www.carbontrust.com/certification

Institute of Chemistry of Ireland as a Co-Owner Benefits when you publish in PCCP



Support our Institute by publishing you new research results in the prestigious peer reviewed journal.

Scope

PCCP (*Physical Chemistry Chemical Physics*) is an international journal for the publication of cutting-edge original work in physical chemistry, chemical physics and biophysical chemistry. To be suitable for publication in *PCCP*, articles must include significant new physical insights; this is the prime criterion that referees and the Editors will judge against when evaluating submissions.

The journal has a broad scope which includes spectroscopy, dynamics, kinetics, statistical mechanics, thermodynamics, electrochemistry, catalysis, surface science, quantum mechanics and theoretical developments play an important part in the journal. Interdisciplinary research areas such as polymers and soft matter, materials, nanoscience, surfaces/interfaces, and biophysical chemistry are especially welcomed whenever they include a physico-chemical approach.

PCCP is proud to be a Society journal and is co-owned by 19 national chemical societies. The journal is published by the Royal Society of Chemistry on a not-for-profit basis for the benefit of the whole scientific community.

Impact factor: 4.493*
Publishing frequency: 48 per year
Indexed in MEDLINE and Web of Science

http://pubs.rsc.org/en/journals/journalissues/cp#!recentarticles&adv

WELCOME TO MANUFACTURING SOLUTIONS 2017

Organised by the Limerick Institute of Technology (LIT) & GTMA, The Manufacturing Solutions Event is a focal point for manufacturing technologies and engineering solutions from over 70 of the most advanced providers of metrology, inspection, machine tools, workholding, cutting tools, and CAD/CAM/PLM manufacturing software and ancillary products and services.

Bringing all the leading technology suppliers together the GTMA and LIT are providing an ideal conduit for the transfer of technology from the specialist suppliers to the practical industrial landscape, where its take-up and practical application can be used to gain a competitive business advantage."

Additionally, a comprehensive programme of leading industrial keynote speakers will also be an integral part of the event

Free parking and refreshments are available to all Manufacturing Solutions visitors

About Sigma-Aldrich: Sigma-Aldrich is a leading Life Science and High Technology company whose biochemical, organic chemical products, kits and services are used in scientific research, including genomic and proteomic research, biotechnology, pharmaceutical development, the diagnosis of disease and as key components in pharmaceutical, diagnostics and high technology manufacturing.

Sigma-Aldrich customers include more than 1.3 million scientists and technologists in life science companies, university and government institutions, hospitals and industry. The Company operates in 35 countries and has nearly 9,000 employees whose objective is to provide excellent service worldwide.

Sigma-Aldrich is committed to accelerating customer success through innovation and leadership in Life Science and High Technology.

For more information about Sigma-Aldrich, please visit its website at **www.sigma-aldrich.com**

Your local contact:

Andreina Moran
Account Manager
Sigma Aldrich Ireland Ltd

086 389 8647
andreina.moran@sial.com

Open Letter from the Pharmaceutical Industry Heads of Research and EFPIA on the Relocation of the European Medicines Agency

On April 24, 2017, the European Federation of Pharmaceutical Industries and Associations (EFPIA) and a group of executives from several big pharma companies composed an open letter to the European Medicines Agency (EMA) regarding its relocation. In the letter, published on EFPIA's website, the executives expressed concern that the United Kingdom's exit, often referred to as Brexit, from the European Union would disrupt the agency's activities.

http://www.efpia.eu/mediaroom/388/44/Open-Letter-from-the-Pharmaceutical-Industry-Heads-of-Research-and-EFPIA-on-the-Relocation-of-the-European-Medicines-Agency

The EFPIA executives express concerns about the disruptive effect of BREXIT and urge a rapid decision on relocation.

"The smooth operation of the Agency relies on its ability to mobilise effectively the diverse and readily-available scientific expertise required for its effective functioning from all across the entirety of the EU Member States. Moreover, with a view to ensuring that EU regulatory procedures continue to function as designed and, at the same time, guaranteeing that the EMA's scientific committees continue to operate at the same, irrefutably high standards, the Council's deliberations on the Agency's future location need to be conducted on the basis of very essential criteria and put for decision as early on as possible, preferably at its meeting in June this year".

The letter continues:

"There must be an equally vigorous focus on retaining a highly competent staff component. Sufficient and decent housing, access to international/ European schools for staff with children, employment opportunities for spouses/ partners are also likely to be prerequisite factors for any future location selection process…..".

A Reuters report claims 21 countries, including Ireland are in contention:-

> No fewer than 21 EU member states have expressed their interest in hosting the EMA, including Italy, Denmark, Sweden, Spain, France, Ireland and Poland.

http://www.reuters.com/article/us-britain-eu-pharmaceuticals-idUSKBN17P0ZE

The EFPIA letter is signed by executives from many big pharma companies such as Novartis' Bayer Pharmaceuticals, Servier, Pfizer, Teva, Amgen, UCB Pharmaceuticals, Ipsen, Eli Lilly, Boehringer Ingelheim, AstraZeneca, MSD, Takeda, ROCHE, Merck, Johnson & Johnson, Novo Nordisk A/S, GSK, Sanofi.

The letter ends with a statement:-

"Decision-makers in Brussels should not lose sight of the common goal towards which we all work: 'the protection and promotion of public and animal health'".

According to Pharmaceutical technology in a report:-

"EMA has made no formal indication of where it plans to move post Brexit".

http://www.pharmtech.com/pharma-execs-compose-open-letter-ema-relocation-0?topic=402&CID=pteealert.1740238.PTE*%2520Pharm%2520Tech%2520Europe%2520Enews&eid=211836554&bid=1740238

Industry and Business
Promoting Manufacturing Excellence

Irish researcher leads €4.9m project to halve CO2 footprint of carbon fibre production

Posted on08 March 2017. Tags: energy, environment, Jobs, research

Researchers from across Europe, led by University of Limerick (UL), have begun a project to produce carbon fibre from forestry by-products.

Carbon fibre is a reinforcement which when added to plastic improves its mechanical properties, thereby forming a composite material. Composites are used in many products including automotive parts and wind-turbine blades. However, carbon fibre is currently produced from petroleum which is expensive and detrimental to the environment.

The LIBRE project, led by Dr Maurice Collins of the Stokes Labs, Bernal Institute at UL, aims to create carbon fibre materials in a cost-effective and more environmentally friendly way, by producing them from a naturally derived wood product called 'lignin'. It is hoped that this will allow us to move away from the reliance on fossil fuel.

The strength-to-weight ratio of carbon fibre offers excellent potential to reduce the weight of products including vehicles, with consequent saving of fuel. Currently, the cost of carbon fibre makes it prohibitive for widespread use. The LIBRE project is expected to reduce production costs sufficiently to find mass-market applications for carbon fibre. This will enable European producers to rely less on imported precursors and imported carbon fibre thereby securing an indigenous and sustainable European carbon-fibre manufacturing base.

"Together, the project partners will create new innovative materials and manufacturing processes capable of lowering the cost of end products by 30% while cutting in half the CO2 footprint of carbon fibre production," Dr Collins said.

Commenting on the project, Patrick Barrett, Department of Agriculture, Food and Marine, Ireland and National Contact Point for Bio-Based Industries said, "Dr Maurice Collins' successful award under the Bio-Based Industries Public Private Partnership is a great example of a leading Irish academic talent aligning with industry to develop high-value products from valorisation of forestry by-products. This allows for business diversification, provides opportunities for jobs, growth and investment in the Irish economy and reduces the need for fossil fuel use for product development with the use of biobased replacements such as from forestry side-streams".

LIBRE is co-ordinated by Dr Collins at University of Limerick and run in cooperation with European partners from Ireland, Germany, Sweden, Belgium, UK and Italy. The project has been awarded €4.9million in funding from the Bio-Based Industries Joint Undertaking. This grant is awarded under the European Union's Horizon 2020 Research and Innovation Programme.

Industry and Business
Promoting Manufacturing Excellence

Job losses at Nenagh plant

Posted on14 March 2017.

250 employees at the Coty plant in Nenagh are to lose their jobs when the multinational company closes its business in the town. Staff at the former Procter & Gamble site were called to a meeting last week, with the management shutting down production for the day. The company is expected to announce a phased closure of the plant over the next 12-18 months.

Coty, which makes cosmetics, fragrances, and hair and skincare products, is transferring the operations to another plant in Ashford, Kent. The Nenagh plant had been in competition with Ashford for the business and union leaders had hoped that, with Brexit looming, the Tipperary facility would have an advantage.

Coty is the company behind cosmetic brands such as Rimmel, Max Factor, Cover Girl, Calvin Klein, and Mark Jacobs, as well as Clairol and Wella products. Founded in Paris in the early 20th century, it is now headquartered in New York.

Staff will receive redundancy payments under the terms previously available from Procter & Gamble, amounting to six weeks' pay per year of service, plus two weeks' statutory redundancy.

Speaking at the publication of Coty's second-quarter financial results in February, chief executive Camillo Pane said the company still expected to make savings of $750 million by 2020 as a result of merging the Procter & Gamble business. "The integration is progressing as expected, with no major issues to date. It's fair to say this is a significant undertaking as we are both integrating and simultaneously reorganising the entire company to create the organisation we need to deliver our mission," he said.

Industry and Business
Promoting Manufacturing Excellence

IDA's new Advance Technology Building in Tralee opens

Posted on30 March 2017.

IDA's new Advance Technology Building (ATB) in the Kerry Technology Park has been officially opened by An Taoiseach Enda Kenny and Martin Shanahan, CEO, IDA Ireland. The Advance Technology building is designed to provide high quality production and office accommodation, which will be suitable for future technology or life sciences projects.

Speaking at the ceremony Taoiseach Enda Kenny said: "The Government's focus is to expand economic development across the country and into the regions. That is why we are investing resources in towns like Tralee. Our aim is to create a further 135,000 jobs outside Dublin by 2020. A continued focus on investment in skills, property and infrastructure as well as competitiveness, is required if Ireland is to replicate its past successes in FDI into the future."

IDA Ireland's CEO Martin Shanahan said: "The availability of high quality property solutions is a key component in winning Foreign Direct Investment (FDI) projects. IDA has a particular focus on regional job creation and this new Advance Technology Building will advance that aim in this region.

"IDA continues to market Kerry for investment throughout our global network of offices. Our new marketing tool – 'Invest in Kerry' – which highlights the key attributes of Kerry as a location for investment, will go live.

"From talent to property availability investors can go online and experience what Kerry has to offer. Potential Investors can hear about the experiences of companies like Fexco, Astellas, Borg Warner, JRI America and Liebherr.

"Kerry is a great place to invest. It has an existing base of overseas and indigenous companies, fantastic amenities and the Institute of Technology making it an attractive place to live and work. These attributes combined with IDA's new world class property solution, suitable for clients in the pharma, med tech, engineering or technology sectors, makes Kerry a compelling location for investment.

"Winning investment for Ireland is a Team Ireland approach. I would like to thank Kerry County Council who partnered with us on the creation of a short video on Kerry which is featured on the site. I would also like to thank the companies who gave of their time to participate in this project," concluded Martin Shanahan.

Industry and Business
Promoting Manufacturing Excellence

DCU Showcase gives companies opportunities to engage with research experts

Posted on19 April 2017.

For companies interested in innovation through R&D, the DCU Business Matchmaker and Research Showcase 2017 gives firms the opportunity to meet face-to-face with experts who are actively engaged in research that has applications across many industry sectors. The event, being held on the 11th of May in The Helix, DCU gives companies the chance to outline to research experts the challenges they are facing, explore new ideas and the various options to collaborate and fund future R&D projects. Companies with both an established R&D programme and start-ups with new ideas are all welcome to attend this free event.

Following a light breakfast, an overview of research at DCU will be delivered where attendees will hear from companies who have previously collaborated with DCU and speak about innovation. This will be followed by short, pre-scheduled, one-to-one meetings that will take place between individual DCU researchers or business development specialists and industry representatives who are interested in extending their R&D capability by working with DCU.

Companies are invited to register at www.b2match.eu/dcubusinessmatchmaker2017. At registration, companies can also create a profile of their company and their areas of interest. They will then be able to request individual meetings with DCU researchers who have expertise in their field. Additionally, firms can request meetings with other enterprises of interest.

Attendees at the Showcase will:

Learn how R&D can be funded when collaborating with DCU

Hear about DCU research capabilities available for firms to access

Meet with research experts to discuss business challenges

Find out how DCU does business

Upskill For Your Future

- **Develop your Business and Technology skills in the Pharmaceutical and MedTech Industries**
- **Gain expertise in Pharmaceutical Manufacturing, Business Improvement, Regulatory Affairs, Clinical Trials and Data Analytics**

ENROL TODAY

Roles available in the industry

- Research and Development / Formulation
- Quality Assurance / Regulatory Affairs
- Manufacturing / Supply Chain
- Pharmacovigilance
- Clinical Trial Co-ordination
- Marketing

- **BA in Pharmaceutical Business Operations (Level 7)**
- **BA (Hons) in Pharmaceutical Business Operations (Level 8)**
- **MSc in Pharmaceutical Business & Technology (Level 9)**

innopharmalabs
college of applied sciences

Innopharma Labs is an award-winning Irish technology company and the leading provider of industry led innovative education and training programs for the pharmaceutical and MedTech industries. These programs, which are delivered in conjunction with Griffith College Dublin and ITT Dublin are the number one choice for graduates and experienced professionals seeking to upskill for careers in the Pharmaceutical and MedTech sectors.

Contact Ann Ryan directly on (087) 2433847 or email: ryana@innopharmalabs.com
website: www.innopharmalabs.com
Office: (01) 4853346