09

Annual Review
and IRC Directory
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director’s Introduction</td>
<td>4</td>
</tr>
<tr>
<td>Advisory Board Members</td>
<td>6</td>
</tr>
<tr>
<td>IRC Interactions</td>
<td>7</td>
</tr>
<tr>
<td>Academic Directors</td>
<td>16</td>
</tr>
<tr>
<td>Future Research</td>
<td>17</td>
</tr>
<tr>
<td>Networking Activities</td>
<td>18</td>
</tr>
<tr>
<td>Industrial Club</td>
<td>19</td>
</tr>
<tr>
<td>Continuing Professional Development</td>
<td>20</td>
</tr>
<tr>
<td>Conferences</td>
<td>22</td>
</tr>
<tr>
<td>Centres for Knowledge Transfer</td>
<td>25</td>
</tr>
<tr>
<td>Key Contact Points</td>
<td>28</td>
</tr>
<tr>
<td>IRC Directory</td>
<td>29</td>
</tr>
</tbody>
</table>
On November 1st 2008 I became the Director of the Polymer IRC, following the departure of Tom McLeish to become Pro-Vice Chancellor for Research at Durham University. I took on the role on a part-time basis for a limited period to assist in the restructuring of the Polymer IRC and help define a future path.

The first task was to visit each of the component Universities of the Polymer IRC and talk with leading researchers and with each of the Vice-Chancellors and senior members of their executive team.

Objectives identified for the Director were to:

♦ Promote greater inter-university research collaboration,
♦ Encourage greater coherence amongst IRC members,
♦ Raise the profile of the Polymer IRC with University executive groups,
♦ Promote the benefits of the IRC to Research Councils, Industry and Government bodies.

These objectives were agreed by the newly formed Executive Group consisting of the Associate Directors from each University, Dr Barry Maunders, responsible for network development, and Helen Clancy the Executive Manager for the Polymer IRC. The Executive Group has revised the membership and terms of reference for the Advisory Board and involved younger researchers in the management of the Polymer IRC through the formation of a Research Group.

The role of the Advisory Board was defined as:

“To advise, warn and encourage the Executive Group on the current and proposed activities of the Polymer IRC in the areas of research, training and knowledge transfer. Strategic advice will be of the greatest value to the members of the Polymer IRC in formulating their future activities, thus maximising its potential to enhance and develop polymer science and technology in the UK.”

The newly formed Research Group’s remit is to:

♦ Identify areas of research strength in polymer science and engineering within the Polymer IRC.
♦ Seek out and specify possible research programmes that utilise the ability of the Polymer IRC to address multidisciplinary topics.
♦ Nominate PIs and co-Is; identify possible sources of funding; e.g. Research Councils, Charities, Government Organisations, Industry.
♦ Explore the possibilities for individual research funding; e.g. fellowships; European Research Council awards; Royal Society Research Chairs.
♦ Review the current research portfolio and comment, where appropriate, on any proposals for follow – on activities made by PIs and co-Is.

The activities of the Research Group are reported later in the Annual Review. Already two major research programmes have been identified that are particularly suitable for the multidisciplinary approach of the Polymer IRC.
Since the autumn of 2008 there has been a significant change in the prospects for research funding not only in the UK but worldwide. Loss of confidence in the business sector, together with the expenditure of public funds to maintain the banking system means that in the future money for research programmes will be more difficult to acquire. An immediate effect on the Polymer IRC was a contraction in the renewal of industrial subscriptions to the IRC Industrial Club.

A further change in the IRC’s operating environment is the identification of major research themes by UK Research Councils along with their encouragement to submit longer, larger research proposals. In addition, following the forthcoming General Election, the expectation is that funding for Universities will not increase and may be cut to reduce Government borrowing levels. It was these considerations that led the Executive Group to evolve new strategies to respond to changing circumstances.

The Polymer IRC also wanted to refresh its knowledge of what members (current and future) need from the IRC Industrial Club. The amalgamation of businesses and consequent rationalisation of activities by these larger concerns has introduced fragmentation which requires Polymer IRC members to understand the new industrial environment, in particular the increasingly global nature of industrial polymer research and development. The Networks Director, Barry Maunders, will play a key role in helping bring this understanding into the Polymer IRC. To assist in this process Helen Clancy and I have visited a number of researchers in industry to learn of their concerns and determine what the Polymer IRC can do for them.

The work over the past year has gone a long way to restructuring and refocusing the Polymer IRC in what has been a very turbulent time for both industry and academe. The Polymer IRC is now positioned to exploit new areas of research which have the potential for growth e.g. in biologically related arenas; energy research etc. Moreover, the UK Government will in all likelihood want to see the outcomes from research move more rapidly from the laboratory bench to the market place. The Polymer IRC is well suited to such tasks with its reputation for high quality research allied to an efficient network of industrial contacts and supporters.
Advisory Board Members

Dr David Bott (Technology Strategy Board, Chair)
Dr Andrew Bourne (EPSRC)
Dr David Farrar (Smith & Nephew)
Professor Ray Hudson (University of Durham)
Professor Richard Jones (University of Sheffield)
Dr Rudy Koopmans (Dow)
Professor Kurt Kremer (Max Plank Institute)
Professor Jimmy Mays (Tennessee)
Dr Peter Mills (Cytec Engineered Materials)
Professor Mike Wilson (University of Leeds)
Professor Alastair Wood (Bradford University)
Dr David York (Procter & Gamble)
IRC Interactions

A Molecular Search For Happier Skin

Leeds scientists are collaborating with Unilever R&D to tackle the question of what makes skin feel good, and why.

The research is coordinated at the University of Leeds by Professor Peter Olmsted, who is bringing atomic force microscopy, computer simulation and theoretical physics to bear on the problem, within a larger collaborative project led by Dr Massimo Noro at Unilever R&D Port Sunlight. The aim is to design better skin products that appeal to consumers by working well - and making them feel good too.

Peter Olmsted will examine the properties of the lipid bilayers that are found in the stratum corneum membrane, the outermost layer of skin which is just 50-100 microns thick - about a tenth of the thickness of a sheet of paper. The Leeds team, which also includes Dr Simon Connell, will concentrate on understanding how the extremely complex composite structure of skin gives it its unique properties of strength and elasticity. Scientists will be able to construct a profile of the skin lipids that is accurate up to a millionth of a millimetre. The team will use this information to carry out experiments and make theoretical calculations that model how skin behaves at a molecular level to the ingredients of personal care products, from simple water molecules to complex oils. In examining the science of these membranes the team hopes to come up with design rules for products that work better and are more appealing to the person who is using them. They will be testing the various ingredients used in these products to see what effects they have. Their wish is to link these effects to the science of the mechanics and permeability of complex membranes.

As skin grows from the inside of the body towards the outside, cells are pushed to the surface layers of the skin. They over-express certain proteins that form mechanical "bricks", held together by a "mortar" made of special lipid molecules called ceramides, in a form that only exists in skin. The research group is interested in how the special features of these molecules contribute to the elastic, strong, and supple object that is skin.

The project is funded by regional development agency Yorkshire Forward and Unilever R&D. A further award of £2 million has recently been made which also involves the Universities of Bradford and Hull.

Further information:
Peter Olmsted, Leeds,
email: p.d.olmsted@leeds.ac.uk
Massimo Noro, Unilever,
email: massimo.noro@unilever.com
Spin coating is a widely used tool in the manufacture of very smooth and very thin polymer films. For example, it is routinely used on a massive scale for making integrated circuits and colour filters for liquid crystal displays. It is likely to be a centrally important processing step in the emerging field of polymer electronics.

The most common situation is the spin coating of a polymer solution (a polymer dissolved in a solvent). A flat disc, which has been flooded with the solution, is rotated at speeds of up to 10,000 revolutions per minute. This results in a uniform coating of solution. The solvent then rapidly evaporates to leave a very smooth and high quality film of pure polymer.

A more complicated situation, that has great technological potential, occurs when two polymers are spun from a common solvent. Most chemically different polymers do not like to mix, but if diluted enough in a solvent favourable to both polymers a mixed solution forms. However, the two polymers will separate from each other as the solvent evaporates.

Significantly, this can result in a wide variety of microstructures in the final films. These can range from two well defined layers to situations in which lateral phase separation takes place on a variety of length-scales, from nanometres to many micrometres. In thin films of, for example, semiconducting polymers used in light emitting diodes and photovoltaic devices, the device efficiency depends critically on the microstructure. Hence, if one understands how to control the microstructure, one can achieve an optimised film in a single, inexpensive processing step.

Further information: Nigel Clarke
email: nigel.clarke@durham.ac.uk
High-efficiency Block Copolymer Solar Cells: A Scaleable Prototype for Low Cost Energy Generation

Mike Turner, Stephen Yeates & Brian Saunders, University of Manchester; Jenny Nelson and Saif Haque, Imperial College; David Lidzey, Anthony Ryan and Ahmed Iraqi, University of Sheffield; Nigel Clarke, Durham University.

EPSRC Funded Research

Widespread implementation of photovoltaic electricity to meet changing energy demands requires a step-change in the cost of photovoltaic power. This programme assembles a consortium of chemists, physicists and materials scientists from Imperial College London and the universities of Manchester, Sheffield and Durham to produce new prototype polymer solar cells that have high power conversion efficiencies and could be mass produced cost effectively.

The work proposes new polymer solar cell designs that integrate flexibility with inexpensive materials and solution based processing. In one approach, block copolymers are used to direct formation of nanostructured thin films to provide high efficiency polymer solar cells. In a second approach, block copolymers will be used to direct crystallisation within nanostructured films.

Independent optimisation of the optical and electronic properties, together with theoretical modelling input, will provide design rules for maximising power conversion efficiency. The project will establish strategies for scaling up the device designs which have the highest efficiencies. Our objective is to construct affordable and scaleable polymer solar cells that have an energy conversion efficiency of at least 7%.

Further information: Nigel Clarke
email: nigel.clarke@durham.ac.uk
DYNACOP—Dynamics of Architecturally Complex Polymers

University of Leeds, Forschungszentrum Jülich, Foundation for Research and Technology Hellas, Universidad del Pais Vasco/Euskal Herriko Unibersitatea, Universiteit Twente, Universite Catholique de Louvain, Technical University of Denmark, Universita degli Studi di Napoli Federico II, National and Kapodistrian University of Athens, University of Durham, DOW Chemicals, BASF

EU Funded Research

This is a new Framework 7 Marie Curie Initial Training Network, involving ten universities and two industrial companies across Europe.

The scientific objective of DYNACOP is to obtain a fundamental understanding of the flow behaviour and the dynamics of blends of topologically complex macromolecular fluids and their role in processing and properties of nanostructured blends. These materials exhibit complex dynamics and rheology and, in many cases, show hierarchical relaxation over many different timescales. This in turn affects the processing and properties of the final materials. Such fluids include branched low density polyethylene, which is a fundamental material that appears in plastics of all forms. The processing of these materials, and the relation to properties, has frustrated and encouraged industry for many years: a simple recurring problem is instability in extrusion that leads to imperfect plastic parts, with costly results. The ability to predict and control this behaviour as a function of molecular chemistry has attracted a long history of collaboration between academia and industry.

In order to rationally design appropriate materials and processes for various technological applications, a rigorous, knowledge based approach is needed. This is especially urgent in face of the current opportunities offered by tailored molecular engineering of polymers at the industrial scale, and the proposed use of these materials in nano-structured composites for smart applications in devices, electronics, and high performance applications. The training objective of the ITN is to provide young post-doctoral researchers with the necessary interdisciplinary knowledge and experience in the field of soft-materials properties, which will allow them to address some of the many scientific and technological challenges in the field. This will first and foremost be achieved through a collaborative research programme and portfolio of training courses intimately linking industry and academia. To ensure fruitful collaborations, the participating research groups will work around a limited number of model systems; exchange the samples and apply to them the techniques and/or theoretical approaches developed in the different laboratories. The research groups are selected to obtain the needed synergy, as they have different backgrounds/expertise, in physics, chemistry and materials science. Very high profile international visiting scientists will bring their expertise to Europe to participate in the training and research.

Further information: https://eudoxus.leeds.ac.uk/dynacop
Innovation in Industrial Inkjet Technology
University of Cambridge, University of Durham, University of Leeds, Industrial Consortium

EPSRC Funded Research

A cross-disciplinary consortium of the Universities of Cambridge, Durham, Leeds and a group of nine companies, including the major players in the UK inkjet sector, have received a grant of £5 million from EPSRC to extend the benefits of inkjet technologies. The award will support a five-year programme of research to study the formulation, jetting and deposition of specialist printing fluids, and develop an overall process model. The work will improve the robustness of industrial ink-jet printing and help companies develop new applications for the technology.

Inkjet printing already dominates the desktop printing market. In commercial printing, it is rapidly becoming established for short-run applications and has, in only a few years, conquered a market previously occupied by conventional screen printing equipment, where its greater flexibility and inherent scalability give significant advantages. Further applications for ink-jet technology exist in the manufacture of high-value, high precision products such as flat-panel displays, printed electronics and photovoltaic cells for power generation.

The programme will consider three themes focused on key aspects of the industrial inkjet process: the formulation, rheology and jetting behaviour of colloidal printing fluids; understanding and controlling dynamic micro-scale drop impact, spreading and fixing; and development and validation of an advanced process model for industrial inkjet. Within these themes the team will develop: a theoretical and practical understanding of how to make stable high solid-content colloids suitable for inkjet deposition, and how they behave in an inkjet system and on the substrate; explore post-impact processes that determine the structure and functionality of the printed features, including surface morphology, chemistry and surface treatment, fluid dynamics of wetting and the interaction of successively printed materials; and develop a set of models, validated by precise measurements and underlying physical theory, to describe all aspects of the formation and ultimate fate of inkjet drops.

Further information: Oliver Harlen

email: o.g.harlen@leeds.ac.uk
Microscale Polymer Processing (µPP)


EPSRC Funded Research

One of the MuPP industrial collaborators summed up the enormity and ambition of the project when he called it “turning the polymer materials design arrow the other way around”. Instead of developing commercial materials empirically, we have delivered to industry the molecular rules to design and engineer the molecular mix of macromolecules with process targeted. Using the tools such as REPTATE and FLOWSOLVE have helped the project partners create new products, and short-circuited the design process of blends. The Cambridge MPR is now on the way to becoming a standard “bridge-building” instrument between laboratory and process. Concurrently with this applied programme, the very act of doing it has unearthed fundamental new science in both theory and experiment. The system of bimodal blends has proved wonderfully rich, and a paper in preparation displays the astonishing result that for a material as complex as the highly-branched low density polyethylene, we can actually show the connection between the chemistry and the rheology quantitatively. Melt flow predictions now include anticipating where and how polymer crystals will first form, and capture the delicate tracery of stress between particles embedded in a polymer flow.

Tom McLeish.

µPP was funded by EPSRC and Industry sponsors and brought together over 30 scientists from eleven major UK and international Universities: Leeds, Bradford, Durham, Cambridge, Sheffield, Reading, Oxford, UCL, Nottingham, Virginia Tech and TU Eindhoven, with industrial collaborators from BASF, Dow, DSM, LyondellBasell, ICI, Ineos, Lucite International and Mitsubishi.

Key Outcomes

♦ Development of advanced polymer theory software (REPTATE) and computational modelling software (FlowSolve)
♦ New chemistry for novel branched polymer molecules
♦ Prediction of chemical synthesis rules from bulk polymer properties defined by end users
♦ Processing of minute quantities of expensive materials
♦ Development of sophisticated instruments to measure structural changes in flowing polymer melts
♦ Knowledge Transfer activities
Computational Modelling - FlowSolve

FlowSolve is an advanced Computational Fluid Dynamics (CFD) software, developed at the University of Leeds, for the analysis of polymer processing and hosts a library of molecular polymer melt models. FlowSolve is capable of visually predicting process features of plastic melts that depend on their specific molecular structure.

Rheology Characterization – REPTATE

REPTATE software is uniquely suited to understand the molecular structure of polymers via easy-to-do rheology measurements and advanced molecular theories. It has potential applications in understanding batch to batch variability and designing new polymers for a given target application.

Bottom up prediction – REACT and BoB

♦ “React” software predicts molecular shapes from reaction chemistry
♦ “BoB” (for “Branch-on-Branch) predicts flow characteristics of arbitrarily branched polymers (http://sourceforge.net/projects/bob-rheology)

Knowledge Transfer

Our aim is to guide improvements in complex material handling and processing, and to help in the development and production of novel plastic products for specialized applications.

Working with SMEs

Development of new polymer materials is now increasingly sophisticated and designed with many molecular parameters in mind. However their processing is still more an art than a science. We are therefore keen to work with SMEs in delivering our advanced scientific tools. Some of the benefits are:

♦ Savings in cost and reduction of down-time
♦ Considerable reduction in time-to-market.
♦ Improved product quality.
♦ Increased knowledge assurance.
♦ To enable SMEs to secure niche markets.

μPP Showcase Event

We plan to hold a showcase event during 2010. This will be a highly interactive event, including discussions of a shared research agenda and a chance to formulate future project plans.

Further information: Suneel Kunamaneni

email: s.kunamaneni@leeds.ac.uk
Science Bridges Award
University of Bradford/China

RCUK Funded Programme

The programme focuses on the development of products aligned with the strategic priorities of both the Chinese and British governments in their respective health delivery policies and associated industries (e.g. diabetes, infection control, traditional Chinese medicine (TCM) and medical devices). Its overall purpose will be to provide effective solutions to these needs. Outcomes are expected to be new therapies, enhanced biomaterials and medical devices, and the application and validation of processes to accelerate the discovery and commercialization of new drugs/ medical devices.

We have two major themes: Pharmaceutical Sciences and Medical Technology. In the first theme, emphasis will be placed on Traditional Chinese Medicine, and in the second theme, materials for biomedical applications, and related devices. All the programme activities will involve Bradford-based teams (strengthened by other UK universities, Health Services and companies whenever appropriate) and identified leading Chinese universities and organisations. Building on existing strong links between the University of Bradford and Chinese academia, we aim to accelerate product invention, design, and development through stimulating open innovation between the UK and China, for Pharmaceutical Sciences - particularly drug discovery and delivery - and Medical Technology, meeting aligned needs of the UK and China. This will be addressed by three main activities: (i) an Open Innovation project scheme to develop prototypes and products, (ii) reciprocal training programmes based on the two themes, and (iii) developing state-of-the-art knowledge and commercial networks. We will also provide means for managing exploitation of the outcomes.

Each theme is associated with leading research and KT areas in Bradford: Pharmaceutical Sciences and drug discovery & development and Advanced Materials Engineering. Over the past 2 years these groups have developed an exciting third area of combined research, Healthcare Technologies - including a recent joint Chair in Pharmaceutical Engineering Science, and collaborative research and commercialisation projects. All three R&KT areas have extensive but developing (and sometimes connected) links with leading Chinese Universities and co-operative organisations such as Medilink Y&H Ltd, which is taking a major lead on behalf of UK Trade and Industry on health technology partnerships with China, to help regional high technology companies, including SMEs, develop opportunities and products.

Further information: Phil Coates

email: p.d.coates@bradford.ac.uk
This EPSRC-funded (£227k) People Collaboration programme, focused on developing polymer engineering co-operations with academics in China, Japan, Taiwan and Korea. Led by Phil Coates, interactions started with strategy plus technical meetings with Chinese academics in Shanghai in July 2007, which surveyed leading polymer engineering-related groups in China. This was followed by meetings in Chengdu (State Key Laboratory for Polymer Materials Engineering), Beijing (Institute of Chemistry, Chinese Academy of Sciences) and Tokyo in May 2008.

At PPS-24, Salerno, June 2008, there was opportunity to meet with colleagues from the participating Far East countries, to discuss collaboration in micromoulding, nanocomposite structuring and processing of modified polymers. This complemented Phil Coates’ visit to Taiwan, in conjunction with IUPAC Macro2008, which included a laboratory visit to the fluid-assisted moulding centre of Prof Liu. In July 2008, there were visits to four institutions in Beijing (Beijing University of Chemical Technology, ICCAS Beijing, Sinopec Beijing Research Institute and Tsinghua University). Leeds IRC colleagues have been involved in cooperative visits to Japan including Frederico Roschztardtz on a 6 month placement with Prof H Watanabe at Kyoto University, and China.

The VIPps UK meeting was held during September 2008, coinciding with the UK Polymer Showcase conference. 27 Chinese academics attended from Sichuan University, ICCAS, and Shanghai Jiao Tong University. Technical meetings between invited Chinese and IRC academics were held for two days in Bradford. Three academics from Sichuan came to Bradford for 2 weeks for cooperative research studies in our laboratory, with a view to building more substantial programmes (picture 1). Prof Koyama (Yamagata University) came to Bradford during February 2009. Further international contacts were developed at PPS-25 in India in March 2009 and the VIPps UK technical meeting was mirrored by one in China with 17 UK attendees and over 50 Chinese academics presenting their research (picture 2). The Polymer IRC was well represented by speakers including Nigel Clarke (Durham), Xiaosong Wang and Chinmay Das (Leeds) in addition to Bradford speakers. During the visit Phil Coates was made an Honorary Professor at Beijing University of Chemical Technology.

Academic and industrial activity in China is developing rapidly, so these co-operations have been both timely and strategic. In general the polymer industry has limited experience of R&D, although there is a trend by major polymer manufacturers to establish new laboratories in Beijing. Japanese polymer groups are strong, with an established industry base, so the nature of our interaction is more ‘one to one’. The VIPps programme has received an extremely warm welcome, and has generated many new opportunities upon which we are now building. We are grateful for the very strong support for VIPps in each of the collaborating institutions.

Further information: www.polymervip.com

email: p.d.coates@bradford.ac.uk
Professor Steve Armes  
University of Sheffield  
s.p.armes@sheffield.ac.uk

Dr Nigel Clarke  
University of Durham  
nigel.clarke@durham.ac.uk

Professor Phil Coates  
University of Bradford  
p.d.coates@bradford.ac.uk

Professor Peter Olmsted  
University of Leeds  
Executive Group Chair 2010  
p.d.olmsted@leeds.ac.uk
Polymer IRC Research Group

To ensure that the Polymer IRC is alert to new opportunities and aware of new areas of research that we could break into, a research group has been formed from emerging talented academics from across the four member universities.

The tasks of the group include:

♦ The identification of areas of research strength within the Polymer IRC;

♦ Seeking out and specifying possible research programmes that utilise the ability of the Polymer IRC to address multidisciplinary topics. If there is a gap in the abilities available within the IRC, the group will identify collaborators who are willing and able to participate in the programme;

♦ The nomination of Principal investigators and Co-investigators;

♦ The identification of suitable sources of funding;

♦ Exploration of possible areas of individual research funding such as fellowships and Royal Society Research Chairs;

In the past year the Research group have met to collate the portfolio of skills across the IRC. From this they have identified a number of broad research themes that may be suitable for large collaborative research programmes. The research group organised workshops in the areas of Nanocomposites and Biopolymers and the results of these days are being developed into multidisciplinary proposals.

Research Group Membership

Dr Mark Geoghegan (Sheffield)

Dr Tim Gough (Bradford)

Dr Lian Hutchings, Chair (Durham)

Dr Daniel Read (Leeds)

Further information: Lian Hutchings

email: l.r.hutchings@durham.ac.uk
External networking is one of the many interactions that are undertaken by the Polymer IRC to raise the profile of the expertise and skills that are available within the university groups. The Knowledge Transfer Networks (KTNs) funded by the Technology Strategy Board have been established to help businesses innovate by bringing together and supporting companies and innovators.

A significant activity for the IRC during the past year has been the delivery of seven further Foresight Workshops for the Polymer Sector (formally Polymer Innovation Network node) of the Materials KTN. The management, organisation and delivery of the workshops was handled by Steve Morris. The delivery of the workshops benefited greatly from the very generous support from individual members of the Polymer IRC who not only attended but also helped with the facilitation. In turn this exposed the Polymer IRC to several new, often small, companies for the first time and led to opportunities to be involved in potential projects arising from the workshops. In addition to working with the Materials KTN, Dr Ahmed Iraqi of the Polymer IRC was invited by the UK Displays and Lighting KTN to present at a Taiwanese mission held in the UK.

The EPSRC is a major partner for the Polymer IRC. Maintaining the profile of the Polymer IRC within EPSRC has taken place in a variety of ways including attending EPSRC events and one-to-one meetings. Reorganisation within EPSRC has seen the disappearance of a specific Programme for Materials. The new Physical Sciences Research Programme is most relevant for Polymer IRC interests and discussions have been held with the Head of Programme, Andrew Bourne, who is now a member of the Polymer IRC Board. The Polymer IRC Director, Randal Richards, met with the EPSRC Directors after the reorganisation to explore their views on how the Polymer IRC could look to the EPSRC for support in ensuring the IRC thrives and delivers for the UK. Discussions have also been held with EPSRC’s John Baird, Head of Knowledge Transfer.

There are of course many other examples of external networking that we are all involved in, formally or informally, which raise the profile of the Polymer IRC; the ones described here are just a flavour. As people change and organisations revise and tune their strategies our challenge is to keep them aware of the Polymer IRC and our developments. For example, the KTNs have recently undergone significant changes as they enter into contracts with the Technology Strategy Board for the next 3 years, involving mergers, new management and revised business plans.

Barry Maunders
Network Development Director

email: b.maunders@leeds.ac.uk
**Our Industrial Club**

A major aim of the IRC is to build strong relationships with the industrial community. An Industrial Club Network Member can:

- access the research, technical development, knowledge transfer and enterprise activities of internationally recognized experts through a single gateway;
- network with other researchers to gain understanding across disciplines to develop new thinking and approaches;
- plug into technical and scientific developments at an early stage;
- convert networking opportunity into technical innovation;
- gain interdisciplinary understanding and develop new thinking and approaches;
- take advantage of opportunities to identify potential industry recruits from networking with academic researchers.

**Partnership**

The IRC can provide assistance to a diverse range of industries including (but not limited to) those involved in the production of plastics, elastomers, man-made fibres, adhesives, composite materials, surface coatings, food, packaging, personal care and medical sectors. Academics in the IRC network actively engage with industrial members, providing opportunities to develop first-class working relationships with internationally recognised experts. Regular meetings encourage the development of a common language and the sharing of skills, knowledge and technology necessary for successful innovation in polymer science and technology.

Exchanging ideas with other professional researchers in this way allows industrialists and academics to develop a better grasp of each other’s needs, encouraging the conversion of networking opportunities into technical advances.

The wide range of core expertise includes:

- polymer synthesis;
- polymer self-assembly;
- molecular modelling;
- computer modelling of processing and products;
- materials characterisation;
- polymer processing.

The IRC can tackle almost any polymer related challenge, including nanotechnology, the control of polymer process and production, energy efficiency, polymers in electronic devices, biopolymers and medical/biomedical applications.

There are three levels of membership available to suit companies’ needs.

**Further information: Helen Clancy**

email: h.e.clancy@leeds.ac.uk
Modular Training Course

43 delegates, evenly split between industrialists and academics, attended the IRC modular courses in Autumn 2009, at the Novotel in Sheffield. Feedback from the courses indicates that, once again, delegates were very impressed with the depth and content of the training provided.

This year the training portfolio was expanded to match market demand by introducing a module on Organic Electronics to the course programme. This gives an overview of the design, preparation and uses of organic conjugated polymers and oligomers in the electronics industry.

The new module complements the established course which already covers a wide range of topics including polymer engineering, physics, chemistry, biomaterials and nanotechnology.

Programme

♦ Basic Polymer Science Part I - Synthesis Properties and Processing
♦ Basic Polymer Science Part II – Characterisation and Analysis
♦ Polymer Chemistry
♦ Polymer Engineering
♦ Polymer Physics
♦ Multiphase Polymer Materials and Composites
♦ Organic Electronics – Synthesis, Properties and Application in Devices
♦ Polymeric Biomaterials
♦ Introduction to Polymer Nanotechnology
♦ Polymer Dynamics and Macromolecular Rheology

Delegates can choose to take part in as many or as few of the modules as required and each participant receives a personalised set of electronic and bound course notes. The 10-day programme is run annually during the last week of October and first week of November.

High demand for Basic Polymer Science I and II has led to them being repeated in the Spring for the past two years. The courses are aimed at those who interact with polymer scientists, either as a customer, supplier or within a research and development team, providing the basic skills that allow delegates to understand more about how products and/or processes work.

Further information: Shelagh Cowley
email: s.h.cowley@sheffield.ac.uk
Workshop Programme

The Polymer IRC has delivered a series of foresight workshops and technology alerts on behalf of the Polymer Sector (previously the Polymer Innovation Network node of the Materials KTN).

The Workshops

The themes for the workshops were developed in consultation with Polymer IRC staff, PIN Board members and IRC Industrial Club members to ensure the inclusion of topics with industrial relevance.

The topics were prioritised and merged with topics suggested by PIN Board members to create a final list of workshop themes.

The 8 workshops agreed and delivered were:

♦ New Frontiers in Polymer Waste Management
♦ Polymers to ‘Lighten the Load’ in Transport
♦ Polymers and ‘Plastics in People’
♦ Polymers and ‘Building Blocks’ in Construction
♦ Polymers to ‘Light up Life’ (Polymer Electronics and Battery Technology)
♦ ‘Polymers that Help Themselves’ (Self-Healing/Self-Cleaning Polymers)
♦ ‘Clever’ Polymers (Smart Packaging and Labelling)
♦ Polymers and ‘The Real Crystal Ball’ (Building Polymers by Molecular Design).

Outcomes identified to date for specific workshops are:

**Polymers and New Frontiers in Waste Management**
An integrated UK-based plastics recycling plant.
Advanced construction composites from recycled plastic containing materials.
Regional plastics recycling infrastructure.

**Polymers to “Lighten the Load” in Transport**
A major car manufacturer and a global research company are collaborating to develop lightweight sound deadening materials for automotive applications.
The National Non-Food Crops Centre has developed a new thematic working group with Materials KTN focusing on polymers from natural/renewable sources.

**Polymers that Help Themselves**
A potential application was identified for Sheffield University’s self-healing technology.

**Polymers and “The Real Crystal Ball”**
The Polymer IRC and Napier University have held discussions with Napier offering to help with dissemination of knowledge developed in the MuPP programme in a way that SMEs will be able to use to enable them to be more productive.

The reports from the workshops can be found on the Materials KTN website:

http://amf.globalwatchonline.com/epicentric_portal/site/AMF/menuitem.402fde7a047b645a4391fa108380e1a0/

Please note you must register with the Materials KTN to view these pages.
The 2008 UK Polymer Showcase was held in York at the National Science Learning Centre. Along with a round up of current IRC research projects, sessions addressed four topical research themes. Polymers in medicine looked into how microstructural design of materials creates biocompatibility. Advanced Polymer Waste Management examined naturally sourced polyurethanes alongside the bulk reprocessing of mixed plastic waste. Polymers for Sustainable Energy examined organic photovoltaics for large-scale solar energy harvesting and Polyolefins—The Next 50 Years, looked at the future for this particular polymer on the 75th anniversary of its invention.

Science, Education and the Media were brought together, with Radio presenter Quentin Cooper putting forward his views on how the public perceived science and scientists. John Holman, Director of the National Science Learning Centre, emphasised the need for excellence in science teaching in the UK and the importance of communicating what was happening in science to the wider community was emphasised by Tom Sheldon of the Science Media Centre.

The 2008 meeting was particularly pleased to host a delegation of 24 scientists from China. Their presence at the meeting was made possible by the IRC’s EPSRC funded Virtual Institute-Polymer Process Structuring grant which aims to develop co-operations with fellow polymer scientists in China, Japan, Taiwan and Korea.

The meeting had a truly global feel, with delegates attending from Korea, Japan, China, USA and Europe.

The meeting also saw Professor Phil Coates, IRC Director at Bradford University, present the Institute of Materials, Minerals and Mining’s 2008 Swinburne Lecture, before receiving the award from IRC founder member, Professor Ian Ward.

Further information: www.polymerirc.org/PolymerShowcase

email: polymer.showcase@leeds.ac.uk
Polymers in Sport: A Success Story

The development of polymeric materials, fibres and coatings has contributed directly to improvements in performance and is vital in safety applications in sports as diverse as formula one racing, track and field and swimming, with uses in clothing, footwear, surfaces and all types of vehicles. The 2009 UK Polymer Showcase demonstrated how advances in polymer science and technology are being applied in sports to add competitive edge, help protect participants from injury, aid damage repair and bring winter sports closer to home.

The programme opened with Dr Andrew Lynn of Orthomimetics taking a look at developments in the design and manufacture of regenerative medical implants and minimally invasive delivery systems for the treatment of sports injuries and other conditions that affect articular joints. This was followed by Dr Aileen Crawford from the University of Sheffield, describing the regenerative medicine approaches and tissue engineering techniques being utilized to provide cartilage and bone grafts to replace or regenerate defective cartilage, delaying the need for joint replacement.

The second session focussed on advanced clothing and footwear. Cath Rogan of the Smart Garment People demonstrated how nanomaterials could be incorporated into clothing for sports and personal protection. Neil Hopkinson (Loughborough University) described how rapid manufacturing techniques which require no tooling could be used to make sports footwear, reducing manufacturing costs.

The meeting moved on to consider developments in winter sports. Jonathan Philby described how Bradford University and Briton Engineering had worked together to improve the artificial ski slope surface “Snowflex”, enabling ski fanatics to reduce their carbon footprints by practising their sport at home. Peter Styring (Sheffield University) explained how the advanced engineering in the Wildfire system for self-waxing skis could give competitive advantage and how this was entwined with sports regulation.

Mark Preston of Formtech Composites Ltd continued the speed theme in looking at the development of advanced polymer composites that could deal with the harsh environment of Formula 1 racing cars and how developments in this field affect industries such as aerospace and automotive manufacturing. Finally, Peter Hine (Leeds University) looked at the challenges of creating new generation single polymer self-reinforced composites and how these materials offered new opportunities for manufacturers.

In addition to insights into how advances in materials science were currently being applied in sports related industries, the speakers shared their visions and wish lists of how future advances might be harnessed by sportsmen and women, leaving the audience with food for thought on where they might contribute.

Further information: www.polymerirc.org/PolymerShowcase
Polymer Process Engineering 09
A polymer micro and nano technology focus

The biennial Polymer Process Engineering international meeting was held in the Norcroft Conference Centre, Bradford on 27th & 28th October 2009, organised in association with the Polymer Processing & Engineering Committee of the Polymer Society, Institute of Materials, Minerals and Mining and supported by the European Union FP7 programme (COTECH) and Nanofactory, a European Regional Development Fund initiative, both of which focus on polymer nanocomposites. PPE09 was hosted by the Polymer IRC laboratories, School of Engineering, Design & Technology at the University of Bradford.

The two day event was very well attended (ca. 100), with an international range of participants, and covered process, particularly injection and extrusion technology, monitoring and simulation developments, as well as a major focus on polymer nanocomposites and micro & nano technology developments. The well received key note presentation was given by Professor Ian Ward on the orientation processing of polymers. Medical applications of polymer process innovation were emphasised with the use of polyetheretherketone for long term implantable medical devices, which have a better mechanical properties match to bone, for structural use in areas such as spinal and orthopaedic applications, and the use of hot melt extrusion for enhancing the solubility of drugs.

A significant range of polymer micro and nano technology presentations formed the major part of the conference. These included precision moulding studies, including surface replication, proactive stimulation of stem cell development by surface structures, a dental root canal product, and microfluidics system moulding; novel techniques and products for two-component micromoulding and in-process thermal measurements and optical evaluations; validation of modelling, and strategies for accelerating innovation.

During the event, the launch of the new Polymer Micro and Nano Technology Centre at Bradford (a £1.4m investment) was celebrated.

During the coffee and lunch breaks opportunity was available for participants to network and visit the exhibitors, which included equipment suppliers Rondol, Battenfeld, Thermo Fisher and Desma, and the various Nanofactory partners. The last sessions on both days were used to provide laboratory demonstrations for the participants in the Polymer IRC / Polymer MNT Centre. Overall the 2 days were very successful with a great mix of presentation, networking and practical demonstrations. The conference papers are available in a hardbound book – Polymer Process Engineering 09, Enhanced Polymer Processing, Edited by P D Coates (ISBN 13 978 85143 262 2).

Phil Coates

www.polyeng.com
The Polymer Centre

The Polymer Centre represents approximately 40 academic staff and their research groups active in seven departments across the University of Sheffield. Managed by Dr Liam Sutton, the Polymer Centre staff co-ordinate a range of training and technology opportunities for industry and other external partners, with a particular focus on shorter term interactions key to building the strong relationships necessary for successful, longer term collaborations.

The Polymer Centre provides a single-point-of-contact access to all aspects of polymer science and technology at the University of Sheffield, managing relationships and projects with a focus on clients and commercial expectations.

Polymer Centre Review of 2009

Further information: www.polymercentre.org.uk
email polymers@sheffield.ac.uk

FaraPack Polymers Ltd

FaraPack Polymers provides industry with technical expertise and problem solving capabilities in all areas of polymer science. It undertakes short to medium term proof-of-concept and trouble-shooting work in the area of polymer materials supported by the expertise and facilities of the Polymer IRC.

Specialising in short to medium term projects of a few days through to several months, it can meet the polymer research needs of both industry and academia by:

- Utilising FaraPack Polymers’ in-house scientists
- Hiring academic and post-doctoral research staff from within the Polymer IRC
- Utilising state of the art facilities available at the four universities

Further information: www.farapackpolymers.com
email: enquiries@farapackpolymers.com
The N8 Molecular Engineering Translational Research Centre
“The Science of Everyday Things”

METRC is a virtual lab pooling expertise from leading research centres across Universities in the North of England. Our focus is on soft nanotechnology and its applications in UK industry. Together, we deliver the strategic R&D services needed to drive the research agenda and stimulate economic growth.

What we do

We make it possible for academic and industry researchers to work alongside each other to deliver research into innovative new projects. Our combined strength means we can tackle challenges and capitalise on opportunities beyond the scope of any one partner.
We build networks and foster partnerships, enabling people to work together towards a common goal. We undertake fundamental and applied R&D with our industry partners and help them to secure funding for these purposes.

How we do it

Our research is focused on translation to industry. We target markets where our knowledge and technology can make an economic impact and benefit society.

The benefits for industry

- Shared risk and reward on translational projects
- Ability to build wider multi-partner projects and networks
- Opportunity to help direct and focus research agendas
- Insight into new commercial opportunities
- Early access to new technology developments

Further information: www.molecular_engineering.co.uk
email: METRC@shef.ac.uk
Polymer CIC

Making Knowledge Work, by Research Excellence
Applied to Industrial Needs

The Polymer CIC, in the world-class IRC polymer engineering laboratories at Bradford University, is a centre of research excellence for advanced materials processing, especially polymers, and computer modelling of processes and products, plus material and product characterisation. It offers R&D solutions, long and short-term projects for companies of all sizes, and a gateway to its extensive networks of companies and academic groups. It aims to help companies with their R & D, regardless of size or location.

The Polymer CIC is of particular interest to businesses operating in full, or in part, in the following areas:

- Raw materials—polymers, compounds, additives
- Process—trade processors and technology suppliers
- Applications—processing polymers in-house to manufacture products for sale
- Associated areas—supply chain i.e. those using polymers in their products

Further information: www.polycic.com
email: j.c.mcgrath@bradford.ac.uk

Centre for Micro and Nano-Moulding

Recent advances in micro and nano-technology are realising devices with a huge range of applications in the telecommunications, biomedical and automotive sectors. Micromoulding has emerged as a technique for micro-device and nano-scale surface feature manufacture, which offers all the benefits of conventional injection moulding such as high production capacity at low marginal cost.

The laboratory has been internationally recognised for pioneering research in the micromoulding field for over half a decade. Insights gained over this period have provided an impressive range of techniques and knowledge which can be applied to future challenges, including materials development and characterisation, process troubleshooting and product development for emerging markets.

Further information: www.microandnanomoulding.com
email: b.r.whiteside@bradford.ac.uk
# Key Contact Points

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Steve Armes</td>
<td><a href="mailto:s.p.armes@sheffield.ac.uk">s.p.armes@sheffield.ac.uk</a></td>
<td>+44 (0) 114 2229342</td>
</tr>
<tr>
<td>Director, University of Sheffield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Simon Butler</td>
<td><a href="mailto:simon.butler@sheffield.ac.uk">simon.butler@sheffield.ac.uk</a></td>
<td>+44(0) 114 2229450</td>
</tr>
<tr>
<td>Manager METRC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mrs Helen Clancy</td>
<td><a href="mailto:h.e.clancy@leeds.ac.uk">h.e.clancy@leeds.ac.uk</a></td>
<td>+44 (0) 113 3433856</td>
</tr>
<tr>
<td>Executive Manager Polymer IRC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Nigel Clarke</td>
<td><a href="mailto:nigel.clarke@durham.ac.uk">nigel.clarke@durham.ac.uk</a></td>
<td>+44 (0) 191 3342069</td>
</tr>
<tr>
<td>Director, University of Durham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor Phil Coates</td>
<td><a href="mailto:p.d.coates@bradford.ac.uk">p.d.coates@bradford.ac.uk</a></td>
<td>+44 (0) 1274 234540</td>
</tr>
<tr>
<td>Director, University of Bradford</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miss Shelagh Cowley</td>
<td><a href="mailto:s.h.cowley@sheffield.ac.uk">s.h.cowley@sheffield.ac.uk</a></td>
<td>+44 (0) 114 2229520</td>
</tr>
<tr>
<td>Training and Events Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer Centre, University of Sheffield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Lian Hutchings</td>
<td><a href="mailto:l.r.hutchings@durham.ac.uk">l.r.hutchings@durham.ac.uk</a></td>
<td>+44 (0) 191 3342133</td>
</tr>
<tr>
<td>Chair, IRC Research Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Barry Maunders</td>
<td><a href="mailto:b.maunders@leeds.ac.uk">b.maunders@leeds.ac.uk</a></td>
<td>+44 (0) 1483 765584</td>
</tr>
<tr>
<td>Network Development Director</td>
<td></td>
<td></td>
</tr>
<tr>
<td>John McGrath</td>
<td><a href="mailto:j.c.mcgrath@bradford.ac.uk">j.c.mcgrath@bradford.ac.uk</a></td>
<td>+44 (0) 1274 233624</td>
</tr>
<tr>
<td>Manager, Polymer CIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor Peter Olmsted</td>
<td><a href="mailto:p.d.olmsted@leeds.ac.uk">p.d.olmsted@leeds.ac.uk</a></td>
<td>+44 (0) 113 3433830</td>
</tr>
<tr>
<td>Director, University of Leeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Liam Sutton</td>
<td><a href="mailto:l.r.sutton@sheffield.ac.uk">l.r.sutton@sheffield.ac.uk</a></td>
<td>+44 (0) 114 2229383</td>
</tr>
<tr>
<td>Polymer Centre Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Sheffield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Ben Whiteside</td>
<td><a href="mailto:b.r.whiteside@bradford.ac.uk">b.r.whiteside@bradford.ac.uk</a></td>
<td>+44 (0) 1274 236266</td>
</tr>
<tr>
<td>Technical Manager Micro &amp; Nano-Moulding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Bradford</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dr David Adolf, School of Physics & Astronomy, University of Leeds
Applications include rheology, gas diffusion in melts, chain folding/biopolymer & controlled delivery. Experimental: Time resolved optical spectroscopy to monitor local polymer dynamics (solution to blended and unblended melt) at pressures up to 3000 atmospheres. Computational: Molecular dynamics simulations of gas permeability in polymer melts. Molecular and brownian dynamics simulations of linear and dendritic polymers from the solution to the melt state.

+44 (0) 114 2229679
d.b.ades@sheffield.ac.uk

Dr Ammita Aggar, Centre for Molecular Nanoscience, School of Chemistry, University of Leeds

+44 (0) 114 2229402
a.aggar@chem.leeds.ac.uk

Professor Steven P Armes, Department of Chemistry, University of Sheffield

+44 (0) 114 2229542
s.p.armes@sheffield.ac.uk

Dr Stefan Auer, Centre for Molecular Nanoscience, University of Leeds
Application of theoretical computational tools developed in soft condensed matter physics to investigate the phase behaviour and transitions of complex systems of biopolymers. Colloidal crystalization and the aggregation of proteins into amyloid fibrils. Nucleation and regulation of normal and aberrant self-assembly in biological systems and their functionalisation as nanomaterials.

+44 (0) 114 2223918
sauer@leeds.ac.uk

Professor Colin Bain, Department of Chemistry, University of Durham

+44 (0) 191 3343597
c.d.bain@durham.ac.uk

Professor David Barton, Mechanical Engineering, University of Leeds

+44 (0) 114 2223597
c.d.barton@leeds.ac.uk

Dr Giuseppe Battaglia, Department of Biomedical Sciences, University of Sheffield
Internalisation pathways of nanoparticles. Bio nanotechnology; synthetic biology. Biophysics; biomedical delivery. Self-assembling polymers in water for the design of functional materials (e.g. drug delivery systems and tissue engineering scaffolds) Phase behaviour of amphiphilic polymers in self-assembled membranes.

+44 (0) 114 2223597
g.battaglia@sheffield.ac.uk

Professor Hadj Benkreira, School of Engineering, Design & Technology, University of Bradford
Rheology of polymers, films and coating flows, polymer processing, especially extrusion processing; biaxially oriented films; novel processes.

+44 (0) 1274 223721
h.benkreira@bradford.ac.uk

Dr, Elatine Brown, School of Engineering, Design & Technology, University of Bradford
Ultrasound melt flows. Enhanced Polymer Processing.

+44 (0) 1274 223631
s.brown@bradford.ac.uk

Dr Alastair Buckley, Department of Physics and Astronomy, University of Sheffield

+44 (0) 114 2223597
plastair.buckley@sheffield.ac.uk

Dr Ashley Cadby, Department of Physics and Astronomy, University of Sheffield
Advanced microscopy including scanning tunnelling, atomic force and scanning near field (STM, AFM and SNOM). Investigation of the optical properties of a variety of sub-refraction length scales (<50nm). Energy transfer at the interface of two conjugated polymers (for development of polymer devices with higher efficiencies). Nano-scale spectroscopy. Light harvesting in biological systems.

+44 (0) 114 2224299
a.cadby@sheffield.ac.uk

Professor Neil Cameron, Department of Chemistry, University of Durham

+44 (0) 191 3342008
n.cameron@durham.ac.uk

Dr Matt Carre, Department of Mechanical Engineering, University of Sheffield

+44 (0) 114 2227839
m.j.carre@sheffield.ac.uk

Dr Phil Eaton-Rose, School of Engineering, Design & Technology, University of Bradford
FEA of solid polymer deformation.

+44 (0) 1274 224551
p.eaton-rose@bradford.ac.uk

Dr Buddhapriya Chakrabarti, Department of Mathematical Sciences, University of Durham

+44 (0) 191 3340727
buddhapriya.chakrabarti@durham.ac.uk

Dr. Kongjun Chen, Centre for Molecular Nanoscience, University of Leeds

+44 (0) 113 3453102
r.chen@leeds.ac.uk

Dr Chuh Chong, Department of Engineering Materials, University of Sheffield

+44 (0) 114 2225984
s.k.chong@sheffield.ac.uk

Dr Frederik Claeyssens, Department of Engineering Materials, University of Sheffield

+44 (0) 114 2235513
f.claeyssens@sheffield.ac.uk
Flow instabilities and flow-induced transitions in complex fluids including surfactants, polymers and liquid crystals.

Ultrasonic measurement of interfaces and lubricant film thickness in machine components.

Industrial wear and lubrication problems: testing and modelling components. Examples include polymer and composite bearings and gears.

Process modelling using finite element analysis in conjunction with process measurement techniques.

Improving device performance of organic photovoltaics through understanding the effect of morphology.

Monte Carlo modelling of charge transport in organic materials.

Dr. Chris Groves, School of Engineering and Computing Sciences, University of Durham

Field effect transistors (FETs) using organic semiconductors.

Flow visualisation, rheo-optics, spectroscopy, x-ray and neutron scattering for improved understanding of materials processing.

Dr. Elaheh Ghassemieh, Department of Mechanical Engineering, University of Sheffield

Neutron reflectometry, scanning probe microscopies, confocal microscopy, fluorescence correlation spectroscopy, ion beam analysis

Dr. Mike Evans, School of Physics & Astronomy, University of Leeds

Theory of Complex Fluids: polymer/liquid crystal mixtures, colloids, amphiphiles.

Effects of molecular polydispersity on phase equilibria, structure & dynamics.

Kinetics of phase ordering: nucleation, spinodal decomposition, metastable phases morphosopic morphology.

Dr. Dr. Mike Evans, School of Physics & Astronomy, University of Leeds

Thermoresponsive gels.

Electrospun fibres.

Scaffold materials.

Semi-crystalline polymers, crystallisation mechanisms.

Interfacial effects and crystallisation control and their implication for adhesion between semi-crystalline and amorphous polymers.

Dr. Sharon Cooper, Department of Chemistry, University of Durham

Semi-crystalline polymers, crystallisation mechanisms.

Dr. Aileen Crawford, School of Clinical Dentistry, University of Sheffield

Cartilage tissue engineering: roles of cell source and scaffold on the quality of engineered tissue.

Scaffold materials.

Elastoresponsive gels.

Dr. Steve Daley, Department of Automatic Control and Systems Engineering, University of Sheffield

Active control of sound and vibration.

Dr. Chris Groves, Department of Chemistry, University of Sheffield

Additive layer manufacture (wing structure).

Image processing techniques for micro-structural evaluation.

Finite element modelling for fracture mechanics, stress and micromechanical analysis.

Dr. Tim Gough, School of Engineering, Design & Technology, University of Bradford

Flow visualisation, rheo-optics, spectroscopy, x-ray and neutron scattering for improved understanding of materials processing.

Dr. Martin Grell, Department of Physics & Astronomy, University of Sheffield

Field effect transistors (FETs) using organic semiconductors.

FETs as sensors for pollutants.

Development of simple, portable characterisation methods that can work in the field.

Light emitting organic materials.

Dr. Rammile Ettelaie, Department of Food Science, University of Leeds

At-process spectroscopy of polymers.

Dr. Suzanne Fielding, Department of Physics, University of Durham

Thin films.

Scattering.

Modelling.

Theory.

Semi-crystalline polymers, crystallisation mechanisms.

Dr. Aileen Crawford, School of Clinical Dentistry, University of Sheffield

Cartilage tissue engineering: roles of cell source and scaffold on the quality of engineered tissue.

Scaffold materials.

Elastoresponsive gels.

Dr. Steve Daley, Department of Automatic Control and Systems Engineering, University of Sheffield

Active control of sound and vibration.

Dr. Chris Groves, Department of Chemistry, University of Sheffield

Additive layer manufacture (wing structure).

Image processing techniques for micro-structural evaluation.

Finite element modelling for fracture mechanics, stress and micromechanical analysis.

Dr. Tim Gough, School of Engineering, Design & Technology, University of Bradford

Flow visualisation, rheo-optics, spectroscopy, x-ray and neutron scattering for improved understanding of materials processing.

Dr. Martin Grell, Department of Physics & Astronomy, University of Sheffield

Field effect transistors (FETs) using organic semiconductors.

FETs as sensors for pollutants.

Development of simple, portable characterisation methods that can work in the field.

Light emitting organic materials.

Dr. Rammile Ettelaie, Department of Food Science, University of Leeds

At-process spectroscopy of polymers.

Dr. Suzanne Fielding, Department of Physics, University of Durham

Thin films.

Scattering.

Modelling.

Theory.

Semi-crystalline polymers, crystallisation mechanisms.

Dr. Aileen Crawford, School of Clinical Dentistry, University of Sheffield

Cartilage tissue engineering: roles of cell source and scaffold on the quality of engineered tissue.

Scaffold materials.

Elastoresponsive gels.

Dr. Steve Daley, Department of Automatic Control and Systems Engineering, University of Sheffield

Active control of sound and vibration.

Dr. Chris Groves, Department of Chemistry, University of Sheffield

Additive layer manufacture (wing structure).

Image processing techniques for micro-structural evaluation.

Finite element modelling for fracture mechanics, stress and micromechanical analysis.

Dr. Tim Gough, School of Engineering, Design & Technology, University of Bradford

Flow visualisation, rheo-optics, spectroscopy, x-ray and neutron scattering for improved understanding of materials processing.

Dr. Martin Grell, Department of Physics & Astronomy, University of Sheffield

Field effect transistors (FETs) using organic semiconductors.

FETs as sensors for pollutants.

Development of simple, portable characterisation methods that can work in the field.

Light emitting organic materials.

Dr. Rammile Ettelaie, Department of Food Science, University of Leeds

At-process spectroscopy of polymers.

Dr. Suzanne Fielding, Department of Physics, University of Durham

Thin films.

Scattering.

Modelling.

Theory.

Semi-crystalline polymers, crystallisation mechanisms.

Dr. Aileen Crawford, School of Clinical Dentistry, University of Sheffield

Cartilage tissue engineering: roles of cell source and scaffold on the quality of engineered tissue.

Scaffold materials.

Elastoresponsive gels.

Dr. Steve Daley, Department of Automatic Control and Systems Engineering, University of Sheffield

Active control of sound and vibration.

Dr. Chris Groves, Department of Chemistry, University of Sheffield

Additive layer manufacture (wing structure).

Image processing techniques for micro-structural evaluation.

Finite element modelling for fracture mechanics, stress and micromechanical analysis.

Dr. Tim Gough, School of Engineering, Design & Technology, University of Bradford

Flow visualisation, rheo-optics, spectroscopy, x-ray and neutron scattering for improved understanding of materials processing.
Professors

**Dr Oliver Harlen**, School of Mathematics, University of Leeds


**Dr Sarah Harris**, School of Physics & Astronomy, University of Leeds


**Dr Paul Hatton**, School of Clinical Dentistry, University of Sheffield

Glass-ionomer cement bond. Facilities for assessing of polymers and other materials used in the healthcare industry. Broad-scale glasses and ceramics for mineralisation tissue repair. Tissue engineering (cartilage and bone) and polymer biocompatibility. Academic-industrial collaboration and technology transfer in the orthopaedic, craniofacial and dental material sectors.

**Dr John Haycock**, Department of Engineering Materials, University of Sheffield


**Dr Simon Hayes**, Department of Engineering Materials, University of Sheffield

Nanoscale technology, including nanocapsulation for testing bulk polymers, thin polymer coatings and biological materials. Viscoelastic properties of very low modulus polymers at a range of temperatures and frequencies. Self-sensing and self-healing smart materials for damage/degradation detection/monitoring and cure monitoring systems.

**Dr John Missling**, School of Physics & Astronomy, University of Leeds

The production and properties of novel self-reinforced polymer/polymer composites (Hot Compaction). The use of particulate fillers (including nano-fillers) to modify the mechanical properties of polymers in the solid and melt states. Linking molecular structure to processing and properties in unfilled and filled polymers. Structure/property relationships in novel polymers including functionalised novel norbornenes synthesised at Durham University.

**Dr Jamie Hobbs**, Departments of Chemistry and Physics and Astronomy, University of Sheffield


**Dr Alima Hodzic**, Aerospace Engineering, University of Sheffield


**Professor Kirill Koroshechkov**, School of Engineering, Design & Technology, University of Bradford


**Dr Luan Hutchings**, Department of Chemistry, University of Durham

Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers.

**Professor Frank Jones**, Department of Engineering Materials, University of Sheffield

Semi-crystalline and amorphous polymers. Self-healing, self-sensing composites. Smart-polymer matrix composites. Functional coatings for composite reinforcing fibres (e.g. plasma polymers). Compositional prediction of resin properties.

**Professor Richard Jones**, Department of Physics & Astronomy, University of Sheffield

Nanomechanical testing, including nanoindentation for testing bulk polymers, thin polymer coatings and biological materials. Viscoelastic properties of very low modulus polymers at a range of temperatures and frequencies. Self-sensing and self-healing smart materials for damage/degradation detection/monitoring and cure monitoring systems.

**Professor Zhongmin Jin**, School of Mechanical Engineering, University of Leeds


**Professor Zhanmin Jin**, School of Mechanical Engineering, University of Leeds

Joint replacement and substitution. Tissue re-engineering. Functional spinal interventions.

**Professor Frank Jones**, Department of Engineering Materials, University of Sheffield

Bioreinforced composites; mechanics, chemistry and performance. Self-healing, self-sensing composites. Smart-polymer matrix composites. Functional coatings for composite reinforcing fibres (e.g. plasma polymers). Computational prediction of resin properties.

**Professor Richard Jones**, Department of Physics & Astronomy, University of Sheffield


**Professor Lian Hutchings**, Department of Chemistry, University of Durham

Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers.

**Dr Adrian Kelly**, School of Engineering, Design & Technology, University of Bradford

Polymer melt processing and thermal optimisation, including extrusion, compounding and injection moulding. In-process monitoring techniques such as rheometry, ultrasound and spectroscopy. Pharmaceutical polymer formulations, processing and characterisation. Polymer melt processing and thermal optimisation, including extrusion, compounding and injection moulding. In-process monitoring techniques such as rheometry, ultrasound and spectroscopy. Pharmaceutical polymer formulations, processing and characterisation. Polymer melt processing and thermal optimisation, including extrusion, compounding and injection moulding. In-process monitoring techniques such as rheometry, ultrasound and spectroscopy. Pharmaceutical polymer formulations, processing and characterisation.

**Dr Robert Kellett**, Centre for Molecular Nanoscience and School of Electronic & Electrical Engineering, University of Leeds

Theory and simulation of semiconductor and molecular nanostructures and nanodevices.

**Dr Ezat Khosravi**, Department of Chemistry, University of Sheffield

Synthesis and characterisation of a wide range of tractable, functionalised, regioregular polythiophenes by post-modification of preformed precursor polymers. Electro- and photo-active polymers including polythiophenes, conjugated main-chain carbazole polymers and polyacenes. Design and development of conjugated polymers for application in displays and solar cells. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers. Living polymerisation techniques principally anionic polymerisation but also ring opening metathesis polymerisation (ROMP), atom transfer radical polymerisation (ATRP) and reversible addition-fragmentation chain transfer polymerisation (RAFT). Synthesis and application of novel well defined, long-chain, branched polymer architectures - Dendrimers and Hyperbranched Polymers.
Dr Tim Richardson, Department of Physics & Astronomy, University of Sheffield
Modelling the interactions of porphyrins and molecular species.
Electrical and optical properties of gold nanoparticle Langmuir-Blodgett (LB) and Langmuir-Schaefer (LS) films.
Building organised molecular multi layered architectures using a wide range of materials.
Sensing using thin films.
Applied molecular engineering.
Ultra thin film deposition of polymers.
Nanolithography.
Polymer LB films for battery applications and luminous polymers.

Dr Mike Rice, School of Physics & Astronomy, University of Leeds
NMR micro imaging, diffusion tensor imaging, self-diffusion constants and rheo-nmr.
Solid state NMR to measure dynamics in polymer systems.
NMR experimental & theoretical studies of: Orientation & dynamics in polymer networks, network blends & interpenetrating polymer networks; crosslink densities, screening lengths & correlation times.
Structure & dynamics of miscible polymer melt blends; local friction coefficient & entanglement length as a function of composition.
Rouss & reptation parameters of linear monospecific polymer melts; Kuhn length, Rouss times & ideal glass transition temperature.
Polymer electrolytes; the effect of salt on dynamics & structure of polymer matrix.

Dr Steve Rimmer, Department of Chemistry, University of Sheffield
Synthesis of telechelic oligomers (living radical/cationic/polymerizations and chain cleavage).
Molecular imprinted polymer colloids (synthetic antibodies).
New synthetic methods for the synthesis of polymers.
Polymers that undergo phase transitions in response to biological stimuli.
Polymer co-networks.
Polymers for tissue engineering.
Synthesis of designed functional polymers for medical applications.

Dr Jan Rongong, Department of Mechanical Engineering, University of Sheffield
Fibre-based damping systems, particle dampers (e.g. granular polymeric materials as fillers).
Characterisation of materials in terms of their damping characteristics.
Design of damped components (e.g. hollow turbomachinery blades).
Active and adaptive structures for damping.
Vibration damping using polymers.
Pseudoelastic modeling of vibrating and damped systems.
Viscoelastic damping materials; development, analysis and testing of polymers; design and testing of syntactic foams and other multiphase systems.
Surface damping treatments: free and constrained layer systems using organic and ceramic materials.

Dr George Rosara, School of Engineering, Design & Technology, University of Bradford
Finite element analysis of polymer solids and engineering materials.

Professor Tony Ryan, Department of Chemistry, University of Sheffield
Polyurethanes.
Nanotechnology, responsive polymers and control of microstructure.
Building analytical techniques into processes.
Building new techniques to follow development of structure.
Polymer structures, properties and processing.
Following structural changes in real time during processing synthesis and use.

Dr Ian Scowen, Department of Chemical Technology, University of Bradford
Organo-metallic catalysis.

Professor Costas Soutis, Department of Mechanical Engineering, University of Sheffield
Structural health monitoring of composite.
Structural applications of composites.
Aerospace.
Advanced composites structures mechanical properties and characterisation.
Failure analysis and fracture mechanics from micro to macro scale.
Joining and repair of composites.
Intelligent materials and structures.
Non-destructive testing and evaluation.
Modelling and finite element analysis.

Professor Peter Styring, Department of Chemical & Process Engineering, University of Sheffield
Immobilisation of catalysts onto swellable polymers to facilitate heterogeneous catalysis (androgy nous catalysis).
Design and synthesis of electromechanical polymers for use as micro pumps and valves.
Chemical micro and mini reactors.
Polymers and soft actuators in chemical engineering.
Snow sports engineering: self waxing skis and new functional polymers for ski surfaces.
Carbon cycle: carbon capture, activation and conversion.
Green, benign and sustainable technologies.

Dr Liam Sutton, The Polymer Centre, University of Sheffield
General Manager of the Polymer Centre.
Contract research, consultancy and testing services (pure and applied research).
Training and education course.
Developing collaborative links between academia and industry.
Commercial exploitation and demonstrator projects.
Industrial seminars and outreach activities.
Marketing and communication.
Research and training partnerships.

Dr Linda Swanson, Department of Chemistry, University of Sheffield
Motion of polymers in solid and solution phases.
Interactions of polymers with other types of polymers, biopolymers and surfaces.
Use of luminescent labels attached to polymer backbones to monitor the dynamics of individual polymer chains in polymer solids and blends.
Use of labelled polymers to establish links between molecular properties and mechanical and electrical behaviour.

Dr John Sweeney, School of Engineering, Design & Technology, University of Bradford
Solid phase deformation processing of polymers; combinatorial relationships for solid polymers; finite element analysis of deformation processing.

Dr Annette Taylor, School of Chemistry, University of Leeds
Complex systems.
Excitable media.
Biomimetics.
Chemical and biological kinetics.
Nonlinear dynamics.
Oscillations, waves and patterns.

Dr Richard Thompson, Department of Chemistry, University of Durham
Ion beam analysis and neutron scattering techniques applied to study polymer surfaces and interfaces.
Ion beam and AFM services for visiting researchers.

Dr Harvey Thompson, School of Mechanical Engineering, University of Leeds
Experimental flow visualisation.
Process flow simulation and optimisation.

Professor Geoff Tomlinson, Department of Mechanical Engineering, University of Sheffield
Novel damping technologies (e.g. non-contact damping devices, gradient materials and energy transfer concepts).
Characterisation of materials in terms of their damping characteristics.
All aspects relating to the vibration of engineering structures.
Vibration damping using polymers/viscoelastic materials and composites.
Finite element models to estimate the characteristics of materials in service.
Non-linear analysis.
The work is heavily applied; materials passing test criteria are subsequently incorporated into engine and other test beds in industry, prior to production.

Dr Lance Twyman, Department of Chemistry, University of Sheffield
Synthesis, properties and commercial exploitation of highly branched polymers and dendrimers.
Control of architecture and morphology of hyper branched polymers.
Dendrimers and hyperbranched polymers for drug and gene delivery.
Dendritic polymers as enzyme mimics, size selective inhibitors to protein-protein binding and potential artificial blood.
Light harvesting dendritic polymers.
Immobilized dendrons for solid phase applications.
Professor Ric van Noort, School of Clinical Dentistry, University of Sheffield

Finite element analysis to study behaviour of the system as a whole.
Interaction between the materials and the biological environment.
Customised prostheses based on detailed imaging data.
Enamel/dentine and other bond strength measurements and testing.
Structural integrity of the restored tooth.
Structural integrity and interaction between the properties and design of dental materials and their clinical performance.

Dr Alison Voice, School of Physics & Astronomy, University of Leeds

IR and Raman spectroscopy/microscopy, DSC, Rheology.
Polymer Gel Electrolytes. Lithium Batteries.
PVDF, PEN, PEEK.

Dr Xiasong Wang, School of Chemistry, University of Leeds

Functional nanomaterials: to create nanomaterials through supramolecular chemistry and explore nano-size induced properties for application in modern technologies.
Synthesis of well designed polymers that have controlled designed attributes.
Synthesis, macromolecules, Supramolecular chemistry, Functional Nanomaterials, Biomedical applications.

Dr Ben Whiteside, School of Engineering, Design and technology, University of Bradford

Modeling.
Glass filled polymer injection.
Micro and Nano-moulding.

Dr Mark Wilson, School of Mechanical Engineering, University of Leeds

Industrial coating flows.
Thin film flow over topographies.
Ink jet printing.
Droplet dynamics.
Mixing/adsorption.
Lattice Boltzmann methods.
Dynamic wetting.
Vehicle ventilation for animal welfare.

Professor Mark Wilson, Department of Chemistry, University of Durham

Molecular dynamics and Monte Carlo simulation techniques - simulation of functional polymers including amphiphilic polymers at interfaces and liquid crystal polymers.
Simulation of polymers, dendrimers, liquid crystals and soft matter.
Development of coarse-grained simulation models for macromolecular systems.
Development of new parallel simulation methods for polymers.
Studies of diesel and diesel additives.
Simulations of biopolymers including proteins and studies of amino acid/lipid interactions.

Dr Andrew Wilson, School of Chemistry, University of Leeds

Organic synthesis.
Supra-molecular chemistry.
Molecular recognition.
Self-assembly.

Professor Alastair Wood, School of Engineering, Design & Technology, University of Bradford

Phase change.
Numerical heat transfer.
Numerical techniques for polymer forming.
Plastics fusion modelling.
Energy modelling.
Optimisation.

Dr Junjie Wu, School of Engineering, University of Durham

Tissue Engineering.
Bioactive Chemistry.
Biomedical engineering and Energy Conversion.

Dr Xiangbing Zeng, Department of Engineering Materials, University of Sheffield

Nano-scale structural studies using small angle x-ray and neutron scattering (SAXS and SANS).
Study of 1-d, 2-d, 3-d ordered macromolecular and supra-molecular nano-structures (on the scale 1-100nm).
Transient structures and rapid transformations such as polymer crystalization.
Liquid quasi-crystalline polymers.
High band gap polymers.
Nanocomposites (porous aluminas with LC in channels).