

# Polymer Interdisciplinary Research Centre

布拉德福德大学聚合物交叉学科研究中心

Strategic Links with China

与中国的战略合作



2019

Welcome	2
Our Bradford RCUK Science Bridges China team	3
UK China Advanced Materials Research Institute	5
Our UK-China Collaboration Successes	9
Research Workshops	14
Joint Research Laboratories	18
Journal Publications associated with the Science Bridges China/UK-China AMRI Platform	20
Researcher Exchanges	22
High level meetings with government	26
Awards	28
Polymer Interdisciplinary Research Centre	31
Our Web sites	38
<i>Appendix</i>	
Science Bridges China platform – Origins	41

# CONTENTS

Polymer IRC

2019

Strategic Links with China



The longest bridge  
in the world

# Strategic Links with China - the Science Bridges China/ UK-China AMRI platform





We celebrate some of the achievements to date, and our ongoing progress. A further extension of our capabilities in the healthcare technologies area is the EPSRC UK Centre for Innovative Manufacturing in Medical Devices, MeDe Innovation – a key grouping of five leading universities, which we introduce briefly here. We are also linking MeDe strongly with our Chinese partners.

In the Appendices origins of the Science Bridges China/UK-China AMRI platform are described. We also note briefly some further excellent international links, with leading groups in the pharmaceutical and polymer science and engineering areas in India. All of this exciting progress is only possible because of an excellent team of like-minded, dedicated people, who are developing the capability and capacity of our research laboratories, which continue to pursue an upward trajectory, with local through to international impact.

We are always open to new opportunities, and welcome academic, industrial and clinical collaborations, so please do contact us!

# WELCOME

The internationally recognised Polymer Interdisciplinary Research Centre (Polymer IRC) at the University of Bradford has a strong track record of warm co-operation in the UK and abroad, with academics, industry and clinicians across the area of advanced materials, especially polymers and polymer composites, and with an emphasis on healthcare technologies.

This booklet provides brief background information on ongoing developments in the world-class UK Polymer IRC, which was founded through an EPSRC grant in 1989. It then focusses on our extensive and warm collaborations in China for more than a decade, based on the Science Bridges China platform, where we have established the UK-China Advanced Materials Research Institute and have a vibrant, growing community of research leaders, researchers and early career researchers, with a highly productive programme of Research Workshops and researcher exchanges, and three Joint International Research Laboratories.



**Prof Phil Coates FREng**  
**Director, Polymer IRC**  
**Director, Science Bridges China**

International Science & Technology Co-operation Award of PR China (2017)  
中国国际科学技术合作奖获得者  
Famous Overseas Scholar, MoE China  
中国教育部海外名师  
Sichuan Province Foreign Expert  
四川省外国专家局外国专家  
Leading International Professor, Sichuan University  
四川大学高端外籍教师  
Honorary Professor, Sichuan University  
四川大学名誉教授  
Honorary Professor, Beijing University of Chemical Technology  
北京化工大学名誉教授

## Our Bradford RCUK Science Bridges China team



Prof Phil Coates FEng  
Director Polymer IRC  
Director, Science Bridges China  
Co-Director AMRI Board



Xiaolei Wang  
International Programme Manager,  
AMRI Board Member



Dr Fin Caton-Rose  
Manager Solid Phase  
Processing & Modelling  
AMRI Board Member



Prof Anant Paradkar  
Director, Pharmaceutical  
Engineering Science



Prof Ben Whiteside  
Director, Polymer Micro  
& Nano Technology Centre  
AMRI Board Member



Dr Pete Twigg  
Reader,  
Medical Engineering



Prof Steve Rimmer  
Head, Chemistry & Biology  
Faculty of Life Sciences



Prof Adrian Kelly  
Manager, Extrusion



Prof Tim Gough  
Manager Polymer  
Characterisation

Please contact us via:

Prof Phil Coates  
Xiaolei Wang

[p.d.coates@bradford.ac.uk](mailto:p.d.coates@bradford.ac.uk)  
[xwang5@bradford.ac.uk](mailto:xwang5@bradford.ac.uk)

+44 1274 234540  
+44 1274 234034

For well over a decade we have developed extensive and warm collaborations in China.

After initial visits by Prof Coates to China (between 2000 and 2007), the EPSRC funded Virtual Institute for Polymer Process Structuring programme drew together some of the polymer research community in China, Japan, Taiwan and Korea (2008-9) led by Bradford but including Leeds University academics.

This was followed by the RCUK/ EPSRC – Bradford top-ranked grants for the Science Bridges China platform. From the Science Bridges China/ EPSRC Global Engagements programme, we established the UK-China Advanced

Materials Research Institute and a vibrant, growing community of research leaders, researchers and early career researchers, with a highly productive programme of Research Workshops and researcher exchanges, and three Joint International Research Laboratories to date. This Science Bridges China/ UK-China AMRI platform has included an expanding range of leading UK and Chinese Universities, companies and clinicians.

The Science Bridges China £1.27m grant began in 2009 with three groups at the University of Bradford, led by Prof Coates (the Pro Vice Chancellor for Research & Knowledge Transfer) - the

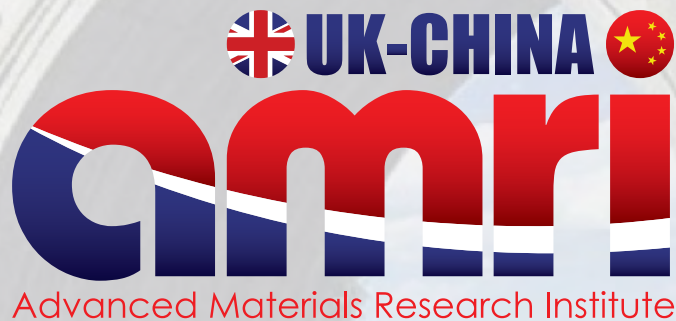
Polymer IRC, Institute for Pharmaceutical Innovation and Institute for Cancer Therapeutics, in collaboration with 11 Chinese academic institutions. It aimed at collaborative research, development and open innovation in pharmaceuticals and healthcare, and to bring together scientists and companies from the UK and China to develop new therapies, medical diagnostics, materials and devices.

Science and technology are primary production forces

*Xiaoping Deng, 'Chief Architect of China's Economic Reforms', 1988*



# RCUK Bradford Science Bridges China UK-China Advanced Materials Research Institute



中英先进材料研究所

building science, technology and people bridges - and crossing them

An initial Board Meeting of leaders from the six founding research groups in Sichuan, BUCT, ICCAS, CIACCAS, SIMMCAS and Bradford. was held on 19 April 2012, 5pm-6pm, Shangri-la Hotel, Chengdu.

**Purpose:** The leading researchers involved in UK-China collaborations in polymer-related materials, brought together by the RCUK Bradford Science Bridges China programme, agree to form the UK-China Advanced Materials Research Institute. This virtual institute will represent the growing UK-China research collaborations in a more coherent and substantial way, linking members together more visibly, for increased impact.

This will be valuable to all members, as it will:

- show a critical mass of leading Chinese and UK researchers who wish to collaborate in areas of research which are identified by our countries as strategic, and who show that they have a successful track record of collaboration, and
- help to increase our research co-operations and friendship, and create new opportunities for exchanges and funding.
- strengthen our joint approaches to UK and Chinese funding agencies.

**Initial Scientific Focus:** The Research Institute will aim to bring together leading UK and Chinese research groups with Advanced Materials research strengths, especially Polymer-related materials and processing. An initial focus will be on 'advanced materials for healthcare'. This is an area identified by both the UK and China as a priority for research cooperation. This area also includes a range of materials interests, built strongly on our polymers and polymer-related materials expertise, and includes drug delivery and biomaterials aspects. Our approach is genuinely interdisciplinary, across materials science, engineering, physics, chemistry and biomaterials disciplines. Many materials advances offer potential application to healthcare, an initial focus, but the Institute will cover other advanced materials 'themes' which are also strategically important, such as advanced materials for Energy/ Resource Efficiency, and more general materials areas such as polymer nanocomposites.

#### Research Institute proposed activities:

- **Communications** – by regular emails, by conference call, web site and organised meetings.
- **Annual meeting:** this would involve (i) a technical meeting, reporting progress of collaborative research and aiming to discuss funding

opportunities, develop new research and staff exchange opportunities, and (ii) a business/strategy discussion for the Institute and its research directions. Depending on funding streams, co-hosting, etc, it should be feasible to call an annual 2-day meeting in China or the UK. (Bradford currently has support for this for the next year).

- **Researcher exchanges** are encouraged, to develop research capacity and research training; similarly joint supervision of Research Students is encouraged.
- **Joint international laboratories:** Although the proposal is for a 'virtual' Research Institute, we aim to have joint international laboratories established or developed. Bradford and Sichuan University currently have such a joint laboratory for Polymer Micro Processing. An alternative is to identify clusters of research groups with at least one Chinese member and one UK member, with similar research interests.
- **Joint research projects and funding bids** (in China to MOST and NSFC, in the UK to EPSRC, and potentially in Joint Calls); industrially supported projects are welcome.

**Web site:** [www.ukchina-amri.com](http://www.ukchina-amri.com)







UK Core members:



Universities of Leeds, Bradford, Durham and Sheffield

We build too many walls and not enough bridges

Isaac Newton, 'Father of Modern Science'



Chinese Core members (& leaders):

Sichuan University: SKLPME, NERCB



Prof Guangxian Li



Academician,  
Prof Qi Wang



Prof Hesheng Xia



Prof Lin Ye

Beijing University of Chemical Technology



北京化工大学



Prof Liqun Zhang



Prof Daming Wu

Changchun Institute of Applied Chemistry,  
Chinese Academy of Sciences



Prof Yongfeng Men

Institute of Chemistry, Chinese  
Academy of Sciences, Beijing



Prof Dujin Wang



Prof Dong Qiu

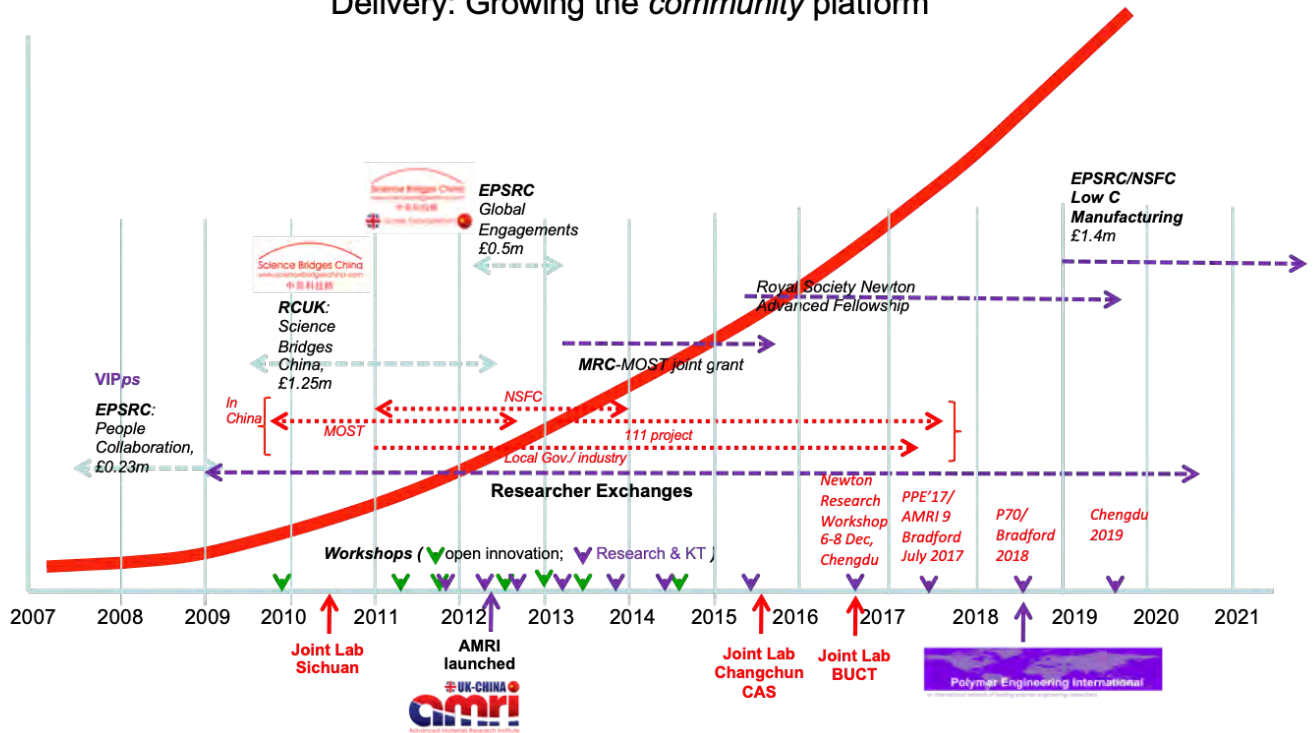
Shanghai Institute Materia Medica  
Chinese Academy of Sciences



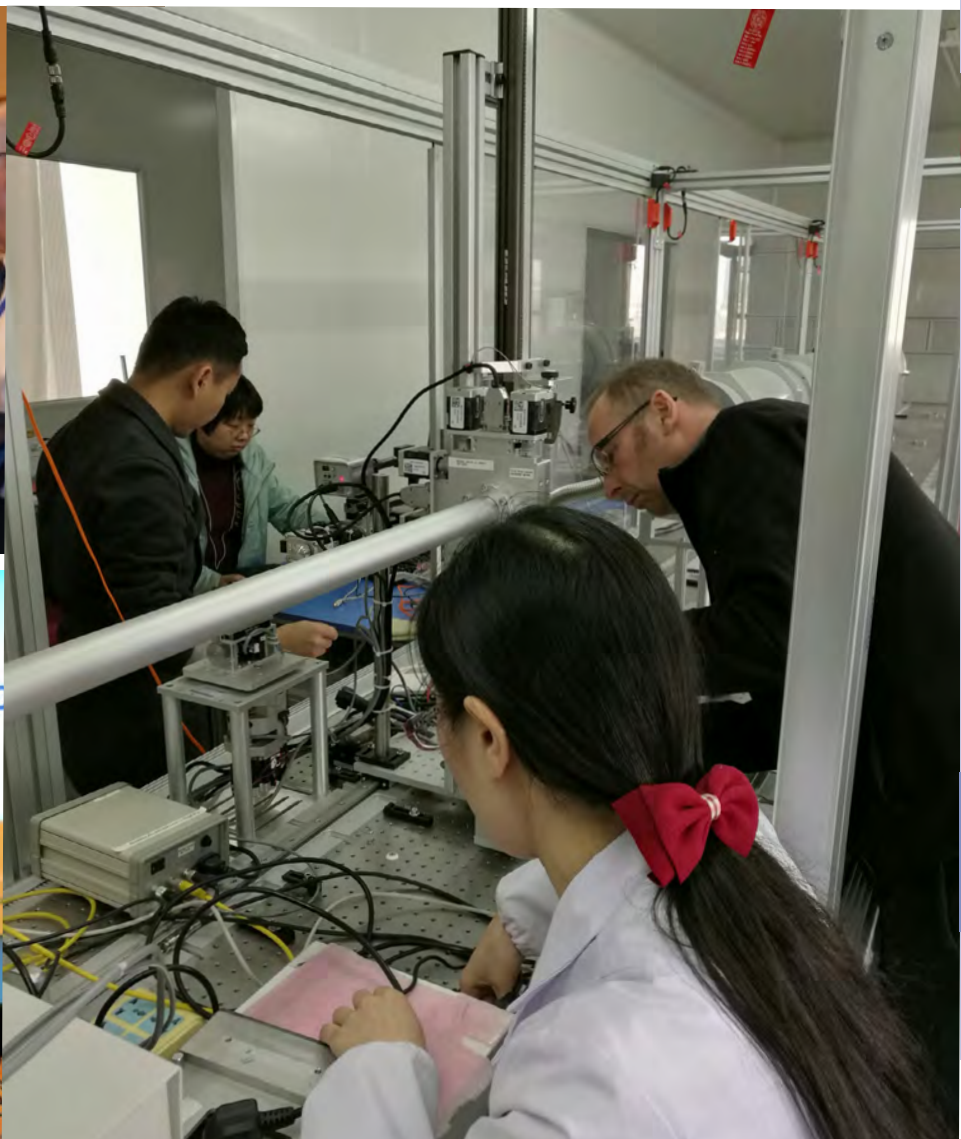
Prof Jiwen Zhang

### Delivery: Growing the community platform

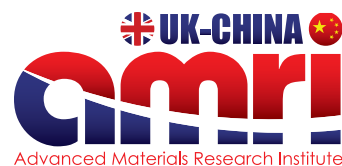
**Outputs**  
Papers,  
Exchanges,  
Projects,  
Innovation,  
KT,  
Joint IP;  
  
-Building  
Research  
Capacity  
& Capability



🇨🇳 In China : Sinopec, DePuy/J&J, Paragon, Molex, AZ +.... 🇬🇧 In UK: Smith & Nephew, Autodesk, Sabic, +...  
+ Clinicians from Beijing, Sichuan, Bradford,



# Our UK-China Collaboration Successes

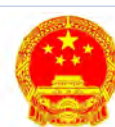


We have built strongly on success. Following the **EPSRC Science Bridges China** and **Global Engagements** grants, ongoing collaborations include externally funded programmes awarded to our teams:

**111 Programme of Introducing Talents** - Introducing Talents from leading institutions or groups to Chinese Universities' Sichuan University, announced September 2012 (to 2017)



**RCUK –MOST Joint Call** of April 2012, project announced December 2012: Biomaterials for Joint Soft Tissue Repair - Improving Health in Older Age; - Bradford, Sheffield, Durham, Sichuan, ICCAS;



**Royal Academy of Engineering UK-China research exchange scheme** (Dr Zhiyong Jiang of Changchun CIACAS, March 2014, 10 months)



**Royal Society Newton Advanced Fellowship Award:** Advanced processing physics of micro molding and die drawing of polymers for control of properties; Prof Yongfeng Men, Changchun CIAC Chinese Academy of Sciences & Prof Phil Coates, Polymer IRC, Bradford 2015-18



**British Council Newton Researcher Links Workshop for Early Career Researchers** – joint with NSFC – in Healthcare Technologies for Aging Populations Dec 2016



**EPSRC Centre for Innovative Manufacturing in Medical Devices** (MeDe Innovation), £5.7m national centre; commenced October 2013 which has expanded opportunities for international co-operation

**EPSRC Capital for Great Technologies** award (total value £6.5m, including industry and University support) for Advanced Materials in Healthcare for facilities providing opportunities for international co-operation, 2014-17

**EPSRC Healthcare Impact Partnership grant** Shape memory bone and soft tissue fixations (value £1.1m; with element for UK-China research exchanges); Prof Phil Coates & team, 2018-2021

**EPSRC - NSFC UK-China Low Carbon Manufacturing** - High Efficiency value-added bulk recycling of polymers by solid state shear milling; £1.4m; Sichuan/Polymer IRC Bradford



## Joint International Laboratories

Sichuan (2010), Changchun CAS (2015), BUCT (2016)  
The Sichuan-Bradford Joint Research Laboratory for Polymer Microprocessing was recognized by MOST in 2014



**Chinese Scholarship Council** one year awards



## 111 Programme - Introducing Talents



### A Programme for Introducing Talents from leading institutions or groups to Chinese Universities

1,000 leading scholars from top 100 Institutions in the world: To help to build 100 leading research bases in Chinese universities. Announced 12 September 2012:

#### Sichuan University team:

Leader – Prof Guangxian Li  
Prof Qi Wang, Prof Q Fu, Prof Y Z Wang, Prof LY Chu, Prof Z M Li, Prof C H Zhang, Prof S Y Guo, Prof. C.S. Zhao, Prof H.S. Xia, Prof Q. Yang, Prof J. Zhang, Prof Y.H. Chen

#### International Team:

Leader Prof. P.D. Coates, Bradford University  
Prof. A. Bismarck, Imperial College London  
Prof. BS. Hsiao, Stony Brook Uni  
Prof. L. Ambrosio, CNR-IMCB, Italy  
Prof. DA. Schiraldi, Case Western Reserve Univ  
Prof. P. Ducheyne, Univ of Pennsylvania  
Prof. S. Rimmer, Sheffield Univ (now Bradford)  
Prof H.J. Sue, Dr. M. Lavorgna;  
Dr B. Whiteside, Dr P. Caton-Rose, Dr P. Twigg  
University of Bradford  
Dr J.J. Wu, Durham University

Budget: Total: 9 million RMB in 5 years (renewable) - National 450m RMB ; SCU supporting fund: 450m RMB

#### Research co-operation areas:

1. New theories and technologies in polymer processing
  - Evolution and controlling of multi-level-structures in polymeric materials during processing
  - New theory and technology for micro-processing
2. High performance and functional polymeric materials
  - High-performance materials based on common polymers'
  - Environment friendly polymer materials
  - Environment friendly polymer materials

### RCUK –MOST Joint Call, April 2012



### Biomaterials for Joint Soft Tissue Repair Improving Health in Older Age

the only project funded from 37 applications, announced December 2012:

Led by Dr Pete Twigg (University of Bradford) and Dr Chuhong Zhang (Sichuan University).  
University of Bradford Dr Pete Twigg, Prof Phil Coates, Dr Colin Grant, Dr Fin Caton-Rose, Dr Leigh Mulvaney-Johnson, Dr Ben Whiteside;  
State Key Laboratory of Polymer Materials Engineering, Sichuan University Dr Chuhong Zhang, Prof Qi Wang, Li Li, Ning Chen, Xi Wang, Xiao Chen, Yujun Yang, Jun Zhu, Huan Wang, Jia Wan;

Institute of Chemistry, Chinese Academy of Sciences / Profs Dong Qiu, Dujin Wang, Yunlan Su  
Sheffield University Dr Aileen Crawford  
Durham University Dr Junjie Wu  
Start date: April 2013 China/ June 2013 UK

Budget: £200k from Medical Research Council, UK, and 2M RMB from MOST, China.

Osteoarthritis is a currently incurable condition and a leading cause of functional disability and loss of independence in older adults globally, causing significant economic impact (1-2% GDP). This project proposes a novel cell-conducting osteochondral implant for the treatment of osteoarthritis and traumatic lesions of articular cartilage, which have a similar prevalence in Chinese and Caucasian populations. The implant is a polyvinyl alcohol-based hydrogel nanocomposite, which exhibits compositional/structural regions that mimic the appropriate biomechanical properties of the different regions of native tissue (i.e. subchondral bone, mineralised cartilage and cartilage) and support regeneration of cartilage tissue in situ. This implant should extend the pain-free function of osteoarthritic joints, thereby enhancing patient quality of life and mobility while reducing patient demands on health and social support services. In addition, the need for total joint replacement, with its potential problems of prosthesis loosening and limited lifespan, would be delayed.

This collaboration brings together the requisite multidisciplinary and complementary strands of research, and essential scientific expertise, from the partner institutions into a world class team to conduct the project. The proposal builds on links made through the existing RCUK Science Bridges China programme and will receive additional support through the RCUK Global Exchanges programme.

**UK team:** Our research focus is to fabricate a cell-conducting osteochondral implant scaffold; the material is a polyvinyl alcohol-based hydrogel nanocomposite. Initially the thrust of the research was to optimise the use of established experimental freeze-thaw techniques utilising Poly(vinyl alcohol) (PVA) and  $\beta$ -Tricalcium ( $\beta$ -TCP). The objective is to produce a modified protocol to facilitate a robust testing of the dynamic, mechanical and biocompatibility of the scaffold material. Process variables have included a range of weight % (15-30) and low to high molecular weight (89-98 & 146-186) of the PVA.

Varying the composition of the hydrogel and also the cross-linking is attributable to a change in the functionality of a polymer that can alter the results obtained from Dynamic Mechanical Analysis (DMA). The hydrogel is a viscoelastic substance; to investigate the viscous and elastic characteristics when undergoing deformation both storage modulus ( $E'$ ) elasticity and loss modulus ( $E''$ ) viscosity are to be investigated from the Macro (dynamic compression & torsion), Micro (nanoindentation) and nano (AFM) DMA perspective.

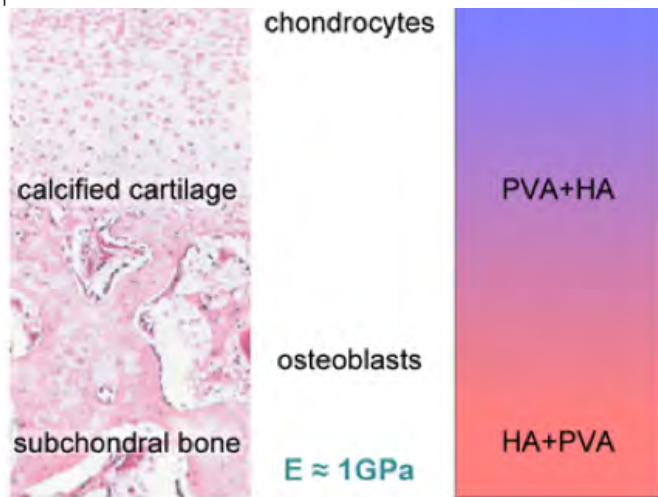
A Bose Electro Force 3200 was the apparatus utilised to produce DMA data from the hydrogel. The sinusoidal stress was pre-set to represents a physiological frequency range 0.1-10Hz (walking mode = 1Hz). The recent delivery of a Biomomentum Mach-1 will facilitate additional torsion tests of the hydrogel. The significance of this new apparatus will be to apply a torsional stress that should allow the study of the intrinsic material properties with reduced fluid exudation from the material. This new data will be compared to the previous compression testing.

The work includes the fabrication of a functionally graded material with a modulus range of approximately 1000X between the extremes of the material. This is necessary to mimic the properties of both cartilage and subchondral bone.

**Sichuan** researched material combinations, including PVA

/ Bioceramics Composites Prepared by Solid state shear milling (S3M) & Thermal Processing; PVA / Gel / Bioceramics Composites Prepared by S3M & Thermal Processing and Thermal Foaming of PVA / Bioceramics Composites. By combining our two developed technologies, thermal processing of PVA and S3M, PVA/bioactive particle composites have been successfully prepared, particle content can reach to 40wt%. The in-situ degradation of collagen fibers to gelatin during thermal processing has been achieved, greatly improving the thermal processability of PVA/bioactive particle composites; Using water as physical blowing agent and bioactive particles as nucleating agent, PVA foams with uniform porous structure have been prepared. These materials have potential applications in the biomedical field, e.g. soft tissue repair.

ICCAS are researching bioactive nanoparticles with well controlled structure, particularly exploring gradient biomaterials for cartilage repair with bioactive glass particles, and polymer-particle interactions.



Property gradient PVA-HA hydrogel composite with TriCalcium Phosphate

## Royal Academy of Engineering UK-China research exchange scheme



### Deformation and Fracture Behavior of Polymer Materials

Dr Zhiyong Jiang of Changchun CIACAS, March 2014

**Research undertaken:** the research focuses on the relationships between nanostructure and macroscopic mechanical properties in polymeric materials, in particular with respect to the effects of processing length scales from micro to macroscopic moulding.

**Original objectives of the award and subsequent main achievements:** our original objectives are to explore the role of tie molecules in the tensile deformation and fracture behavior of polymer materials and provide a whole picture of the mechanisms and laws controlling deformation and fracture in the solid polymeric products. The main achievements of the project include:

(a) A series of samples were fabricated via processing at different length scales from micro to macroscopic injection moulding under various moulding conditions (varying injection velocity, melt temperature, and mold temperature), including

poly( $\epsilon$ -caprolactone) (PCL) and its miscible blends with noncrystallizable poly(styrene-co-acrylonitrile) (SAN) in different proportions, polyethylene, and polypropylene.

(b) The structural evolution of macroscopic moulded PCL was investigated as a function of deformation ratio and crystallization temperature using an in situ synchrotron small-angle X-ray scattering (SAXS) technique. The correlation between the cavitation and the plastic deformation of lamellar crystals as well as their influence on the deformation behaviour of PCL were elucidated based on the SAXS observations. At small deformations, intralamellar crystalline block slips and fragmentation of lamellae greatly stimulated the generation of cavities with their normal perpendicular to the stretching direction, which in turn promoted crystallite shearing quite remarkably during stretching. The oriented cavities with a major axis dimension of several hundreds of nanometers were found to assemble in the interfibrillar regions even at moderate strains where the stress-induced fragmentation and recrystallization just sets in. Accordingly, the long spacing of the newly developed lamellae remained essentially constant after the lamellar-to-fibrillar transition, regardless of the degree of cavitation which occurred in the samples. Upon further deformation the cooperative deformational behavior mediated via slippage of fibrils (stacks of lamellae with their normal parallel to the stretching direction) was evidenced. The extent of this slippage depended on the crystallization temperature, which could be traced back to the significantly different coupling forces imposed by chains connecting adjacent fibrils. The interaction between fibrils decreased with increasing crystallization temperature due to cavities acting as an effective diluent of the interfibrillar entanglements thus increasingly facilitating further sliding of the fibrils leading finally to more shrinkage of the stretched interlamellar amorphous layers during stretching.

(c) The microstructure and deformation behavior of micro-molded PCL/SAN blends were studied as a function of blend composition and melt temperature. It was found that the melt temperature during injection moulding plays a dominant role in determining the mechanical property of the blends. As it appears, the mixtures molded at a melt temperature of 100 oC show brittle fracture under tensile deformation, whereas the samples molded at a melt temperature of 180 oC exhibit ductile behavior apparently. Subsequently, a structural characterization of the different blends was carried out by SAXS. As was found, an injection moulding-induced phase separation between PCL and SAN occurs in the blends molded at a melt temperature of 180 oC. Moreover, the crystalline lamellae of the blends molded at a melt temperature of 100 oC display a higher degree of orientation as compared to those processed at a melt temperature of 180 oC thus leading to a smaller elongation at break. The discrepancy between the degrees of orientation derived from the two sets of blends is due to the fact that the incorporation of SAN practically affects the state of the PCL amorphous phase. In the case of samples molded at a melt temperature of 100 oC, the interactions between lamellae become weaker because of a significant decrease of concentration of tie molecules and an increase in the concentration of chain ends that may easily be freed during deformation, and thus resulting in a less extent of relaxation of lamellar crystals upon solidification from the melt. In summary, a major part of the original work programme submitted in the application form has been completed during the visit. For example, samples with different crystalline morphology and aggregation structure were obtained through controlled shaping operations. Extensive investigations on the mechanical properties of the as-received products have been carried out utilizing true stress-strain measurements. Additionally, the influence of processing conditions and tie molecule density on the deformation behavior has been unraveled by SAXS.

## Advanced processing physics of micro moulding and die drawing of polymers for control of properties



Prof Yongfeng Men, Changchun CIAC Chinese Academy of Sciences &  
Prof Phil Coates FEng, Polymer IRC, Bradford

The focus of the proposed research is understanding and control of polymer morphology via melt and solid phase orientation processing routes to obtain enhanced product properties. We focus on commercially available polyolefins and polylactic acids (PLA), which are of interest for their biomedical and mechanical applications.

### Objectives

- (i) to understand hierarchical process structuring during micro moulding and die drawing of typical semi-crystalline polymers;
- (ii) to build relationships between morphology and mechanical properties of specially structured polymer products;
- (iii) to establish inter-linkages among polymer molecular parameters, processing conditions and mechanical properties for tailor-making smart polymeric products out of ordinary materials using the advanced processing technologies.

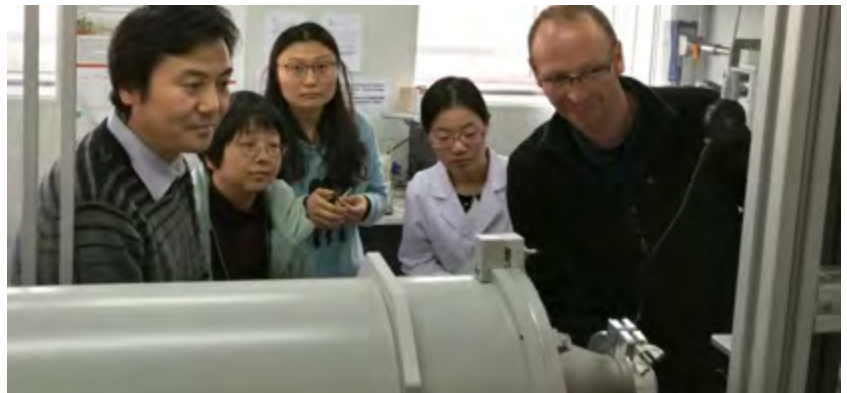
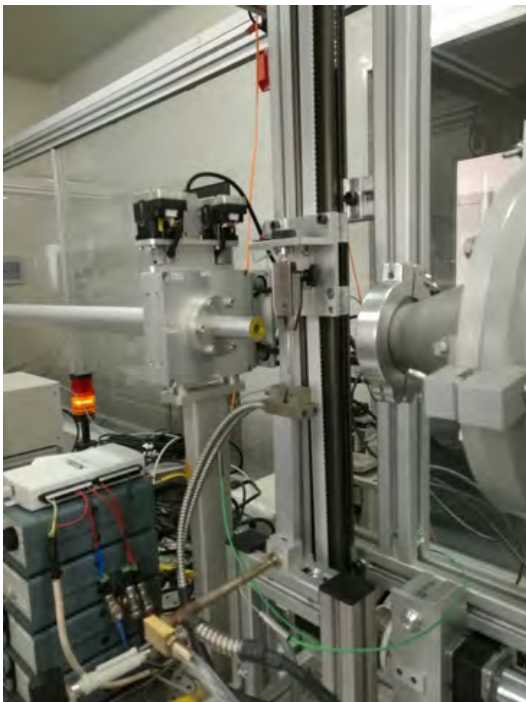
Programme: September 2015- September 2019.  
Budget: £111k from the Royal Society Newton Fund.

Our research team includes Fin Caton-Rose, Ben Whiteside, Tim Gough, Glen Thompson, David Barker and Xiaolei Wang; Yuqing Lai, Zhiyong Jiang, Jidong Zhang, Ying Lu, Dong Lyu, Liao Tao.

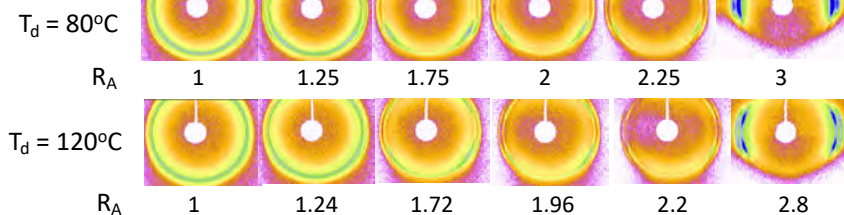
We have achieved world-first in-situ time-resolved microbeam xray structure measurements in both die drawing and micromoulding!

Bradford die-drawing equipment installed in the X-ray beam line at Changchun CIACAS, and in the Shanghai Synchrotron Radiation Facility, with world-first in-situ SAXS and WAXS measurements of structure changes are shown below. The latest in-situ experiments on micromoulding of an HDPE, in the synchrotron SSRF 19U are shown on the next page.

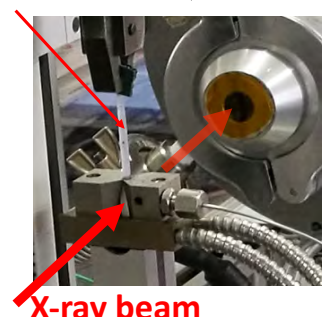
### Solid phase orientation processing - die drawing:



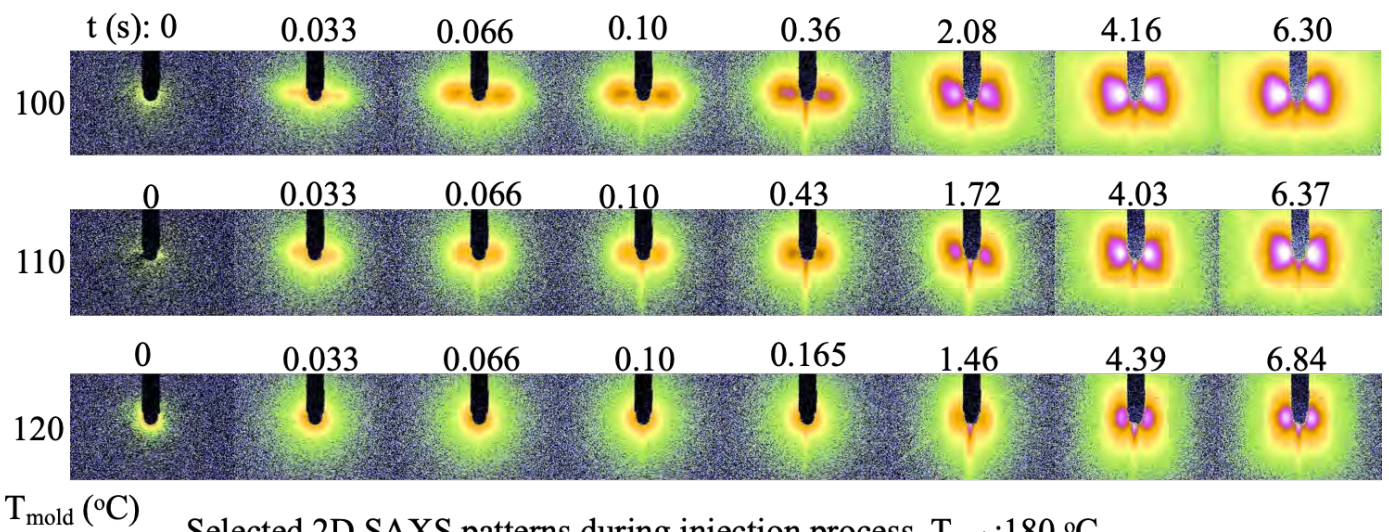
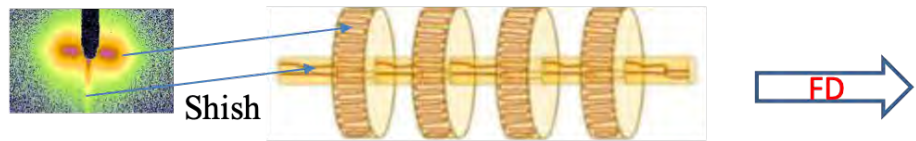
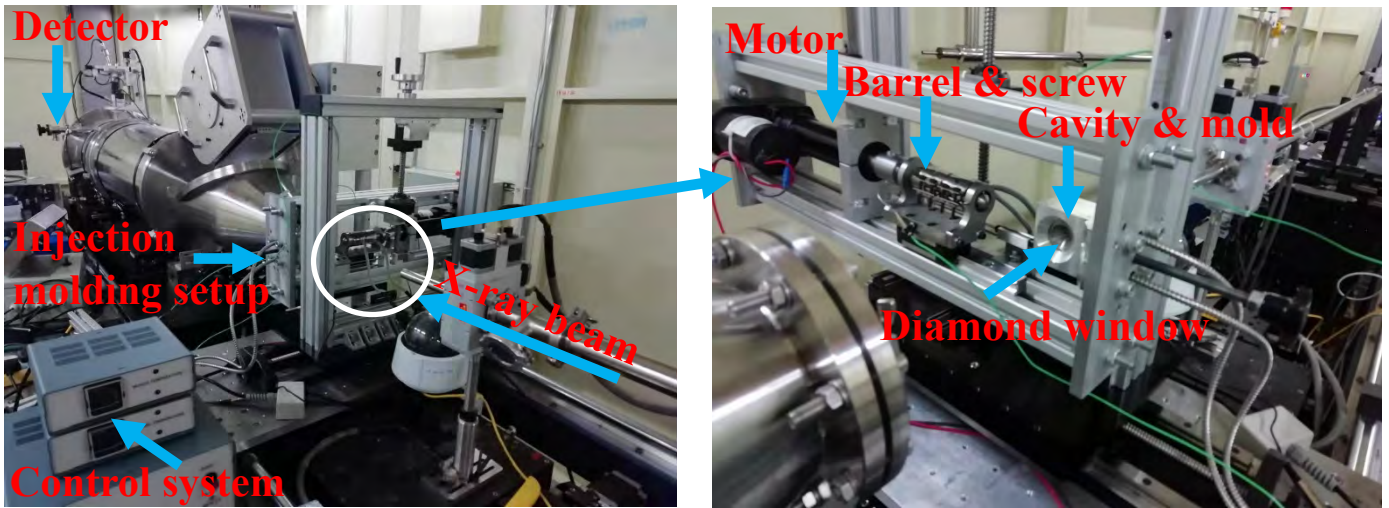
### Die drawing



Die drawn rod ↑  
drawing  
direction  
vertical  
↓



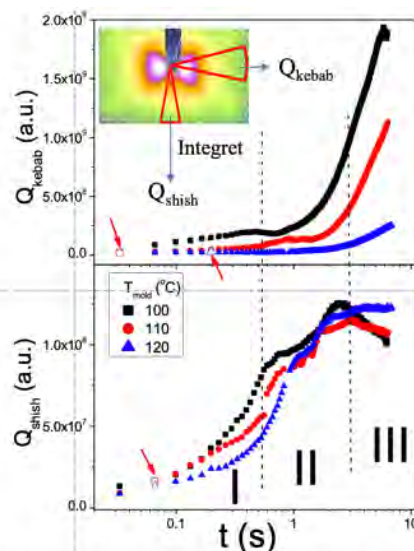
Micromoulding - first in-situ beam line measurements of structure development:



$$Q \propto \Phi_c (1 - \Phi_c) (\rho_{e,c} - \rho_{e,a})^2$$

$Q_{kebab} > Q_{shish}$ ,  
Higher content of kebab  
than shish

- Three stages:  
 I. During injection (flow field)  
 II. Crystal growth, shish growth (no flow field)  
 III. Crystal growth, shish relax (no flow field)



The evolution of “invariant” along meridional direction  $Q_{kebab}$  (top) and equatorial streak  $Q_{shish}$  (bottom) as a function of time

# Science Bridges China/ AMRI

## Advanced Materials Research Workshops

Research Workshops have proven to be a major vehicle for development of our community, along with Researcher Exchanges.

At the Research Workshops, technical information is presented by senior and early career researchers, and collaboration plans and bids are discussed. These began under the Science Bridges China grant (following Open Innovation Workshops in Changzhou and Guangzhou) but have continued outside of that funding, which is a testimony to the strength of our 'People Bridges'

1. Beijing, 14-15 November 2011 co-hosted by BUCT and Bradford
2. Chengdu, 19-21 April 2012 co-hosted by Sichuan and Bradford - *founding of UK-China AMRI*
3. Bradford, 18-20 September 2012
4. Chengdu, 25-26 March 2013 co-hosted by Sichuan and Bradford
5. Bradford, 26-28 November 2013
6. Beijing, 5-6 May 2014 co-hosted by ICCAS, BUCT and Bradford
7. Bradford, 8-10 September 2015, co-hosted by UKIERI
8. Chengdu, 6-8 December 2016, Newton Researcher Links/ Sichuan-Bradford
9. Bradford, 25-27 July 2017
10. Bradford 18-20 September 2018 – P70/UK-China AMRI joint meeting
11. Chengdu, 30-31 August 2019, co-hosted by Sichuan and Bradford
12. *due to be held in Bradford, September 2020*
13. *due to be held in Beijing, 2021*

By bridging the excellence we have, and the excellence in China, we can actually add value to both nations' future potential  
*Professor Peter York*

These were preceded by our **People Collaboration Programmes** in 2008-9, with:

- EPSRC Virtual Institute for Polymer Process Structuring (VIPPS) meeting at Bradford, 15-20 September 2008
- EPSRC VIPPS meeting in Chengdu, 23-25 March 2009 and special events:
  - **Science Bridges China Launch**, Royal Society London, 2 February 2010
  - **Shanghai Expo** 'Celebrating Friendship with China', UK Pavilion, 23 Sept 2010



with Sunan Jiang, Chinese Embassy Minister Counsellor for Science, at PPE'17/AMRI 9, Bradford July 2017







P70/AMRI 10, Bradford September 2018



AMRI 11, Chengdu August 2019



# British Council Newton/ NSFC Researcher Links Workshop for Early Career Researchers

Healthcare Technologies for Aging Populations



## 2016 China–UK Researcher Links Workshop on Healthcare Technologies for Aging Populations

December 5–8, 2016, Chengdu



We had a most enthusiastic input to our Researcher Links Workshop 'Healthcare Technologies for Aging Populations' in Chengdu (see [www.ukchina-amri.com](http://www.ukchina-amri.com)), with 35 early career researchers (ECR) from 11 UK universities and 7 Chinese institutions, supported by 6 Sichuan and Bradford mentors. These were complemented by 7 (six Chinese, one UK) research leaders supporting this workshop, plus 2 Sichuan Province and 4 UK government representatives.

Building on our Science Bridges China platform's 9 previous Workshops, it was particularly exciting to see the energy and commitment from all attendees with the focus on ECRs. They all shared expertise and looked enthusiastically for new research collaborations via:

- technical presentations in themes of biomedical materials for tissue repair, biomechanical/medical technology, incorporating actives and generic issues, each with 2 keynotes from research leaders/mentors;
- group activities on healthcare context and Early Career Researcher career needs, and
- a workshop session on Creating and

Taking Opportunities, including funding routes and a Mentor Panel for advice. This led to 25 excellent bids for 8 Researcher Exchanges we had secured as a very distinct output from the Workshop - supported by the Poymer IRC Bradford and our EPSRC MeDe Centre of Innovative Manufacturing in Medical Devices. This has been expanded by support from our 5 core Chinese institutions, so at least 13 research exchanges will occur. Prof Xia wrote they "shared with each other their excellent work to create innovative ideas based on their research strength. Phil carried a bag of ideas to UK. Those ideas are our future!" That is so true - and we are strongly committed to the next generations of researchers and leaders, and the Workshop. Excellent visits to the Sichuan host laboratories, a medical device company, and the panda research station added much value. The warmth of Sichuan hospitality and its wonderful food made a great impact!

The Science Bridges China (led by Bradford) and MeDe Innovation (co-directed by Bradford) networks has been constructively expanded in terms of the

Those ideas are  
our future!  
*Professor Hesheng Xia*

range of UK universities involved. It was a very harmonious team effort, built on the warmth of previous collaborations, to mutual benefit. It added further opportunities for co-operation for us in China, through the involvement (keynote, plus lab visit) of the National Engineering Research Centre in Biomaterials, Sichuan University.

Senior mentors from 4 leading Chinese groups (ICCAS, Changchun CIACCAS, SIMMCAS and BUCT, +1 extra from Bradford), came at their own expense, adding much extra value to the mentors, and the ECR attendees. We appreciate greatly and will build on this warm expression of co-operation.

A range of other outcomes (including joint grant bids and other co-operations such as sharing materials and facilities) are being pursued. Also, support for other visits will come via other routes, e.g. our Royal Society Newton programme, and some Chinese institution schemes.



# Bradford Polymer IRC - China Joint Research Laboratories

Joint International Laboratory for Polymer Micro Processing, with SKLPME, Sichuan University, 2010:



Prof Wang, Prof Guangxian Li, Prof Phil Coates and Prof Qi Wang unveiling the plaque



This Joint Laboratory received MOST approval in 2014 as a top level laboratory for international co-operation in China

**Joint International Laboratory for Polymer Process Physics,  
with Changchun Institute of Applied Chemistry, CAS – September 2015:**



Prof Coates & Prof Xianiu Yang, Bradford & Changchun teams at the 7th UK-China AMRI Research Workshop, Bradford, Sept 2015

**Joint International Laboratory for Soft Matter Technologies with Beijing University of Chemical Technology,  
December 2016**



Prof Phil Coates and Prof Liqun Zhang at the British Council Newton Researcher Links/ UK-China AMRI 8th Research Workshop, Chengdu December 2016

# Journal Publications associated with the Science Bridges China/ UK-China AMRI platform

An excellent range of high quality journal papers – a growing pipeline – in strategic topics have arisen from the Science Bridges China/ UK-China AMRI platform, particularly through Researcher Exchanges and joint research programmes.

## 2012

Wei T, Lei L, Kang H, Qiao B, Wang Z, Zhang L, Coates P D, Hua K-C, Kulig J Tough Bio-based Elastomer Nanocomposites with High Performance for Engineering Application. *Advanced Engineering Materials*, 14, Nos1-2, 112-118 DOI: 10.1002/adem.201100162 2012

Li H-Y, Yin X-Z, Ji J-Q, Sun L-X, Shao Q, York P, Xiao T-Q, He Y, Zhang J-W, Microstructural Investigation to the Controlled Release Kinetics of Monolith Osmotic Pump tablets via Synchrotron Radiation X-ray Microtomography, *Int J Pharm*, 2012, 427(2): 270-275. DOI: 10.1016/j.ijpharm.2012.02.017

Mardaryev A.N. , Rapisarda V. , Bo L., Xu G. and Botchkarev V.A., Transcription factor inhibits the expression of non-epidermal lineage genes in keratinocytes via regulation of the Polycomb component Cbx4. *Journal of Investigative Dermatology*, 2012, 132, (2), 63

## 2013

H Kang, B Qiao, R Qiang, Z W Qiang, L Zhang, J Ma, P D Coates, Employing a novel bioelastomer to toughen polylactide, *Polymer*, doi: <http://dx.doi.org/10.1016/j.polymer.2013.02.053> (2013)

G-X Fei, C Tuinea-Bobe, D-X Li, G Li, B Whiteside, P D Coates and H-S Xia, Electro-activated surface micropattern tuning for microinjection molded electrically conductive shape memory polyurethane composites *RSC Advances* (Impact Factor: 3.71). 12/2013; 3(46):24132-24139. DOI: 10.1039/C3RA43640C 2013

X Lin, A Kelly, D-Y Ren, M Woodhead, P D Coates, K-S Wang. Geometrical Dependence of Viscosity of Polymethylmethacrylate Melt in Capillary Flow *Journal of Applied Polymer Science* (Impact Factor: 1.4). 12/2013; 130(5):3384-3394. DOI: 10.1002/APP.39591 2013

Coates P D., Caton-rose P., Ward I M, Thompson G. Process structuring of polymers by solid phase orientation processing *Science China-Chemistry* 05/2013; 56(8): 1017–1028. DOI: 10.1007/s11426-013-4881-1 2013

X Lin, F Caton-Rose, D-Y Ren, K-S Wang, P D Coates. Shear-induced crystallization morphology and mechanical property of high density polyethylene in micro-injection molding *Journal of Polymer Research*; 20(4):122-131. DOI: 10.1007/s10965-013-0122-8 2013

X-W Zhao, L Ye, P D Coates, F Caton-Rose, M Martyn. Structure and blood compatibility of highly oriented poly(lactic acid)/thermoplastic polyurethane blends produced by solid hot stretching *Polymers for Advanced Technologies* 09/2013; 24(9): 853-860. DOI: 10.1002/pat.3156 2013

Z-Y Jiang, Y-T Wang, L-L Fu, B Whiteside, J Wyborn, K Norris, Z-H Wu, P D Coates, and Y-F Men. Tensile Deformation of Oriented Poly( $\epsilon$ -caprolactone) and Its Miscible Blends with Poly(vinyl methyl ether) *Macromolecules*, Vol. 46, No. 17, pp. 6981–6990; IF5.927. DOI: 10.1021/ma401052x. 2013

## 2014

X Lin, A Kelly, M Woodhead, D-Y Ren, K-S Wang, P D Coates. Capillary Study on Geometrical Dependence of Shear Viscosity of Polymer Melts *J App Poly Sci* 03/2014; 131(6). DOI:

10.1002/APP.39982, 2014

J Xue, M He, H Liu, Y Niu, A Crawford, P D Coates, D Chen, R Shi, L Zhang, Drug loaded homogeneous electrospun PCL/gelatin hybrid nanofiber structures for anti-infective tissue regeneration membranes, *Biomaterials*. 08/2014; 35(34):9395-9405. DOI: 10.1016/j.biomaterials.2014.07.060, 2014

W Bao, H Wu, S Guo, A Paradkar, A Kelly, E Brown, P Coates Effect of Ultrasound on Molecular Structure Development of Polylactide *Poly-Plast Technol Eng* 06/2014; 53(9):927-934. DOI: 10.1080/03602559.2014.886062, 2014

Chen Zhang, Xiujuan Jiang, Zhiyang Zhao, Lixin Mao, Liqun Zhang, Phil Coates Effects of wide-range gamma-irradiation doses on the structures and properties of 4,4'-dicyclohexyl methane diisocyanate based poly(carbonate urethane)s *Journal of Applied Polymer Science* (Impact Factor: 1.4). 11/2014; 131(22): 41049. DOI: 10.1002/app.41049 , 2014

Xue, J.; He, M.; Liang, Y.; Crawford, A.; Coates, P.D.; Chen, D.; Shi, R.; Zhang, L. Fabrication and evaluation of electrospun PCL-gelatin micro-/nano-fiber membranes for anti-infective GTR implants *Journal of Materials Chemistry B*, 2(39): 6867-6877. DOI: 10.1039/C4TB00737A, 2014

Xue Li, Hailan Kang, Jianxiang Shen, Liqun Zhang, Toshio Nishi, Kohzo Ito, Changming Zhao, Phil Coates Highly Toughened Polylactide with Novel Sliding Graft Copolymer by in Situ Reactive Compatibilization, Crosslinking and Chain Extension *Polymer*. 01/2014; Vol. 55, No. 16, pp. 4313-4323. Impact Factor: 3.766 DOI: 10.1016/j.polymer.2014.06.045, 2014

Jiajia Xue, Min He, Yuzhao Niu, Hao Liu, Aileen Crawford, Phil Coates, Dafu Chen, Rui Shi, Liqun Zhang Preparation and in vivo efficient anti-infection property of GTR/GBR implant made by metronidazole loaded electrospun polycaprolactone nanofiber membrane *International Journal of Pharmaceutics*, Volume 475, Issues 1–2, 20 November 2014, Pages 566-577. Impact Factor: 3.785 DOI: 10.1016/j.ijpharm.2014.09.026, 2014

Z-Q Li, X-W Zhao, L Ye, P D Coates, F Caton-Rose, M Martyn. Structure and blood compatibility of highly oriented PLA/MWNTs composites produced by solid hot drawing *Journal of Biomaterials Applications* (Impact Factor: 2.64). 03/2014; 28(7):978-989. DOI: 10.1177/0885328213490047 , 2014

## 2015

J Xue, R Shi, Y Niu, M Gong, P D Coates, A Crawford, D Chen, W Tian, L Zhang Fabrication of drug-loaded anti-infective guided tissue regeneration membrane with adjustable biodegradation property *Colloids & Surfaces B: Biointerfaces*, DOI: 10.1016/j.colsurfb.2015.03.031, 2015

Li, Z ; Zhao, X ; Ye, L ; Coates, P D; Caton-Rose, P ; Martyn, M, Structure and blood compatibility of highly oriented poly(l-lactic acid) chain extended by ethylene glycol diglycidyl ether *Polymer* 56; 523-534 DOI: 10.1016/j.polymer.2014.11.035, 2015

Z Li, X Zhao, L Ye, P D Coates, P Caton-Rose, M Martyn Fibrillation of Chain branched Poly (lactic acid) with Improved Blood Compatibility and Bionic Structure, *Chem Eng J*, 279 767–776, DOI: 10.1016/j.cej.2015.05.082 2015

Y Gao, X Dong, L Wang, G Liu, X Liu, C Tuinea-Bobe, B

Whiteside, P Coates, D Wang, C C. Han Flow-induced crystallization of long chain aliphatic polyamides under a complex flow field: Inverted anisotropic structure and formation mechanism, *Polymer*; 73, 91-101; 2015 DOI: 10.1016/j.polymer.2015.07.029

Li, D., Fei, G., Xia, H., Spencer, P. E. and Coates, P. D. Micro-contact reconstruction of adjacent carbon nanotubes in polymer matrix through annealing-Induced relaxation of interfacial residual stress and strain, *J. Appl. Polym. Sci.*, 132 (33), 42416, 2015 DOI: 10.1002/app.42416 2015

L Meng, D Wu, A Kelly, M Woodhead, Y Liu Experimental investigation of the rheological behaviors of polypropylene in a capillary flow, *Journal of Applied Polymer Science* 133 (22) 2016

## 2016

Li Z, Ye L, Zhao X, Coates P, Caton-Rose F, Martyn M. High orientation of long chain branched poly (lactic acid) with enhanced blood compatibility and bionic structure. *J Biomed Mater Res A* 2015:00A:000-000. DOI: 10.1002/jbm.a.35640 2016

X Lin, JW Tian, PH Hu, R Ambardekar, G Thompson, ZM Dang, P Coates, Improved dielectric performance of polypropylene/multiwalled carbon nanotube nanocomposites by solid-phase orientation *J App Poly Sci.* 133 (3) 42893 DOI: 10.1002/app.42893, 2016

## 2017

X Lin, L Fan, D Ren, Z Jiao, P Coates, We Yang Enhanced dielectric properties of immiscible poly (vinylidene fluoride)/low density polyethylene blends by inducing multilayered and orientated structures *Composites B Eng.* DOI: 10.1016/j.compositesb.2017.01.065 2017

Li, Z., Ye, L., Zhao, X., Coates, P., Caton-Rose, F., & Martyn, M. Structure and biocompatibility of highly oriented poly(lactic acid) film produced by biaxial solid hot stretching, *J Indust Eng. Chem.*, 52, 338-348, 2017

Li, J., Li, Z., Ye, L., Zhao, X., Coates, P., Caton-Rose, F., & Martyn, M. Structure evolution and orientation mechanism of long-chain-branched poly (lactic acid) in the process of solid die drawing, *Europ.Poly J*, 90, 54-65, 2017

L Meng, D Wu, A Kelly, M Woodhead, Y Liu, Comparisons of the rheological behaviors of polypropylene and polymethyl methacrylate in a capillary die, *J App. Poly Sci* 134 (12) 2017

LS Taylor, J Rantanen, A Paradkar, Y Kawashima, J Zhang Professor Peter York—A Distinguished Career in Powders, Processing, and Particle Design, *J Pharma Sci* 106 (1), 2-4

## 2018

S Korde, S Pagire, H Pan, C Seaton, A Kelly, Y Chen, Q Wang, P Coates, A Paradkar, Continuous Manufacturing of Cocrystals Using Solid State Shear Milling Technology *Cryst Growth & Design* 18(4) DOI: 10.1021/acs.cgd.7b01733 March 2018

Y Lu, G Thompson, D Lyu, P Caton-Rose, P Coates, Y Men, Orientation direction dependency of cavitation in pre-oriented isotactic polypropylene at large strains, *Soft Matter* 14(22), DOI: 10.1039/C7SM02446K March 2018

Lin X, Li K, Gough T, Coates P, Wang D, Zhang L, Influence of the morphological structure of carbon nanotubes on the viscoelasticity of PMMA-based nanocomposites, *J App Poly Sci* 135(27):46444 DOI: 10.1002/app.46444 March 2018

Y Meng, L Ye, P Coates, P Twigg, In Situ Crosslinking of Poly(Vinyl Alcohol)/Graphene Oxide-Polyethylene Glycol Nano-Composite Hydrogels as Artificial Cartilage Replacement: Intercalation Structure, Unconfined Compressive Behavior and Bio-Tribological Behaviors, *J Phys Chem C* 122(5) DOI: 10.1021/acs.jpcc.7b12465 January 2018

## 2019

Li, J; Ye, L; Coates, P Caton-Rose, P; Zhao, X, Multiple Shape Memory Behavior of Highly Oriented Long-Chain-Branched Poly(lactic acid) and Its Recovery Mechanism *J Biomedical Materials Research Part A*, 107, 4, 872-883 <https://doi.org/10.1002/jbm.a.36604>

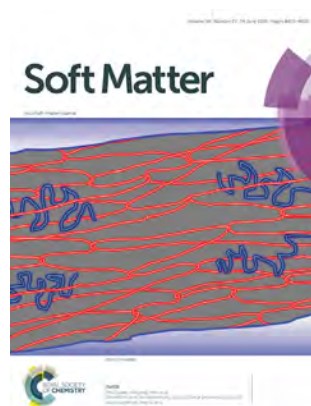
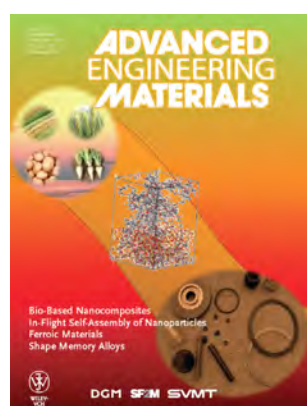
D Lyu, Y Sun, G Thompson, Y Lu, P Caton-Rose, Y Lai, P Coates, YF Men Die geometry induced heterogeneous morphology of polypropylene inside the die during die-drawing process *Polymer Testing*, 74, 2019, pp. 104-112

X Zhang, C Wang, M Liao, L Dai, Y Tang, H Zhang, P Coates, F Sefat, L Zheng, J Song, Z Zheng, D Zhao, M Yang, W Zhang, P Jia, Aligned electrospun cellulose scaffolds coated with rhBMP-2 for both in vitro and in vivo bone tissue engineering *Carbohydrate Polymers* Volume 213, June 2019, 27-38 <https://doi.org/10.1016/j.carbpol.2019.02.038>

Liao T, Zhao X, Yang X, Coates P, Whiteside B, Jiang Z, Men YF, Structural evolution of flow-oriented high density polyethylene upon heating: In situ SAXS and WAXD studies, *Polymer*, 180, 121698 doi.org/10.1016/j.polymer.2019.121698

Z Zhao, Q Yang, P Coates, B Whiteside, A Kelly, YJ Huang, P P Wu, Structure and Property of Microinjection Molded Poly(lactic acid) with High Degree of Long Chain Branching, *Ind. Eng. Chem. Res.* 2018, 57, 11312-11322 DOI: 10.1021/acs.iecr.8b01597

Liao T, Zhao X, Yang X, Whiteside B, Coates P, Jiang Z, Men YF, Predicting the Location of Weld Line in Microinjection Molded Polyethylene via Molecular Orientation Distribution, *J. Poly. Sci. B: Polymer Physics*; in press.



# Researcher Exchanges

## China to UK – Science Bridges China supported

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Dr	Chen	Ning	Sichuan University	UoB	Poly(vinyl alcohol)-based composite products for drug delivery	29/06/2011	24/07/2011
Dr	Fei	Guoxia	Sichuan University	UoB	Solid phase processing of PLA based blends and composites for blood-contacting medical devices	29/06/2011	24/07/2011
Dr	Wu	Hong	Sichuan University	UoB	Effects of ultrasound on molecular structure development and drug release behaviors of PLA.	29/06/2011	24/07/2011
Dr	Zhao	Xiaowen	Sichuan University	UoB	Electrically Conductive Polyurethane/Carbon Nanotubes Composites for Medical Microdevices	29/06/2011	24/07/2011
Dr	Dong	Xia	ICCAS	UoB	Orientation Study of PA1012 Material by Microinject Preparation	13/01/2012	25/01/2012
Dr	Liu	Guoming	ICCAS	UoB	Characterization of the spatial distribution of microinjection parts by micro-beam X-ray scattering	13/01/2012	25/01/2012
Dr	Jiang	Zhiyong	CIACCAS	UoB	Structure and Properties of Micro-Molded Poly( $\epsilon$ -caprolactone) and Its Miscible Blends	12/05/2012	12/06/2012
Dr	Gao	Ying	CIACCAS	UoB	Correlation between Thermal Analysis and X-ray Diffraction of Micro Moulding Polypropylene	08/06/2012	06/07/2012
Dr	Lin	Xiang	BUCT	UoB	Geometrical dependence of shear viscosity in capillary flowing: slip behaviour and pressure sensitivity	06/09/2012	01/10/2012
Dr	Bai	Shibing	Sichuan University	UoB	Preparation of Waster PP/PE Material with High Performance by Pan-milling and Biaxial Stretching	15/09/2012	07/10/2012
Dr	Chen	Ning	Sichuan University	UoB	Poly(vinyl alcohol)-based composite products for drug delivery	15/09/2012	07/10/2012
Dr	Fei	Guoxia	Sichuan University	UoB	Solid phase processing of PLA based blends and composites for blood-contacting medical devices	15/09/2012	07/10/2012
Dr	Wu	Hong	Sichuan University	UoB	Effects of ultrasound on molecular structure development and drug release behaviors of PLA.	15/09/2012	07/10/2012
Mr	Yin	Xianzhen	SIMM	UoB	taste masking, architecture of DDS and extrusion materials	13/01/2012	21/01/2013
Prof	Zhang	Jiwen	SIMM	UoB	taste masking, architecture of DDS and extrusion materials	13/01/2012	21/01/2013
Ms	Guan	Yinyan	ICCAS	Sheffield University	Highly Branched Poly(N-isopropyl acrylamide) Copolymers with Imidazole End Group	03/01/2013	02/02/2013
Ms	Jiang	Xiujuan	BUCT	UoB Durham & Sheffield	Evaluation of bioelastomers application for a novel artificial cervical disc	05/02/2013	20/03/2013
Dr	Liu	Ying	BUCT	UoB	Rheology of polymers for extrusion based micro-channel production	05/02/2013	20/03/2013
Ms	Meng	Limin	BUCT	UoB	Investigation on the rheological behavior for polymer in micro channel	18/02/2013	20/03/2013
Ms	Xue	Jiajia	BUCT	UoB	Electrospun Anti-inflammation Drug-loaded Guided Tissue Regeneration Membrane	20/02/2013	20/03/2013
Mr	Guo	Zhen	SIMM	UoB	Establishment of Evaluation and Prediction Models for Properties of Compounds based on QSPR	04/03/2013	26/03/2013
Dr	Jiang	Zhiyong	CIACCAS	UoB	Structure and Properties of Micro-Molded Poly( $\epsilon$ -caprolactone) and Its Miscible Blends	24/11/2013	23/12/2013
Dr	Li	Li	Sichuan University	UoB	structure formation and development of PVA-based composites during micro-processing and biaxial stretching	14/10/2013	12/02/2014
Dr	Lin	Xiang	BUCT	UoB	Capillary Rheology, Die drawing (biaxial), Rotational Rheology, and actuator and micro sensors with dielectric materials in seeking potential application of microinjection for the constructions of micro sensors	08/03/2015	06/04/2015



Ms	Wang	Lili	ICCAS	UoB	investigation of the microstructure distribution and crystallization transition of micro-injection long chain polyamide alloys	06/04/2015	26/04/2015
Mr	Yin	Xianzhen	SIMM	UoB	micro-needles array preparation	09/09/2015	19/09/2015
Ms	Cui	Yang	ICCAS	Nottingham University*	Manufacture, Characterisation, and Investigation of Particles on a Precisely Defined Scale	31/05/2016	30/06/2016
Ms	Ren	Huihui	ICCAS	Newcastle University*	Development and characterisation of a hybrid composite structure	April 2017	
Miss	Pu	Wuli	Sichuan University	University of Sheffield*	Utilizing 3D printed conductive polyurethane/carbon nano-tube composite as a template for patterned electrospinning	03/07/2017	03/08/2017
Mr	Fu	Daihua	Sichuan University	UoB/Southampton *	The Polymer Graphene Nano Composite Electrode for Wearable Stroke Rehabilitation	06/07/2017	04/08/2017
Mr	Liu	Yalong	Sichuan University	UoB	Preparation of PLA bone fixation material through solid hot stretching microfibrillation and its biological properties	13/07/2017	11/08/2017
Mr	Meng	Yeqiao	Sichuan University	UoB/Leeds*	High strength PVA composites for osteochondral implantation	13/07/2017	11/08/2017
Miss	Chen	Rong	Sichuan University	UoB *	High strength PVA composites for osteochondral implantation	August 2017	
Mr	Zhang	Wei	Sichuan University	UoB	The influence of a pattern formation on coaxial PLGA/Gelatin membranes on guided bone regeneration	17/09/2018	1/10/2018
Mr	Zhao	Zhongguo	Sichuan University	UoB	Materials Processing Engineering	01/01/2018	26/01/2018

\*Partially supported by EPSRC MeDe Centre for Innovative Manufacture of Medical Devices

### Chinese Scholarship Council Awards

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Prof	Chen	Yinghong	Sichuan University	UoB	Structure-Property Relationship of Polymer Nanocomposite under Micro-Processing Conditions	10/01/2011	12/01/2012
Prof	Yang	Qi	Sichuan University	UoB	Study on HDPE/UHMWPE blends through Die drawing method	13/04/2011	14/04/2012
Prof	Liu	Hesheng	Shangrao Normal University	UoB	computer modelling of polymer processing	26/11/2012	21/12/2012
Mr	Li	Dongxu	Sichuan University	UoB	micro processing of polymers	27/03/2013	27/03/2014
Dr	Li	Li	Sichuan University	UoB	structure formation and development of PVA-based composites during micro-processing and biaxial stretching	14/10/2013	12/02/2014
Mr	Han	Rui	Sichuan University	UoB	Preparation and characterization of High-performance Polypropylene and Polypropylene based composites via Solid Phase Processing	14/10/2013	11/10/2014
Mr	Zhao	Zhongguo	Sichuan University	UoB	Materials Processing Engineering	01/11/2017	31/10/2018
Dr	Gao	Xiaolong	BUCT	UoB	Functional polymer devices	Sept 2018	March 2019
Dr	Lin	Xiang	USTB	UoB	Processing and Characterisation of Multi-Functional Polymer Composites	1/11/18	31/10/19
Dr	Shikui	Jia	Shaanxi UT	UoB	Influences of fibrillation and stereocomplexation on strengthening and toughening of PLA-based blends via twin-screw extruder		

### Royal Academy of Engineering Research Award

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Dr	Jiang	Zhiyong	CIACCAS	UoB	Deformation and fracture behaviour of polymer materials - RAE Fellowship	08/07/2014	14/05/2015

## Sichuan Province International Scientific and Technological Cooperation and Exchange Project (Prof Lin Ye and Dr Fin Caton-Rose)

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Ms	Li	Zhengqiu	Sichuan University	UoB	High microfibrillation of PLA bone fixation material and its biological properties	07/09/2015	09/10/2015
Dr	Caton-Rose	Fin	UoB	Sichuan University	High microfibrillation of PLA bone fixation material and its biological properties	10/10/2016	15/10/2016

## Royal Society Newton Advanced Fellowship

(Prof Yongfeng Men of CIACCAS and Prof Phil Coates of UoB, 09/2015-09/2018)

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Dr	Ying	Lu	CIACCAS	UoB	Advanced processing physics of micro molding and die drawing of polymers for control of properties	02/01/2016	30/01/2016
Prof	Yongfeng	Men	CIACCAS	UoB	visits: 24/01/2016 - 30/01/2016; 18/07/2016 - 15/08/2016; 12/07/2017 - 08/08/2017; July 2018 - Aug 2018		
Dr	Yuqing	Lai	CIACCAS	UoB		18/07/2016	15/08/2016
Dr	Caton-Rose	Fin	UoB	CIACCAS	visits: 16/10/2016- 21/10/2016; Aug 2019		
Dr	Thompson	Glen	UoB	CIACCAS		22/10/2016	30/10/2016
Dr	Whiteside	Ben	UoB	CIACCAS		01/12/2016	05/12/2016
Dr	Nair	Karthik	UoB	CIACCAS		01/12/2016	05/12/2016
Dr	Lai	Yuqing	CIACCAS	UoB		12/07/2017	08/08/2017
Miss	Lyu	Dong	CIACCAS	UoB		16/09/2017	19/11/2018
Mr	Liao	Tao	CIACCAS	UoB		18/03/2018	17/05/2018
Dr	Jiang	Zhiyong	CIACCAS	UoB		6/05/2018	1/06/2018
Dr	Ying	Lu	CIACCAS	UoB		July 2018	
Dr	Yuqing	Lai	CIACCAS	UoB		July 2018	Aug 2018

## Sinopec/Bradford Project

Dr	Dali	Gao	SINOPEC	UoB	Solid Phase Orientation Processing of Selected Polymers	28/06/2016	23/09/2016
Dr	Liqui	Chu	SINOPEC	UoB	Solid Phase Orientation Processing of Selected Polymers	08/07/2019	19/08/2019
Mr	Yueming	Ren	SINOPEC	UoB	Solid Phase Orientation Processing of Selected Polymers	08/07/2019	19/08/2019

## UK to China - Science Bridges China supported

Title	Surname	First name	Institution	Visiting Institution	Project	Start	End
Mr	Ambardekar	Rohan	UoB	Changchun	Crystallisation/Orientaton	27/02/2013	31/03/2012
Prof	Paradkar	Anant	UoB	Sichuan University	processing and preparation of pharmaceuticals using the Solid State Shear Milling (S3M) technology	17/12/2012	22/12/2012
Mr	Korde	Sachin	UoB	Sichuan University	processing and preparation of pharmaceuticals using the Solid State Shear Milling (S3M) technology	17/12/2012	26/12/2012
Mr	Pagire	Sudhir	UoB	Sichuan University	processing and preparation of pharmaceuticals using the Solid State Shear Milling (S3M) technology	17/12/2012	28/12/2012
Dr	Tuinea-Bobe	Cristina	UoB	Sichuan University	on injected moulded PEEK samples crystallisation phases' analysis via TEM	15/03/2013	28/03/2013
Dr	Pattinson	Andrew	UoB	Sichuan University	Property gradient PVA-HA hydrogels	Aug 2015	Aug 2015
Dr	Paterson	Tom	Sheffield University	Beijing Jishuitan Hospital	Incorporation of antimicrobial agents into patterned electrospun membranes to provide protection against infection for dental & bone regeneration	04/04/2017	30/04/2017
Dr	Nair	Karthik	UoB	SIMM	Development and evaluation of novel hybrid microneedles containing highly potent drug	15/05/2017	15/06/2017
Dr	Paterson	Tom	Sheffield University	Sichuan University	3D Printed Electrically Conductive Polyurethane for Enhanced Osteoblast & Neuronal Proliferation for Novel Medical Devices	09/04/2018	24/04/2018



# High Level Meetings with Government

Science Bridges China is very visible with UK and Chinese central and local governments.

Our meetings include:

### **Ministry of Science & Technology:**

Regular meetings with Dr Longchao Zhou, Director for Europe, MOST Beijing (accompanied by Prof Liqun Zhang); and with

**Chinese Embassy UK**, Minister Counsellors for Science, Dr Futao Chen and Dr Sunan Jiang

### **RCUK and Science & Innovation Network**

Regular meetings with Grace Lang, Holly White, Karen Maddocks and team, in the UK Embassy, Beijing

### **December 2013 UK Government visit to China**

– Science Bridges China/ UK-China AMRI feature strongly.

UK Science Minister, David Willetts had a meeting on Innovation in Shanghai on 3 December 2013. Prof Jiwen Zhang of SIMM CAS was a member of the discussion panel at this event.

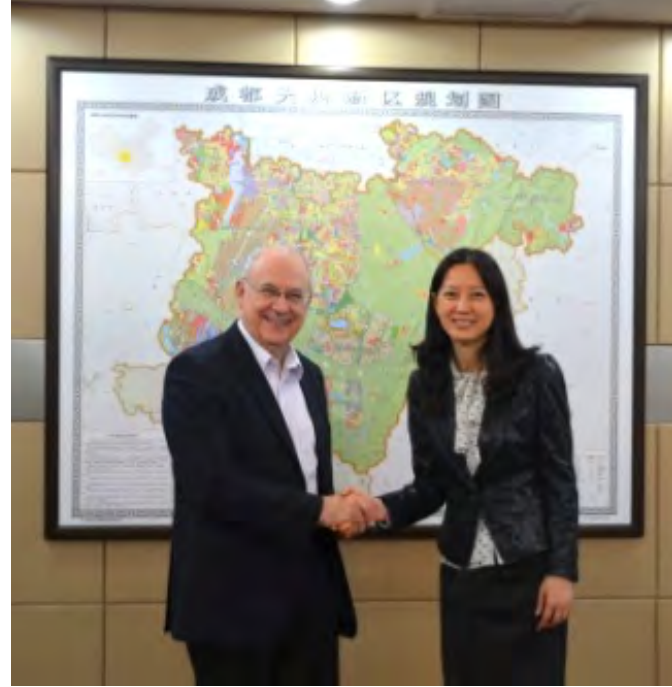
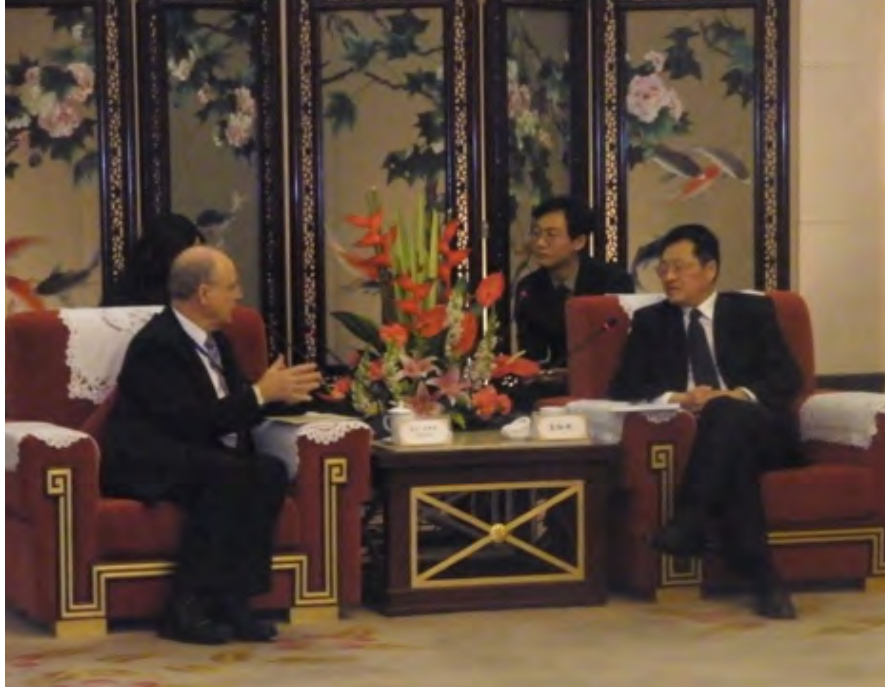
On 4 December the UK Science Minister visited Sichuan University, hosted by Prof Guangxian Li. Prof Li and Prof Phil Coates gave a joint presentation on the strong cooperation between Bradford and Sichuan, emphasising the value of the Science Bridges China platform, and UK-China AMRI. The visit coincided with the launch of the Newton Fund.

On both occasions, the Minister was accompanied by a group of UK Vice Chancellors and government officials.



Li Guangxian addresses the UK delegation





## Awards

The internationally leading nature of the Polymer IRC and our UK-China AMRI is reflected in a range of prestigious international and national awards.

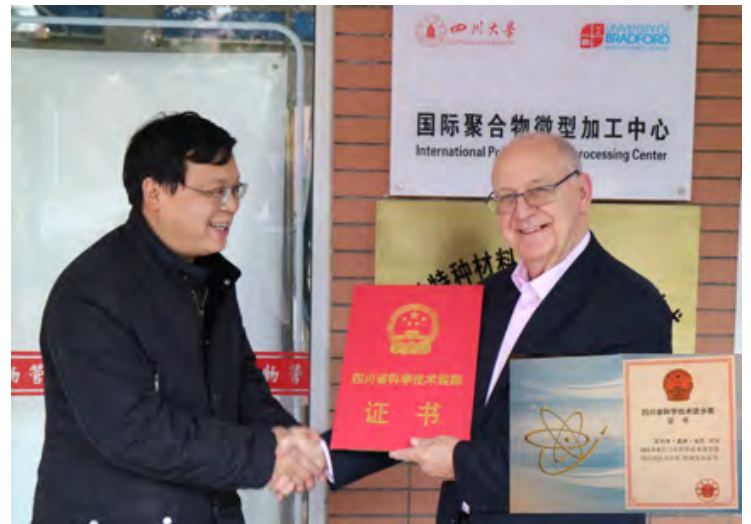
### International Awards (Prof Coates)

2015 Tian Fu Friendship Award, of the People's Government of Sichuan Province (first ever awarded)

2016 Sichuan Science and Technology Progress Award: International Scientific Co-operation (2016) –first time awarded.

2017 James L White Innovation Award of the International Polymer Processing Society, the top award of the PPS for leading achievement in polymer innovation

2018 Society of Plastics Engineers International Award, the top award of the Society, for lifetime achievement in polymer engineering



2018 International Science & Technology Cooperation Award of the People's Republic of China, presented by President Xi Jinping



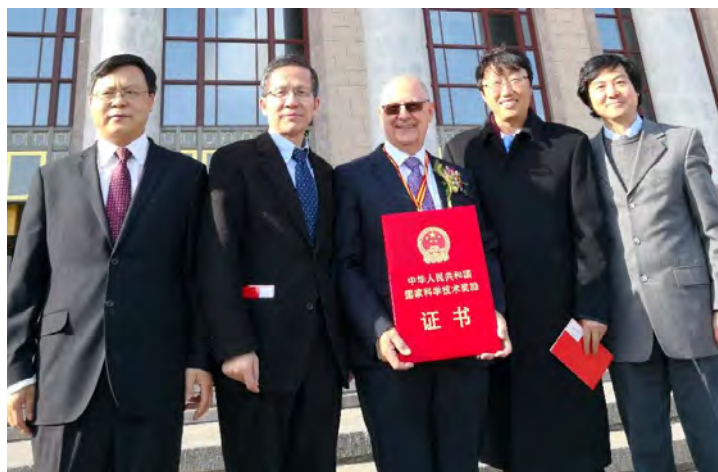
The award; pre-meeting of awardees with President Xi Jinping and the full leadership team of the PR China



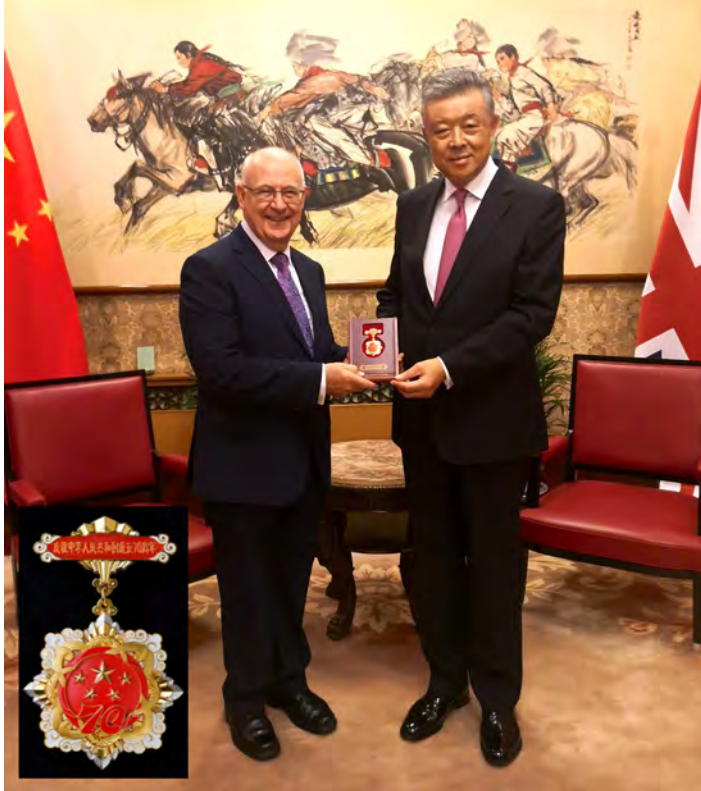
Award Ceremony in the Great Hall of the People



Medal presentation by Vice President, Madam Liu



Outside the Great Hall - with great support from Chinese colleagues, Prof Hesheng Xia, Prof Guangxian Li, Prof Liqun Zhang and Prof Yongfeng Men



China 70th Anniversary medal, presented by Ambassador Xiaoming Liu, Chinese Embassy, London, September 2019

## Some Relevant Personal Awards

Prof Phil Coates:

- 2008 Honorary Professor Sichuan University
- 2008 Molecular Sciences Forum Professor, Chinese Academy of Sciences, Institute of Chemistry, Beijing
- 2009 Honorary Professor Beijing University of Chemical Technology
- 2010 Famous Overseas Scholar, Ministry of Education, China / Sichuan University
- 2010 High End Foreign Professor, Sichuan University
- 2011 Top Foreign Expert of the State Foreign Experts Bureau
- 2012 Changchun Institute of Applied Chemistry, Chinese Academy of Sciences honorary lecturer
- 2019 Molecular Sciences Forum Professor, ICCAS

Prof Qi Wang:

- 1999 Cheung Kong Scholar, MoE China
- 2012 Honorary Professor, University of Bradford, 2012
- 2016 18th WIPO and SIPO golden award for Chinese outstanding patented invention



- 2017 **Academician of the Chinese Academy of Engineering**

Prof Liqun Zhang:

- 2005 Cheung Kong Scholar, MoE China
- 2012 Spark-Thomas Award, ACS Rubber Division
- 2012 Asia Research Award, Society of Chemical Engineering Japan
- 2014 Morand Lambla Award, Polymer Processing Society

Prof Dujin Wang:

- 2007 PetroChina Technology Innovation Award
- 2009 Science and Technology Progress Award of Beijing Municipal
- 2012 Science and Technology Progress Award of Beijing Municipal

Alan Glanville Award of the Institute of Materials, Minerals & Mining

- 2008 – Qi Wang et al, Sichuan
- 2012 – Liqun Zhang et al, BUCT
- 2014– Yongfeng Men et al, Changchun
- 2016 – Hesheng Xia et al, Sichuan

## Science Bridges China team awards

- 2008 RCUK Bradford Science Bridges China top ranked bid
- 2008 UKTI/Y&H China Business Award – Best Education
- 2011 Interdisciplinary Working Award, Bradford University
- 2014 Vice Chancellor's Award for Outstanding Achievement, University of Bradford

## International Funding awards

Some key international awards include:

- 1989-2000 IRC in Polymer Science & Technology original award (£23m)
- 2007-9 EPSRC Virtual Institute - Polymer Process Structuring, with China (£0.23m)
- 2008 -12 RCUK Science Bridges China - top ranked award (£1.25m)
- 2009-12 Design, Preparation and Micromolding of Polymer Nanocomposites for Medical Application" International S & T Cooperation project of MoST, China (0.95m RMB)
- 2010-2013 Preparation and application of high performance biodegradable polymer nanomaterials, International S & T Cooperation project of MoST, China (0.9m RMB)
- 2012 EPSRC Global Engagements: China (£0.5m)
- RCUK-MOST 2013-15 (Bradford, Sheffield, Durham, Sichuan, ICCAS) (£0.2m)
- 2013-2017 111 programme (Sichuan/ Bradford, + international team (led by Bradford; (9m RMB)
- 2013- 2018 EPSRC MeDe: UK Centre of Innovative Manufacturing in Medical Devices (Leeds, Bradford, Newcastle, Nottingham, Sheffield Universities; (£5.7m)
- 2013 - 2021 Sinopec BRICI polymer orientation (£0.68m)
- 2014-2024 EPSRC Capital Grant: Advanced Materials for Healthcare (£5.42m including £2m UoB)
- 2015-18 Royal Society Newton Advanced Fellowship with Prof Men, Changchun; (£0.11m)
- 2016 China-UK Bilateral Conference in Healthcare technologies for aging populations NNSFC (0.2m RMB)
- 2018-21 EPSRC Healthcare Innovation Partnership (£1.1m)
- 2019-2021 EPSRC-NSFC UK-China Low Carbon Manufacturing, 'High Efficiency value-added bulk recycling of polymers by solid state shear milling'; (£1.4m); Sichuan University/ Polymer IRC Bradford







## Polymer Interdisciplinary Research Centre

The Polymer Interdisciplinary Research Centre at Bradford offers internationally leading Polymer Research; genuinely interdisciplinary, with major academic collaborations worldwide, and strong industrial involvement in our research.

The Polymer Interdisciplinary Research Centre was founded in 1989 as a focal point for UK polymer science & engineering, supported by an EPSRC grant of £23m to the Universities of Leeds, Bradford and Durham, over its first 11 years. It formed a critical mass network of leading polymer scientists and engineers, with research interests across advanced materials including soft matter, nanocomposites, biomaterials, with strong UK and International links.

The world-class Polymer IRC research centre at Bradford has 16 processing laboratories (including a suite of 3 clean rooms), 6 materials preparation and characterisation laboratories, a computer modelling centre and large conference room. Processing capabilities include 10 injection moulding machines – emphasising ultraprecision moulding - over 20 extrusion lines, and 10 unique solid phase orientation processing lines; 10 3-d printers; electrospinning and cell culture. Materials characterisation includes TEM, AFM, X-ray, spectroscopy, rheometry, thermal and chemical techniques; product characterisation across the length scales includes surfaces via AFM, confocal laser microscopy, WLI, Raman surface mapping, and energy; physical properties from micro to macro scale – nanoindentation, micromechanical, micro CT, wear. In-process metrology features strongly, with many techniques pioneered in our laboratories, and includes precision optical and thermal imaging (both to ultra high speed).

Professor Phil Coates FEng is the overall Director of the Polymer IRC, based at Bradford in the Faculty of Engineering & Informatics, and Director of the Advanced Materials Engineering RKT Centre. Professor Ben Whiteside is Director of the Polymer Micro & Nano Technology RKT Centre, and Professor Anant Paradkar is Director of the Pharmaceutical Engineering Sciences RKT Centre (hosted in the Faculty of Life Sciences). Over 50 research staff at Bradford are involved in our programmes.

We are delighted to have taken the following major steps since 2014:

1. The EPSRC Capital grant (£3.42m, with a further £3.1m from industry and the University) for new processing and characterisation facilities for advanced materials for healthcare, early 2014.
2. Recladding and re-roofing of the laboratories, around £3m in 2014-15.
3. Materials Chemistry adding to the strength of the Polymer IRC in Bradford, summer 2015;
4. A Joint International Laboratory for Polymer Process Physics was formed in September 2015 between Changchun Institute of Applied Chemistry CAS and the Polymer IRC;
5. Xplore have placed a PM5 specialist compounding and film processing line in our laboratories, particularly for pharmaceuticals processing, in 2016
6. A significant donation of biomedical polymer equipment was made to our laboratory by Smith & Nephew Ltd, 2016
7. A Joint International Laboratory for Soft Matter Technologies between Beijing University of Chemical Technology and the Polymer IRC at the University of Bradford, was announced in December 2016
8. 3 major International Awards in 2017 and 2018.



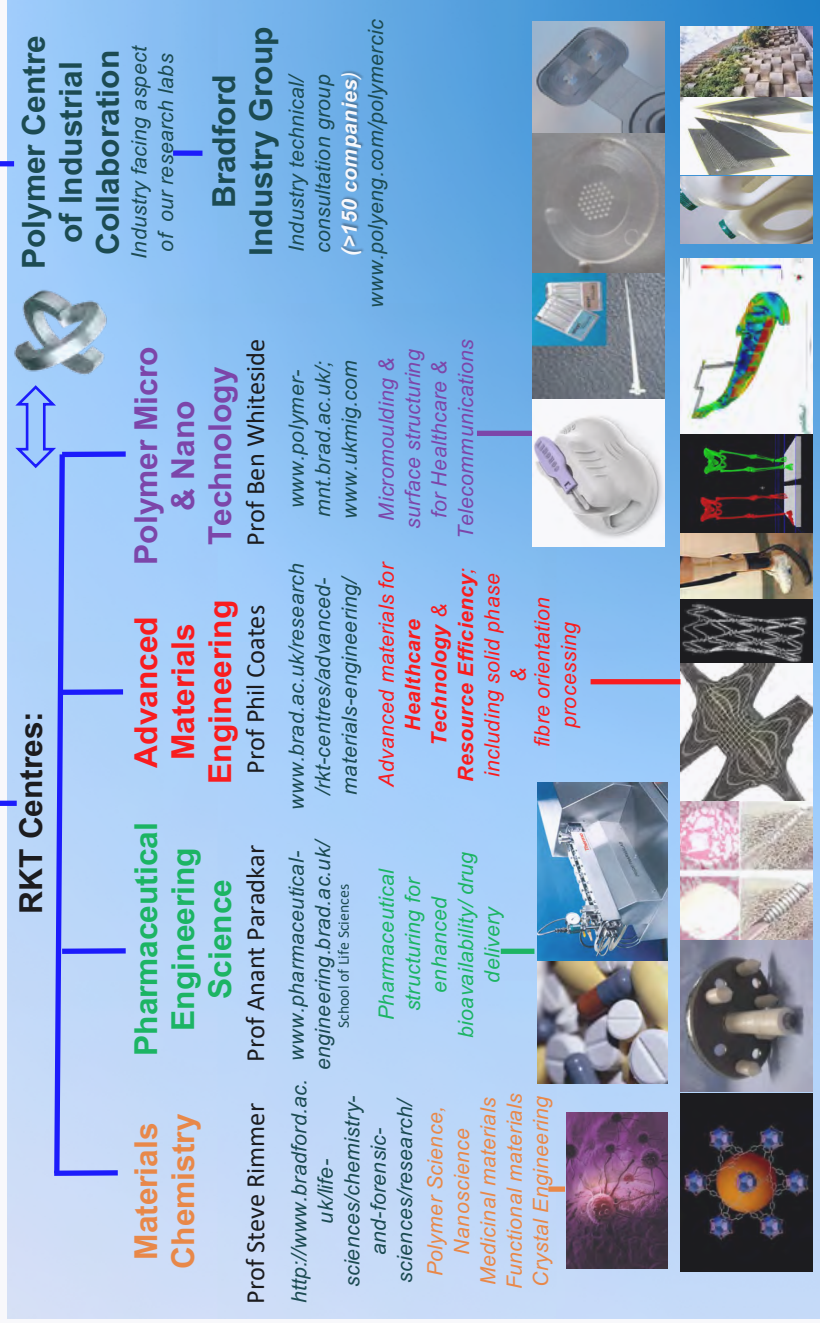
UNIVERSITY of  
**BRADFORD**

# Polymer Interdisciplinary Research Centre



**polymer IRC**  
Bradford  
Leeds  
Durham  
Sheffield  
[www.polymerirc.org](http://www.polymerirc.org)

**Polymer IRC at Bradford (EPSRC; 1989 - )**  
[www.polyeng.com](http://www.polyeng.com)



Directors:

**UK:** QUB, Warwick, York, Oxford, Cambridge, Huddersfield, Swansea, Nottingham, Loughborough; +

**MeDe Innovation**  
EPSRC Centre for Innovative Materials  
11 Blenheim Drive

**International:**  
(inc. RCUK Science Bridges China, EPSRC Global, and Joint international laboratory with Sichuan University)

**中英科技桥**  
Science Bridges China  
[www.sciencebridgeschina.com](http://www.sciencebridgeschina.com)

**UK-CHINA**  
Advanced Materials Research Institute

**INDUSTRY:**  
>100 companies collaborating/projects, joint IP

Faculty of Life Sciences      Faculty of Engineering & Informatics

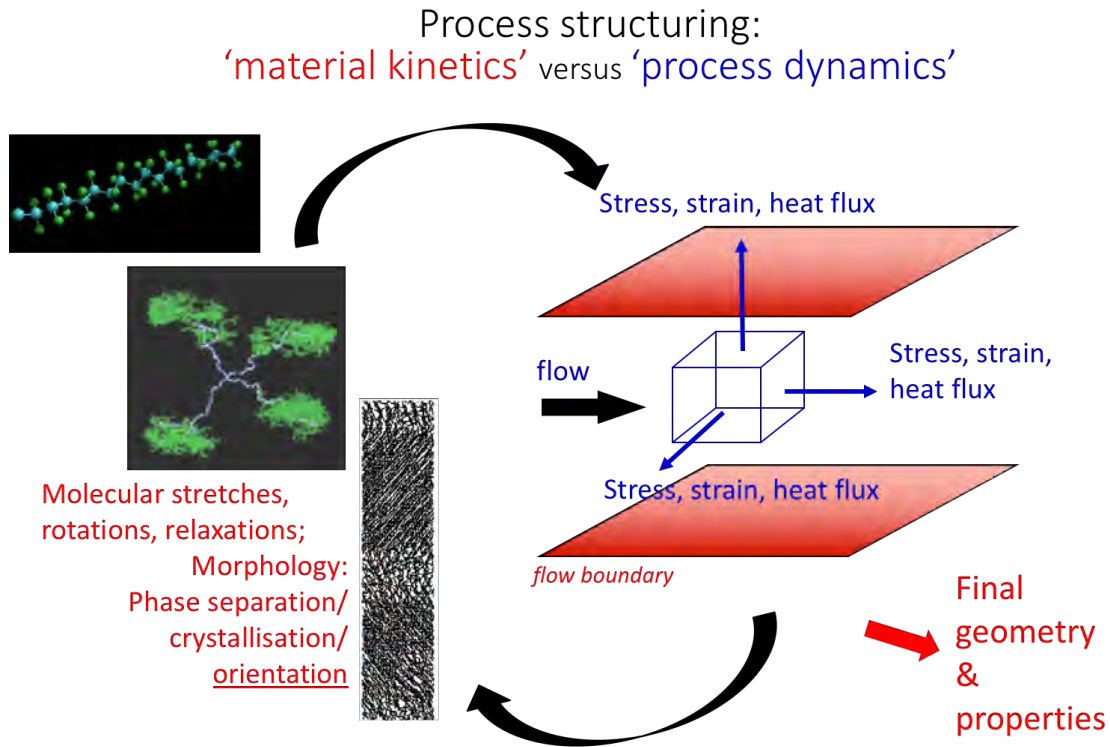
A coherent, internationally leading Polymer Research Laboratory; genuinely interdisciplinary, with major academic collaborations worldwide, and major industrial involvement in our research

Polymer IRC science structure and some collaborative links



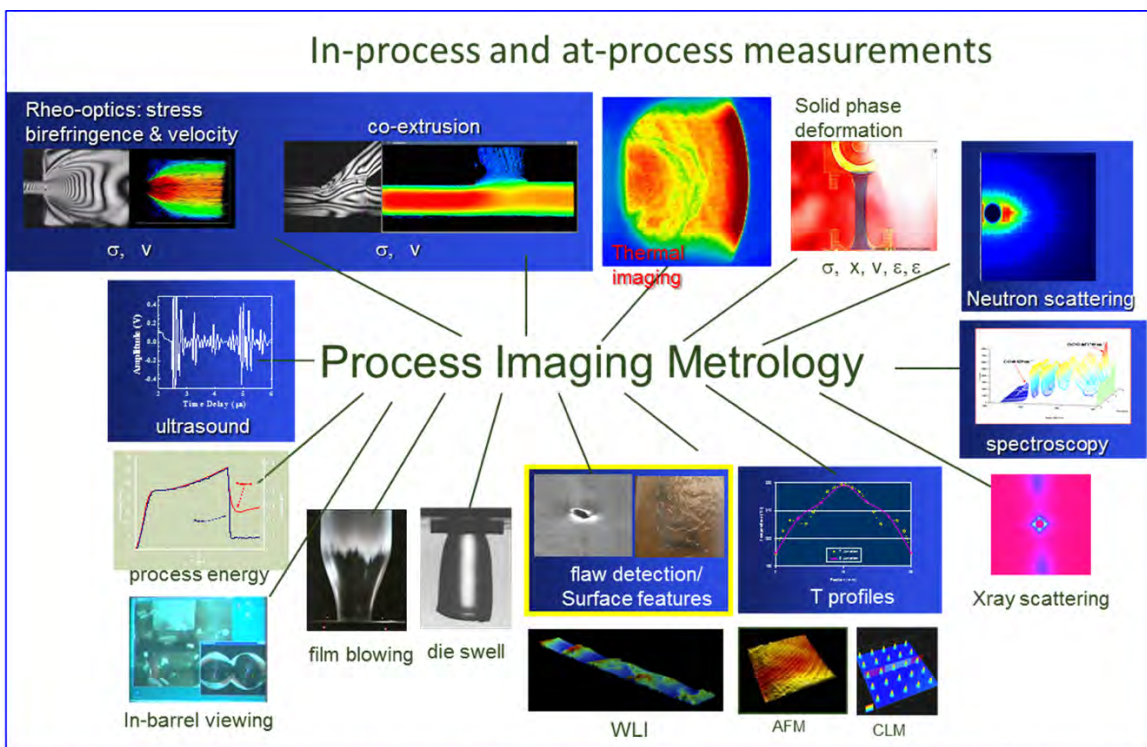
## Research philosophy:

We structure polymers in a controlled way via the manufacturing process, to control and enhance final product properties or functionalities ('process structuring' - see below). The Polymer IRC laboratories at Bradford have been built on pioneering in-process measurements, which are vital for developing understanding of the way in which polymers behave during processing in relation to their molecular structure and the associated kinetics of long chain molecules as they reptate in the melt, then change on cooling to the solid state to particular crystalline or amorphous morphologies in extruded or moulded products - but having been subjected to *imposed* process variables such as stresses, strains, heat fluxes, with their own dynamics. The interaction of material kinetics and process dynamics produces the final product properties.



The products may then undergo further structural changes in subsequent processes e.g. under deformation in the solid phase to cause orientation and further enhanced properties.

**In-process measurements** are vital to our understanding and control of polymer processing operations. We have pioneered in-situ measurements including pressure, IR temperature, thermocouple grids, ultrasonic velocity and transit time for bulk melt flows, visualisation of melt free surfaces, rheo-optical and thermal imaging of process flows, in-situ IR, MIR and UV-vis spectroscopy and in-situ SAXS and WAXS; imaging metrology for polymer deformation and solid phase processing and surface feature assessments.





The Polymer IRC hosts three University RKT Centres. Advanced Materials Engineering, Polymer Micro & Nano Technology and Pharmaceutical Engineering Science. These deliver into focussed areas, but have coherent research activities across discipline boundaries. All pursue the controlled structuring of polymers and polymer-related materials through processing, to achieve enhanced property products.

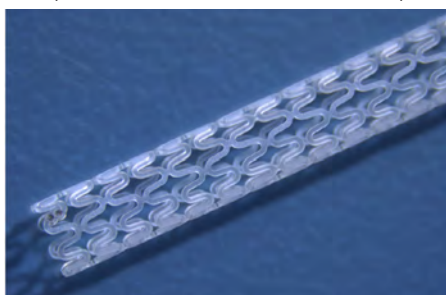
### Advanced Materials Engineering

(director Prof Phil Coates)

Research focusses on structuring advanced polymeric and biomedical materials via processing, and modelling, for

- high added-value products and methodologies and therapies aimed primarily at health and wellbeing; and
- resource efficient materials, enhancing the value of feedstocks.

The AME Centre builds on 'smart materials' expertise associated with the Polymer IRC and beyond, into the growth areas of medical and biomedical products and advanced materials for other high added value applications, and the developing area of sustainable materials. Unique, world-leading capabilities include precision solid phase orientation processing of polymers in a variety of profiles, from high precision oriented tubes for arterial stents to structural building products. Typical medical/ biomedical products include bioresorbable or non-resorbable shape memory polymer orthopaedic components for joint repair or replacement, stents for vascular repair,



spinal braces, structured films for wound dressing, precision tubing, medical devices and components, and medical packaging. These may also include active pharmaceutical ingredients, e.g. aimed at drug eluting implants.

Sustainable material products include novel acoustic materials made from recycled polymers, and smart incorporation of recyclates into conventional products for lower carbon footprint.

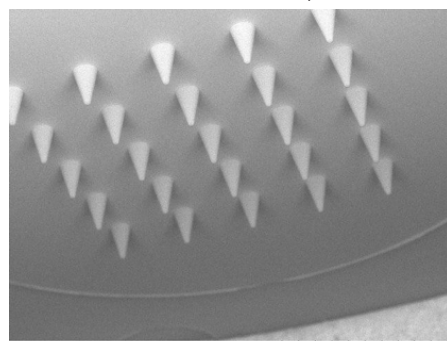
See <https://www.bradford.ac.uk/research/rkt-centres/advanced-materials-engineering/> for more details.

### Polymer Micro & Nano Technology

(director Prof Ben Whiteside)

Polymer Micro & Nano Technology (MNT) is a world-class facility within the Polymer IRC laboratories at the University of Bradford, with research in ultraprecision polymer processing, especially micro injection moulding (micromoulding). simulation, in-situ characterisation and measurement techniques. Micromoulding has developed rapidly for micro-component manufacture or surface feature moulding, offering high production capacity at low marginal cost, with wide applications in healthcare, telecommunications, energy and consumer goods. Extensive in-process measurement techniques include high speed thermal and optical imaging in-situ in micromoulds, optical and mechanical product metrology, including bespoke product characterisation.

Key areas of expertise are in: moulding of microscale features; nano-structured surfaces; nano fillers compounding and processing; metal/ceramic powders; materials characterisation, product measurement; and inspection systems. Applications include: Medical devices, including dental obturation points, eye



surgery devices, implants, microneedles; micro-optics; and integrated micro devices.

Polymer MNT helps develop new and improved micro and nano-components in a range of materials via process optimisation, tool design, proof of concept and low volume manufacture. The Polymer MNT collaborative network is an interdisciplinary partnership with colleagues from academia and industry. See <https://www.bradford.ac.uk/research/rkt-centres/polymer-mnt/> for more details.

### Pharmaceutical Engineering Science

(director Prof AnantParadkar). The Centre for Pharmaceutical Engineering Science (CPES) is an interdisciplinary research and industrial collaboration centre, with expertise across the pharmaceutical sciences, chemistry and polymer engineering disciplines. The Centre has core capabilities in the areas of preformulation analysis including solid state screening, pharmaceutical and healthcare formulation development, drug delivery systems, enabling process technologies including melt processing, proprietary innovative technologies and Process Analytical Technology (PAT) and Quality by Design (QbD) approaches to pharmaceutical and healthcare product development.

Research activity is focused on design of novel formulation technologies for the development of enhanced pharmaceutical and related products, together with process optimisation in the niche areas related to advanced pharmaceutical materials. We offer



expertise and access to a range of proprietary and enabling technologies focused on solubility enhancement of poorly soluble actives and offer pharmaceutical development services covering a range of drug delivery mechanisms including transdermal, inhaled and more conventional solid dosage oral formulations.

The centre has expertise in process understanding and product development to a range of industrial sectors including nutraceuticals, health and personal care, foodstuffs and medical devices. The centre also has a focus on developing innovative green technologies specialising in waste and solvent reduction, energy efficiency and optimisation of processes.

The CPES has established links with research laboratories within the UK, Europe, USA and Canada as well as China and India.

See <https://www.bradford.ac.uk/research/rkt-centres/pharmaceutical-engineering/> for more details.

**Materials Chemistry**, led by Professor Stephen Rimmer, became a fourth research centre in the Polymer Interdisciplinary Research Centre at Bradford, in 2015. Prof Rimmer (previously at Sheffield University) is a long-standing collaborator, having been involved in all of our Science

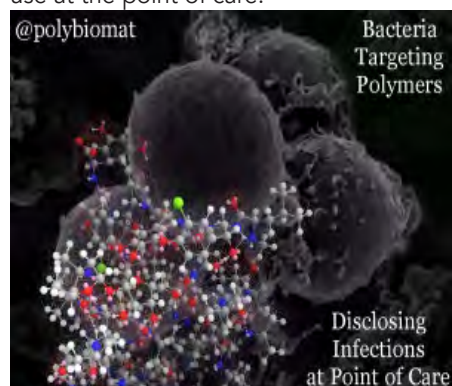
Bridges China/ UK-China AMRI Research Workshops. He is a Board member of the UK China AMRI. Aspects of Steve's work and that of his team can be found at <http://www.brad.ac.uk/life-sciences/chemistry-and-forensic-sciences/research/>.

The Polymer Science activity is focused on the synthesis and properties of functional polymers. Research in Chemistry includes:

- Nanoscience
- Medicinal Chemistry (our Institute of Cancer Therapeutics, is heavily involved in the Science Bridges China/ AMRI platforms)
- Polymer Science
- Functional Materials
- Crystal Engineering and
- Analytical Chemistry.

Functional polymers are produced using a variety of methods including radical, cationic and ring-opening polymerisations as well as step-growth techniques such as polyurethane synthesis. We also make extensive use of polymerisations in disperse media; such as emulsion polymerisations. Recently, one of our focuses has been on producing functional hydrogels to support cells for applications in tissue engineering.

Here our aim is to control cells as they develop and grow and to examine how the structure of the materials affects performance and cell compatibility. Another strong theme is to use functional polymers to detect pathogens in infective diseases and here we are developing unique medical devices for use at the point of care.



The Polymer IRC world class facilities were further enhanced by a major EPSRC Capital award which has seen extensive processing and characterisation facilities installed in our laboratory which promote the interdisciplinary working across Engineering and Life Sciences. Also, industrial donations including extensive biomedical materials extrusion and drawing facilities from Smith & Nephew Ltd (FET fibre line and Rondol fibre drawing frame, Prism extruder) and an Xplore PM5 stainless steel conical twin screw extruder and film line, aimed primarily at pharmaceuticals processing.

## International

A key feature of the Polymer IRC at Bradford is our extensive international presence, collaborating with many leading overseas partners in Europe, India, the USA and especially China. The Science Bridges China platform led to the formation of the UK-China Advanced Materials Research Institute, and we have over 300 leading UK and Chinese academics actively involved in joint research projects, research exchanges, and Joint Laboratories.



### Joint International Laboratories

The Polymer IRC at Bradford has three Joint International Research Laboratories in China.

The first of these was formed with Sichuan SKLPME for Polymer Micro Processing in 2010, and was formally approved by MOST in 2014. It is directed by Prof Coates and Prof Qi Wang, with Prof Xia and Prof Whiteside), and we



have achieved a range of joint research grants, high level publications, patents, awards and many researcher exchanges, including Chinese Scholarship Council awards. Prof Coates is an Honorary Professor of Sichuan and Prof Wang is an Honorary Professor of Bradford.

The second Joint Laboratory was formed with Changchun CIACCAS for Polymer Process Physics in September 2015, directed by Prof Coates and Prof Xianyu Yang and Prof Yongfeng Men, with Dr Caton-Rose and Prof Whiteside. We have excellent joint programmes, especially Royal Society Advanced Fellowship funding, and high level publications.

These were complemented in December 2016 by the new Joint International Laboratory for Soft Matter Technologies with BUCT – directed by Prof Liqun Zhang and Prof Phil Coates. We already have research exchanges, and excellent joint publications with Prof Zhang's team and Prof Coates is an Honorary Professor of BUCT. We look forward to joint programmes!

These laboratories are promoting our research collaborations and joint publications of leading research. They continue to provide a major platform for collaborative ventures and joint funding, and promote our international visibility.

## Web sites

- [www.polyeng.com](http://www.polyeng.com) - our main site, with full information and links
- [www.polymerirc.org](http://www.polymerirc.org) - includes the original Polymer IRC web site
- [www.ukchina-amri.com](http://www.ukchina-amri.com) - our UK China Advanced Materials Institute
- [www.sciencebridgeschina.com](http://www.sciencebridgeschina.com)

# Our Web sites

[www.polyeng.com](http://www.polyeng.com) is the 'gateway' website to all of our sites, and contains much information about our laboratory and capabilities



Welcome to the  
Polymer Interdisciplinary Research Centre!



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36



Welcome to this gateway to our various research and knowledge transfer activities in the Polymer IRC.

The Polymer IRC laboratories at Bradford form part of the wider Polymer IRC (Universities of Leeds, Bradford, Durham and Sheffield). We are a world leading research laboratory for process structuring of polymers, polymer composites/nanocomposites, biomaterials and pharmaceuticals, with novel and conventional materials processing.

Our facilities include: 40 advanced manufacturing lines for melt phase, solid phase and reactive processing, extensive physical and chemical characterisation over the length scales, and computer modelling. We have wide-ranging academic collaborations and currently work with over 150 companies (see also our Bradford Industry Group). Please see the [overview here](#).

See the [Resources](#) page for fuller details of our facilities, projects and publications.

Do contact us for further information, or to arrange a visit/ discussions - our [Laboratory Managers](#) and Research teams will be pleased to find ways to help.

Prof Phil Coates FREng



PPE15 and UK-China AMRI International meetings, 8-10 September 2015 - [see here](#)

PPE17 and UK-China AMRI International meetings, 25-27 July 2017 - [see here](#)

© PDO/IRC 1999-2018

[www.ukchina-amri.com](http://www.ukchina-amri.com) is the web site dedicated to the UK-China AMRI, and includes all of the Researcher Profiles and other useful information about the extensive UK-China collaborations



Building Research Capacity, Growing a Community

Welcome!



AMRI Launch at Chengde University, April 2012

The UK-China Advanced Materials Research Institute is a virtual Research Institute for the leading researchers in UK-China collaborations in polymer-related materials, based on the RCUK-Bradford Science Bridges China and EPSRC-Bradford Global Engagements platform.

This site provides an introduction to our activities and resources for our members.

\*\*\* Next meeting: P70 / UK-China AMRI Meeting, Bradford 18-20 September 2018 \*\*\*  
more international speakers announced!

### Top Award:

Great honour: China International Science & Technology Cooperation Award presented to Prof Phil Coates by President Xi Jinping and key Chinese leaders, Great Hall of the People, Beijing 8 Jan 2018



[see fuller details in a pdf here](#)

CCTV interview with Phil Coates, 28 January 2018





MENU Current students and staff Blackboard Search

UNIVERSITY of BRADFORD

University Home Research Research Centres Science Bridges China

Science Bridges China

About us  
People  
Our research  
News & Events  
Contact Us





**Bradford Science Bridges China**

University of Bradford's RCUK Science Bridges China is an international research platform in advanced materials for healthcare. Led by the **Polymer Interdisciplinary Research Centre**, in collaboration with five leading research institutes at the University of Bradford, namely the **Centre for Advanced Materials Engineering**, the **Centre for Polymer Micro and Nano Technology**, the **Centre for Pharmaceutical Engineering Science**, the **Institute of Cancer Therapeutics** and the **Centre for Materials Chemistry**, it brings together scientists, companies and hospitals from the UK and China to develop areas in drug discovery, drug delivery and medical technology. It supports collaborative research and open innovation activities, with a focus on research community building.

- A major platform for collaboration
- Advancing pharmaceutical science and healthcare technology
- Collaborating in fundamental research
- Translating research for the benefit of society
- Creating new technologies and companies through open innovation



Our Social Media: f, t, in, y, ig, G+

Contact us: University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK. Tel: +44 (0) 1274 232323

Research in Faculties: Engineering & Informatics, Health Studies, Life Sciences, Management, Law & Social Sciences

Information: Accessibility, Freedom of Information Act, Privacy and Cookie Policy. The University is a member of Yorkshire Universities. Please report instances of computer misuse originating from University of Bradford.

www.sciencebridgeschina.com is the University of Bradford hosted web site reflecting our UK-China collaborations, and the two Faculties (Engineering & Informatics and Life Sciences) involved at Bradford.

HOME BACKGROUND MEMBER LABORATORIES RESEARCH EXCHANGES



**Polymer Engineering International**  
an international network of leading polymer engineering researchers

**Welcome!**

**What is Polymer Engineering International?**

We are a relatively informal consortium of leading polymer-related research groups around the world. Initially these groups have been associated with UK Polymer IRC collaborations, where we have a connections between the leaders and research teams, but we aim to reach beyond that.

The aim is **mutual benefit**, to promote collaborative activities, with **practical outcomes** for all who participate actively – in particular with researcher exchanges and other early career researcher opportunities. Our experience in the Polymer IRC of such interactions with leading Chinese groups in our **Science Bridges China** platform over the past decade has been so positive, we feel that it is timely to develop this further, to form, in effect **Science Bridges International!** It would also feed positively into the other structures (such as the PPS in particular, and our professional institutions) to which we are committed. It is not intended to compete against any of these, but provide additional benefit.

**What value is Polymer Engineering International to you and your laboratory?**

- We aim to assist **collaborations** across different groups and discipline boundaries to meet needs in modern day polymer engineering topics – products are reflecting convergence of technologies and functionality, so increasingly there is need for **cross-group collaborations**.
- We aim to develop **Research Exchanges** (e.g. one month duration), especially early career researchers – we have found this to be a most successful route to develop collaborations; shorter *inter-laboratory visits* for awareness could also be arranged.
- We aim for dialogues which open up opportunities for:
  - = **new joint bids** for research funding, or for
  - = formation of teams for UK or international bids, and perhaps in due course,
  - = setting up **joint laboratories** for targeted areas (the Polymer IRC has formed 3 joint laboratories in China since 2010)

**Which groups can be members?**

- We aim initially to have **leading polymer-related research groups** (not individuals) join the consortium to help develop its value and credibility.
- We start with **invited members** from the UK and abroad.

**What is the cost of membership?**

There is no cost to be a member.

However:

- It could take some of your/ your team's time, to help us develop representative information and collaborative activities.
- If, in due course, requirements for some resources become apparent then we would have to consider how members could help with this.

**What are members expected to do?**

- All members will need to complete a simple template, which will give basic information about your group for inclusion on this dedicated web site.
- Members will share information with each other to help promote collaborations, including identifying specific areas in which you would like to find research collaboration partners.
- When a Research Exchange is agreed between two laboratories, the partners will need to fund the Exchange costs (travel, subsistence, materials etc) in an agreed share of costs. (We have a lot of experience of this with Chinese partners)
- Inter-laboratory short visits could be arranged e.g. for early career researchers – this has proven to be very helpful to develop co-operations.

**Who operates this venture?**

- Initially this network will be co-ordinated from the Polymer IRC at Bradford.
- We will then aim to have a representative group of leaders from the membership to develop the venture, but avoid building structures requiring heavy administration.

**How will this relate to existing activities?**

We aim to be complementary to and fully supportive of existing, excellent international societies such as the Polymer Processing Society, SPE, the IOPMM Polymer Society, EPF – certainly not attempting to duplicate their functions (such as the international annual meetings or regional meetings of the PPS). Such Societies have personal membership. We aim for Laboratories/ Groups to be members and to generate activities which are not promoted in practice via PPS and other societies – namely Research Exchanges, joint publications, forming teams for bids and setting up Joint Laboratories.

We look forward to developing what could be called a **Science Bridges International venture – building science, technology and people bridges – and crossing them!**

Professor Phil Coates FREng  
Director, Polymer IRC  
September 2018

Newton Early Career Reskierchei Workshop,  
Chengdu Dec 2016




www.polyeng.com/ukieri provides brief information about our links particularly with the Institute of Chemical Technology Mumbai and the CSIR National Chemical Laboratory, Pune

HOME OBJECTIVE THE TEAM BACKGROUND 2014 SEMINARS PHOTO ALBUM

**Bradford - ICT Mumbai UKIERI**  
UK India Education and Research Initiative – the University of Bradford, UK and Institute of Chemical Technology Mumbai, India

**Welcome!**

Process analytics enabled green technologies for processing of poorly soluble drugs





Prof G Yadav, Vice Chancellor of ICT Mumbai, with Dr Raj Patel, Chemical Engineering co-ordinator at the University of Bradford, meet as part of the UKIERI visit, August 2013, in the Polymer Interdisciplinary Research Centre laboratories.




Prof Phil Coates receives a certificate at ICT Mumbai for an invited lecture (Shri. B.S. Rajgorshi) – second from right - Oration Award on Process Structuring of Polymer, 20 July 2012.

**Congratulations!**

Professor G Yadav receives the prestigious Indian national Padma Shri Award (Jan 2014) and Prof Ashwini Nangia becomes Director of the CSIR National Chemical Lab, Pune Feb 2016

The University of Bradford – Institute of Chemical Technology Mumbai programme supported by the prestigious UK India Education and Research Initiative (UKIERI) provides a platform for co-operation between our two institutes in the strategic area of green processing.



Workshop - Sept 2015  
PPE'15 Conference in Bradford, September 2015  
- UKIERI supported

www.polyenginternational.com is the new leading Polymer Engineering research community/network aimed at promoting cooperation between researchers worldwide, building on the success of our Science Bridges China/ UK-China AMRI platforms.

www.mede-innovation.ac.uk is the web site of the UK's EPSRC Centre for Innovative Manufacturing in Medical Devices, a 5-university consortium for leading edge research.

MeDe Innovation  
 EPSRC Centre for Innovative Manufacturing in Medical Devices

Home About Innovation Challenges & Research News Events Downloads Blog Capabilities Contact

Innovation in orthopaedic medical device manufacture  
 Right product, right process, right patient, right time

Latest News

**Business Development Manager & Senior Innovation Consultant vacancies – National Biofilms Innovation Centre**  
 August 23, 2018

The University of Southampton is currently recruiting for the following vacancies: Senior Innovation Consultant – National Biofilms Innovation Centre School of Biological Sciences  
 Location: Highfield Campus Salary: £38,460 to £48,677 Full Time Fixed Term (until 30/11/2019)  
 Closing Date: Tuesday 04 September 2018  
 Reference: 1051118EJ Recruiting for a self-driven and proactive professional to work as a [...] [Read more](#)

**SBRi Healthcare competition now open**  
 16, 2018

SBRi Healthcare are pleased to announce the latest competition is now open with the following areas of focus: Improving Outcomes in Musculoskeletal Disorders Dentistry, Oral Health & Oral Cancer. The deadline for applications is Wednesday 22nd August 2018. For details on how to apply and for the full call documents, visit the SBRi [...] [Read more](#)

**MeDe Innovation researchers are putting next generation knee implants through their paces**  
 14th 2018

Dr Louise Jennings, of MeDe Innovation, and Ian Rivlin, of Invisio, discuss how the techniques and equipment designed by MeDe researchers are being used, not only to evaluate existing devices, but also to support the development of new designs using novel materials – paving the way for new types of implant that are better tailored to [...] [Read more](#)

**Plaster which sticks inside the mouth will revolutionise treatment of oral conditions**  
 10th 2018

Our Co-Investigator Professor Paul Hutton and researcher Maria Eduarda Santociles-Romero, both from MeDe Innovation Challenge 2, have been in the regional and national press recently for their involvement in developing a dental patch. The full story can be found on the University of Sheffield website. [Read more](#)

Latest Blog Posts

**Ligament repair – Case study**  
 August 21, 2018

Injuries to the anterior cruciate ligament (ACL) are a common sporting injury, resulting in loss of stability in the knee. They account for around 40% of all sports injuries and in the USA over 70,000 ACL reconstructions are performed annually. Most procedures use autograft transplants from a healthy tendon elsewhere in the patient's body while a smaller number use donor tissue from a deceased donor. [Read more](#)

**Bryan Stuart: Life after MeDe Innovation**  
 16th 2018

After five years as one of our Early Career Researchers, Bryan secured a role at the University of Oxford. Here he discusses his time with MeDe Innovation: As I move into the next stage of my career I reflect on the incredible opportunities that MeDe Innovation offered over the last 5 years, during my [...] [Read more](#)

Upcoming Events

**Ask the Expert: Clinically-led manufacture of custom-made collagen membranes**  
 Featured event  
 October 30, 2018

Location: Berks and the Leeds School of Medicine and Dentistry, London

Ask the Expert: Clinically-led manufacture of custom-made collagen membranes (Tuesday 30th October 2018, 10.00 – 15.30 Seminar room, 4th floor, Berg and the Leeds School of Medicine and Dentistry, Turner Street, Whitechapel, London, E1 2AD) This event will highlight key performance requirements and future needs for the scalable manufacture of next generation collagen-based biomaterials. [Read the \[.\]](#)

[Read more](#)

**The Leeds Orthopaedic Biomechanics course 2019**  
 January 21, 2019

The Institute of Medical & Biological Engineering at the University of Leeds is offering a specialised 2 day short course on Orthopaedic Biomechanics on 21 and 22 January 2019. The course aims to give delegates an understanding of the necessary fundamentals of biomechanics and how they are applied to solve problems in orthopaedics. This course [.] [Read more](#)

**Search Our National Capability Database**

Click here to search our extensive database of manufacturing capabilities.

Tweets

MeDe Innovation (@MeDe\_Innovation)

Registration is now open for The Leeds Orthopaedic Biomechanics course 2019 hosted by @LeedsUnEngBioMedUK #orthopaedics #research #biomechanics #innovation #ECR #training #leedsengineering

Leeds Orthopaedic Biomechanics course

Leeds University

Sep 11, 2018

MeDe Innovation (@MeDe\_Innovation)

Rowan Grant @rowangrant

#meinnovation #me2018

Sep 10, 2018

Short-term 4 China  
 The Summer English Program to help Chinese Teachers in China!

Welcome - short term volunteers for China



“One conversation with a good teacher is better than ten years of study”  
 Ancient Chinese saying

2018 dates: 8th July – 6th August

Summer English Programme to help Chinese Teachers in China!

Check this site to help you find out more about being a short term Summer English Programme volunteer teacher in China.

Something remarkable happens when people from different cultures start talking to one another. Language becomes an exchange of ideas rather than a text to be memorised. Culture becomes something to be touched, tasted and explored rather than simply imagined. Even 20 short days of this kind of person-to-person communication can be enough to change a life in a way that no text or course ever could.

Every summer, Amity, a Chinese Non-Governmental Organisation promotes this kind of cross-cultural dialogue as English-speaking volunteers work with rural Chinese teachers of English to develop their listening and speaking skills. Volunteers experience China first hand and gain a deeper understanding of an important and growing nation that is often misunderstood and misrepresented. Seemingly small seeds of faith and friendship are sown in these summer conversations.

If you are a fluent English speaker interested in offering a month of service in China during July, think about joining one of the UK teams coordinated by

on the Amity Summer English Program. We know a lot of people who are eager to have a conversation with a good teacher -- how about you?



Small group discussion aids speaking and listening skills

See our first 'Peer to Peer' Teaching Programmes: May 2014 and July 2015

and the most recent report of Teams in China [here](#)

Contents

- About us
- 2018 locations and our 3 UK teams
- Amity SEP
- Peer to Peer Teaching Program
- How to apply
- FAQs
- Teaching Resources
- Reports from Teams
- Videos

Contact us

www.short-term4china.org.uk is a web site operated for an Amity Foundation Summer English Programme (Jane Coates) which we support – aimed at teaching English auracy to Chinese schoolteachers of English, in areas away from the main cities.

# APPENDIX Science Bridges China platform - Origins


## 1. Some links with China 2008-9

A brief indication of the foundational programme which began to build the community which became the Science Bridges China/ UK-China AMRI.

People Collaboration: EPSRC Virtual Institute for Polymer Process Structuring (VIPps) 2008-9 This is followed by a pictorial booklet produced to capture the early days of the development of our UK-China community. Early involvement with China in Life Sciences and Advanced Materials Engineering led to the major Science Bridges China project and our ongoing successes.

## 2 RCUK Bradford Science Bridges China Background - 2009 – 13

The booklet captured our major programme, funded by RCUK via EPSRC, for our RCUK Bradford Science Bridges China programme. Note that the Open Innovation programme, which was effectively supported through the Science Bridges China has continued in an independent way, particularly with Guangzhou – each workshop has stood alone, so is not reported further here. Our mainstream Science Bridges China platform has achieved a substantial research community and an ongoing, growing connections with core groups and new collaborators.



Anshun Bridge and  
Shangri-la Hotel  
Chengdu, site of  
several of our major  
meetings

# 1. SOME LINKS WITH CHINA, 2008-9

## VIPps

# Virtual Institute - Polymer Process Structuring

[www.polymervip.com](http://www.polymervip.com)

### WHAT IS VIPps?

The **Virtual Institute for Polymer Process Structuring (VIPps)** is a Polymer IRC Polymer Engineering project at the Universities of Bradford and Leeds, funded by the Engineering & Physical Science Research Council (EPSRC). It forms part of the EPSRC programme on 'People Collaboration' and runs from 1 October 2007 to 31 March 2009.

VIPps is a platform to develop new collaborations, particularly with Pacific Rim countries, focussing on the **Polymer Engineering** aspect of our IRC research portfolio, and the increasingly important issue of the interaction between processing and structuring of polymers (linking polymer engineering and polymer physics, and with appropriate polymer chemistry links, for example in reactive processing/ blending).

### VIPps funds travel and meetings

- for Polymer IRC staff at Bradford & Leeds academics in China, Japan, Taiwan, China & Korea,
- for Chinese & Japanese academics to come to the UK to present their work and meet with us.

The meetings include 'one to one' (or 'one to a few') visits to the Far East by IRC staff, and larger joint meetings held in China and Japan respectively, repeated in the UK.

### The VIPps meetings are for:

- sharing of research topics from each laboratory, for awareness and information gathering
- stimulation of possible co-operative projects
- visits/ short stays for particular personnel – including development of inter-personal relationships which are vital to the ongoing success – sowing seeds for the future.

Polymer IRC staff form the core, but we include (a) the wider Polymer IRC staff and (b) associated groups in the UK polymer community - as we do, for example, in the UK Polymer Showcase, which also formed a focal point for VIPps in September 2008, together with relevant overseas groups. This helps to bring researchers together from a selection of groups and research areas in the polymer engineering-polymer physics arena, for mutual benefit.

### COLLABORATIONS

Proposed collaborations to be developed through this initiative focus on the vital area of structuring of polymers by processing – increasingly recognised by academics and industry as being in particular need of enhanced understanding, in order to exploit the possibilities for obtaining novel properties or property distributions from polymers and associated materials (including biomaterials, fine chemicals and foodstuffs). The various groups involved have strong experimental and some theoretical research records in processing and rheology of polymers. Current collaborators include:

#### UK

Polymer IRC:  
Bradford University  
Leeds University  
Durham University  
Sheffield University;

#### plus

Belfast, Brunel, Cambridge, Loughborough Oxford, Swansea & Warwick Universities  
EPSRC  
Medlink Y&H Ltd  
Yorkshire Forward

#### CHINA

State Key Laboratory of Polymer Materials Engineering, Sichuan University;  
Beijing University of Chemical Technology;  
Institute of Chemistry, Chinese Academy of Sciences;  
Zhejiang University;  
Shanghai Jiao Tong University;  
Changchun University

#### TAIWAN, CHINA

Chang Gung University;  
National Taiwan University

#### JAPAN

Tokyo Institute of Technology;  
Tokyo University;  
Yamagata University;  
Kyoto University;  
Kuyusyu University

#### KOREA

Pohang University of Science & Technology



Front left, Prof. Phil Coates (UK), Kim Choon S C Kim (Korea), & PPS Phasitani (UK) at a meeting, Shanghai, China, 2008



Prof. Li Weng (Beihang), Prof. Guo (Beihang), & Prof. Qi Hong (SILPME, Dalian) at a meeting, China



Prof. Charles Han, Director, SCCAS, Beijing, China & Prof. Coates



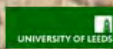
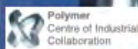
Prof. De Yin, Vice President, Shanghai Jiao Tong University, China & Prof. Coates



VIPps UK Technical Meeting, Bradford, September 2008

### Contact VIPps director:

Prof Phil Coates, FEng,  
Director, Polymer IRC  
Director, Polymer Centre of Industrial Collaboration  
F&I Vice Chancellor, Research & Knowledge Transfer  
School of Engineering, Design & Technology  
University of Bradford  
Bradford BD7 1DQ  
United Kingdom  
Tel: +44 1274 234540  
Fax: +44 1274 234525  
[p.d.coates@bradford.ac.uk](mailto:p.d.coates@bradford.ac.uk)  
[www.polymervip.com](http://www.polymervip.com)



## 1. EPSRC People Collaboration Programme: Virtual Institute for Polymer Process Structuring (VIPps)

The EPSRC-funded (£227k) People Collaboration programme, focuses on polymer engineering and aims to develop co-operations with academics in **China, Japan, Taiwan and Korea**. It is led by Prof Phil Coates and has provided an excellent platform of cooperative meetings to date. These started with Prof Coates' strategy plus technical meetings with Chinese academics in Shanghai in July 2007, in association with the Polymer Processing Society conference (where Prof Coates gave a plenary address), which allowed a survey of leading polymer engineering-related groups in China to be conducted, followed by meetings in Chengdu (State Key Laboratory for Polymer Materials Engineering, SKLPME), Beijing (Institute of Chemistry, Chinese Academy of Sciences, ICCAS) and Tokyo (associated with the major Japan Society for Polymer Processing meeting) in May 2008.

The time in Chengdu was particularly moving, coming just 2 weeks after the disastrous earthquake there, and our visit was much appreciated. Prof Coates was appointed an Honorary Professor of Sichuan University. In Salerno, again associated with the PPS-24 international meeting in June 2008, there was opportunity to meet with colleagues from all of the participating Far East countries, to share information and discuss collaboration in such areas as micromoulding, nanocomposite structuring and processing of modified polymers.

This was complemented Prof Coates visit to Taiwan (in conjunction with IUPAC Macro2008, Prof Coates being an invited speaker) – including a laboratory visit to fluid-assisted moulding centre of Prof Liu.

On to Beijing, July 2008, to visit four institutions, presenting science and discussing strategy. First, Beijing University of Chemical Technology (BUCT), then ICCAS where Prof Coates was honoured to be a Molecular Sciences Forum Professor, then Sinopec Beijing Research Institute, and finally Tsinghua University.

In addition, Leeds colleagues have been involved in cooperative visits to Japan - Dr Easan Savaniah, Frederico Roschttardt (on a 6 month placement with Prof H Watanabe, Kyoto University), and China - Prof Peter Olmsted, Dr Xiaosong Wang.

An exciting outcome was the VIPps UK meeting held during the week of 15th September 2008, including participation in the UK Polymer Showcase, with 27 Chinese academics being brought to the UK under the VIPps programme, from Sichuan University, ICCAS, and Shanghai Jiao Tong University. VIPps technical meetings, with presentations by invited Chinese and IRC academics together with posters from each participant, were in Bradford on Monday and Friday, and the posters were also exhibited at the UK Polymer Showcase, which also included a lecture from Prof Qi Wang, Director of SKLPME Chengdu on polyolefin developments.

Three of the Chinese academics from Sichuan came to Bradford for 2 weeks for cooperative research studies in our laboratory, with a view to building more substantial programmes, 1 -14 Feb, 2009.

We also hosted a visit to Bradford by Prof Koyama (Yamagata University) later in February 2009. Further international contacts were developed at PPS-25 in India in early March 2009.

The VIPps UK technical meeting was mirrored by one in China, March 23-25, 2009. At that meeting, 17 UK attendees and over 50 Chinese academics are presenting their research. We were greatly assisted by Prof Wang and colleagues at Sichuan University in the organisation of this meeting. Prof Coates was then made an Honorary Professor at Beijing University of Chemical Technology, 27 March 2009, during a visit to BUCT by a seven colleagues from Bradford.

Prof Coates wrote in 2009 "Academic activity in China is developing rapidly, so it is a privilege, timely and strategic to be involved in this cooperative venture. It is also a significant time in relation to the development of R&D in the industry there. In general the polymer industry has a limited experience of R&D, although the trend in Sinopec, to establish a new processing laboratory to complement its excellent characterisation facilities in Beijing, reflects that of Sabic and other major developing polymer manufacturers (against the trend to diminish R&D centres in the West). The Japanese polymer groups in particular are strong, with a very strong industry base, so the nature of our interaction is different – more 'one to one'. In all cases, the VIPps programme has received an extremely warm welcome, and has generated many new opportunities, which we aim to build upon. We are grateful for the very strong support for VIPps in each of the collaborating institutions."

In December 2008 EPSRC announced that the University of Bradford Polymer IRC, Institute for Pharmaceutical Innovation and Institute for Cancer Therapeutics groups' bid for a Science Bridges China three year project was successful – and was the top ranked bid in this very competitive programme call. An award of £1.27m was announced to develop knowledge transfer, training and assist with commercialisation of healthcare-related products, in collaboration with 11 Chinese academic institutions. The programme is also supported by Medilink (Y&H) Ltd, the Healthcare Technologies Knowledge Transfer Network and the UKTI.

The following picture album capture some – but not all! – of the active research and knowledge transfer links which the University of Bradford developed with China, from 2008 -9, which was a very formative time for our relationship. It consists largely of pictures and some brief commentary covering:

- our Engineering and Physical Sciences Research Council/ Research Councils UK (EPSRC and RCUK) -funded programmes;
  - Honorary and Visiting Professor appointments;
  - an RCUK Summer School in Shanghai;
  - English teaching in China (in conjunction with the Amity Foundation);
- special editions of an international journal;

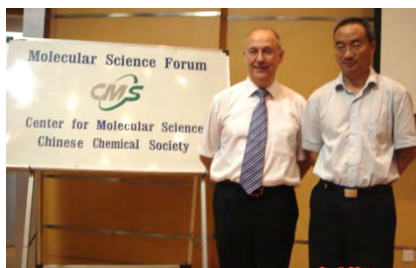
The **VIPps People Collaboration programme (2008-9)** was mainly in the polymer area, developing links between researchers and teachers in the UK and China, at both senior academic and student levels, plus links to school teachers.



Prof Phil Coates is made an Honorary Professor of Sichuan University by Senior Vice President Professor Li, May 2008; Academician Prof Xu Xi is on the right of the picture.



Prof Wan, Director of ICCAS Beijing, welcomes Prof Coates as Molecular Sciences Forum Professor, July 2008; below with Prof Dujin Wang.



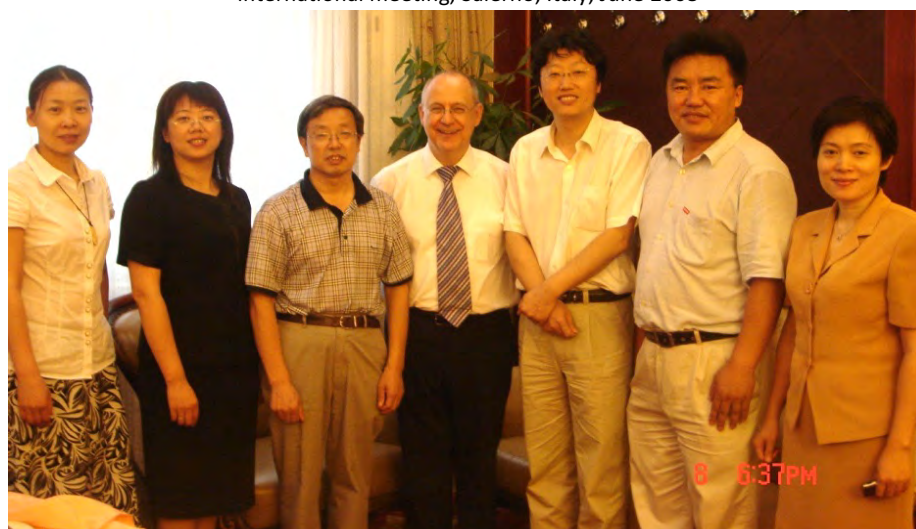
Sichuan University, May 2008:  
Prof Coates, & Mrs Jane Coates, (Honorary People Collaboration Assistant) who provided an English workshop for the Sichuan University Foreign languages department (below).



Jane also leads Amity Foundation teams each July in China, helping Chinese teachers of English to develop their English auracy (listening, language and teaching skills) –typically around 100 teachers each year



Meeting with Sichuan University and ICCAS Beijing senior (inc Prof Qi Wang, centre) and junior academics at the PPS-24 international meeting, Salerno, Italy, June 2008



Meeting with the Dean, Prof Wan, and key Polymer researchers at Beijing University of Chemical Technology, Beijing July 2008



At Sinopec, a major international oil company (hosted by Prof Jingliang Qiao, centre), who link strongly with various Chinese academics; Beijing July 2008



Meeting with the (then) youngest Chinese Academician, Prof Xi Zhang, Tsinghua University, Beijing to develop People Collaboration links, July 2008



EPSRC VIPps technical meeting held in Bradford, 15-20 September 2008; 27 Chinese academics came to this week of technical meetings.



Prof Qi Wang, Director of the State Key Laboratory for Polymer Materials Engineering, addresses the Polymer IRC's UK Polymer Showcase meeting in York, Sept 2008; chaired by Prof Coates





27 Chinese academics from Sichuan, Beijing and Shanghai meet with the Vice Chancellor, senior management, and polymer-related academics, Bradford University, September 2008



China Business Awards, UKTI/ Yorkshire & Humberside at the Queen's Hotel, Leeds: the Bradford team were first winners of the Best Education – China award, January 2009.



Prof Qi Yang, Dr Li Li and Prof Hesheng Xia of Sichuan University, working with colleagues in the Bradford Polymer IRC laboratories on short VIPps projects, 2-14 February, 2009.



Prof Jinhua Dong (Director, NSFC) sits between Prof Qi Wang and Prof Guangxian Li (Vice President, Sichuan University) at the VIPps China-UK meeting, Chengdu, March 2009.



Prof Xu Xi, Academician (seated), gave the introductory technical presentation.



A view of the VIPps conference stage and audience – with over 50 Chinese delegates, including local and regional government, and 17 UK academics.

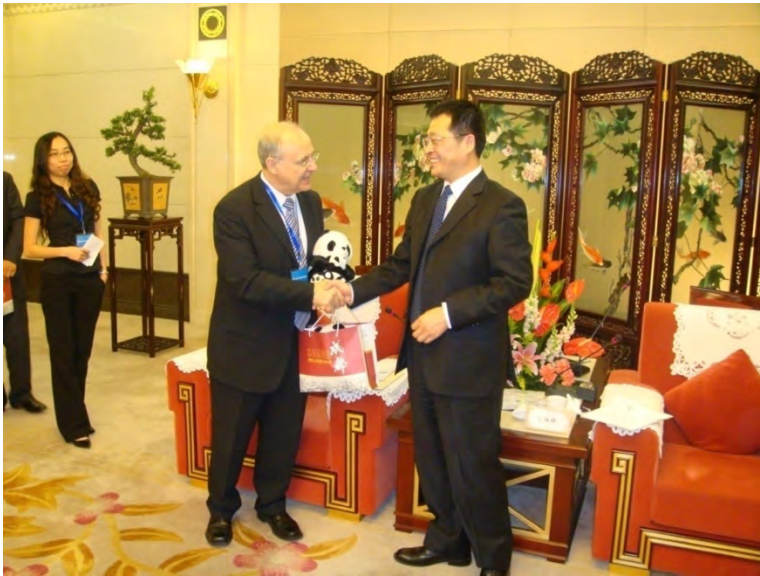


Over 60 technical posters were on show outside the Conference room.

The VIPps China-UK Technical Meeting was held in Chengdu, 23-25 March 2009; 17 UK academics from Bradford, Leeds and Durham, and over 50 Chinese academics from 8 universities and institutions participated. The event was held in the Shangri-la hotel, and included a laboratory visit to the State Key Laboratory for Polymer Materials Engineering, Sichuan University.



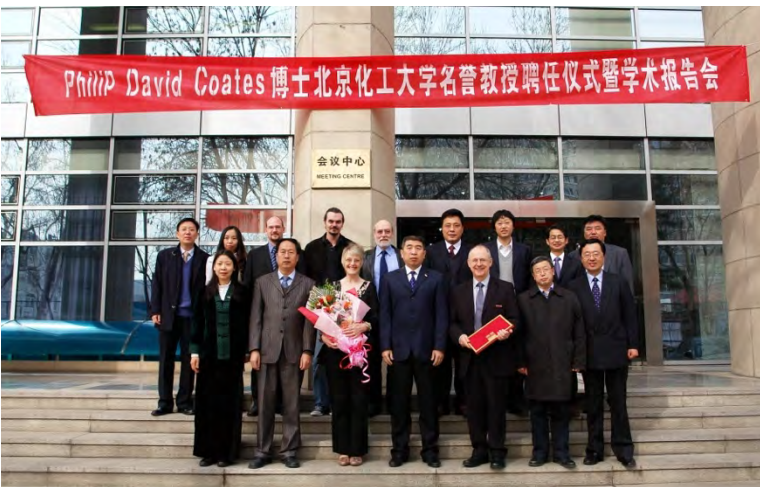
Attendees at the China-UK VIPps Technical Meeting, Chengdu, March 2009



Prof Coates meets the Mayor of Chengdu, Ge Honglin, at City Hall, Chengdu, March 2009, to pass on a letter of friendship from the Lord Mayor of Bradford. Xiao Lei Wang (left) acted as translator for the formal welcome ceremony.



Prof Coates receives his Honorary Professorship from the Vice President Li of Beijing University of Chemical Technology

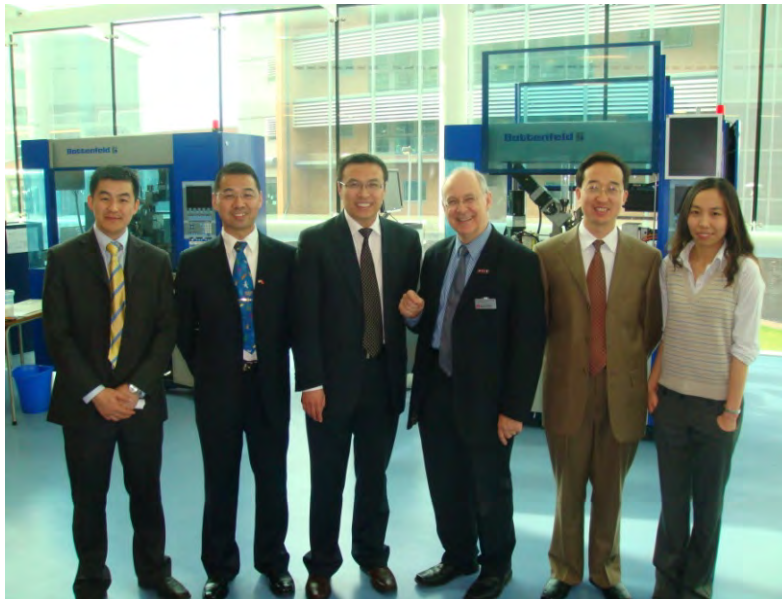


At Beijing University of Chemical Technology, March 2009





Dr. Futao Chen, Minister Counsellor of the Science & Technology Section meets Prof Coates in the Polymer IRC Micro & Nano Technology laboratory, March 2009



Chinese Embassy visitors to the University, March 2009

### Pharmaceutical and Cancer Therapeutics related activities



*Over 60 young researchers attend RCUK-supported Summer School on drug delivery research 28 Oct. 2008*  
Prof Peter York, Dr Qun Shao, IPI, University of Bradford.



RCUK Summer School attendees, Shanghai 2008

The CAS Shanghai Institute of Materia Medica (SIMM) and the Institute of Pharmaceutical Innovation (IPI) at the University of Bradford in the UK on 27 Oct. 2008 launched a week-long Summer School in Shanghai to introduce young researchers to new techniques for drug discovery and drug delivery.

The Summer School is being taught by distinguished professors from SIMM, **Bradford University**, Fudan University, Shanghai University of Traditional Chinese Medicine, and Shanghai Jiaotong University. Over 60 young researchers from Shanghai and as far away as Wuhan have signed on. This event is supported by RCUK China following the first annual UK-China Summer School competition.

The Summer School takes place just as China has announced major new investments in pharmaceutical research and development. A total of RMB6600 million is being allocated to institutes around China. SIMM is looking forward to a major boost in its activities from this budget.



In his opening remarks, **Professor Peter York of IPI** highlighted the key role of the UK in world biotechnology and pharmaceutical research. The UK's biotechnology sector is second only to the USA, and the UK accounts for 27% of all European pharmaceutical investment.

Chris Godwin, Director of RCUK in China, pointed out that the UK is already China's main research partner among European countries, and China is the UK's fastest-growing partner. The UK is the world's most productive research nation, while China is the fastest-growing research nation in history. These facts make China and the UK perfect partners in research.

Prof York (centre) and Prof Jamshed Anwar (right), IPI, at the RCUK event in Shanghai, 2008

Prof. Peter York and Prof. Jamshed Anwar were appointed as Honorary Professors by Shanghai Institute of Materia Medica, Chinese Academy of Science, 2008.



Prof Laurence Patterson, Director of the Institute for Cancer Therapeutics, is made a Visiting Professor of the 3<sup>rd</sup> Medical Military Hospital, Chongqing, January 2008; below -with Pharmacy staff at HMMU, Wuhan January 2008

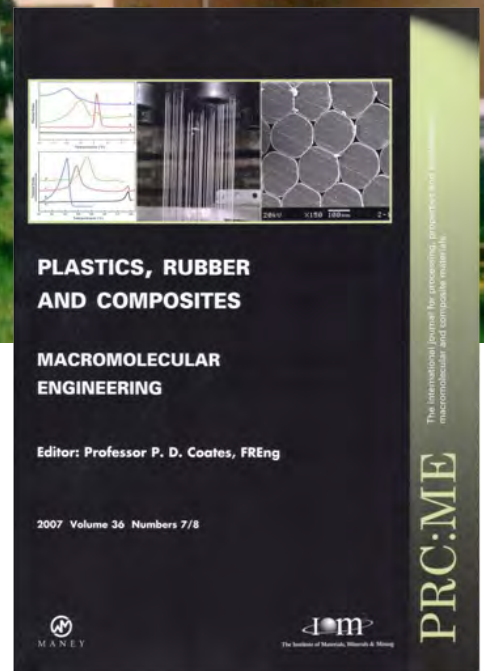


**SCIENTIFIC JOURNALS: a landmark for a Chinese group**

A special double edition of the journal *Plastics Rubber and Composites: Macromolecular Engineering*, an international polymer journal of the Institute of Materials, Minerals and Mining, has research papers in English from the **Sichuan University State Key Laboratory of Polymer Materials Engineering**, Directed by Professor Qi Wang. This high quality **landmark special edition** Vol 36, Numbers 7-8, October 2007 was the first to be published in English in an international journal by a Chinese laboratory.

*The State Key Laboratory for Polymer Materials Engineering, Sichuan University*

The Institute of Materials, Minerals and Mining's 2008 Alan Glanvill Award for "a paper published by the Institute of particular merit in the field of polymers" was awarded to N Chen, L Li and Q Wang, (Sichuan University) for the paper "New technology for thermal processing of poly (vinyl alcohol)". *Plastics, Rubber and Composites* No 7/8 2007 Vol 36, No7/8, pp283-290. – this is one of the papers from the special edition.



## 2. RCUK Bradford Science Bridges China Background - 2009 – 13

Science Bridges China

[www.sciencebridgeschina.com](http://www.sciencebridgeschina.com)

中英科技桥



GLOBAL ENGAGEMENTS



**RCUK Bradford Science Bridges China**

**EPSRC**

**EPSRC Global Engagements Programme**

**‘People Bridges’** (人与人的桥梁)  
for Healthcare Technologies

a Strategic Platform creating Research and Innovation opportunities with China,  
advancing Science & Innovation in Pharmaceutical Sciences & Advanced Materials  
for drug discovery, drug delivery and medical technology



UNIVERSITY OF  
**BRADFORD**  
MAKING KNOWLEDGE WORK™





## INTRODUCTION

This booklet provides an outline, with some detailed information, of activities in our RCUK Science Bridges China Platform, including the EPSRC Global Engagements programme, which focuses on Advancing Science & Innovation in Pharmaceutical Sciences & Advanced Materials, for drug discovery, drug delivery and medical technology. This is a strategic priority area for UK-China co-operation. We have developed a successful, growing platform, extending collaborations to other UK & Chinese partners - universities, companies, hospitals and government agencies.

### OUR APPROACH:

#### Investing in People

People are the key - we have established 'People Bridges' – working collaborations, developed trust and formed excellent research teams - with Research & Innovation Leaders and Young Researchers in 28 leading Chinese institutions and 6 UK universities (Bradford, Durham, Sheffield, Leeds, Nottingham and York).

#### Growing the platform

Our original RCUK Science Bridges China £1.25m programme has achieved total cash support to date of £7.54m, and £1.5m in-kind support in the UK and China, which covers **44 research or innovation projects**. This represents a six-fold cash leverage in £ sterling (7.54/1.25). In terms of value (taking into account the relative cost of R&D in China, the leverage is ~ 32.5/1.25 = 26 fold. (see next page)

#### Creating a Community

We have established close working relationships, which has led to the formation of the UK-China Advanced Materials Research Institute ([www.ukchina-amri.com](http://www.ukchina-amri.com)) - a Community for Research Excellence!

This represents a virtual institute of over 200 UK and Chinese researchers to date, with:

- Researcher profiles
- Joint publication
- Joint international laboratories being formed – the first is the Bradford-Sichuan Joint International Laboratory in Polymer Micro Processing

#### Encouraging Outputs

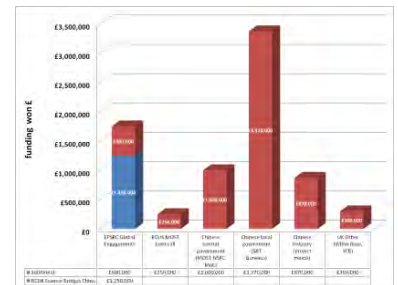
##### 25 collaborative research projects include:

drug development & delivery for diabetes, cancer, malaria, Traditional Chinese Medicines and Advanced materials - Polymer biomaterials, bioresorbables, nanocomposites and micro-processing for medical devices and drug delivery

**3 Research Workshops to date (Beijing (2011), Chengdu (2012), Bradford (2012))** have been held, co-hosted with partners, to develop research programmes

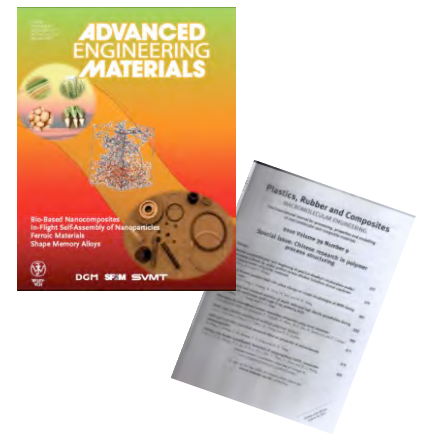
##### 19 open innovation 'proof of concept' projects,

have been formed from **4 Open Innovation Workshops to date**, co-hosted with **Changzhou (2009, 2011) and Guangzhou (2011, 2012) Science & Technology Bureaus**, including drug delivery, biomarkers, stem cells, wound treatment, diagnostics.



**Programme outputs to date** include:

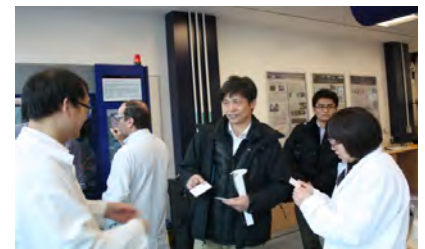
- 13 joint publications
- >120 international conference presentations
- 3 joint international patents filed
- Participation in high level political & trade events
- Joint International Laboratory founded
- UK-China Advanced Materials Research Institute founded



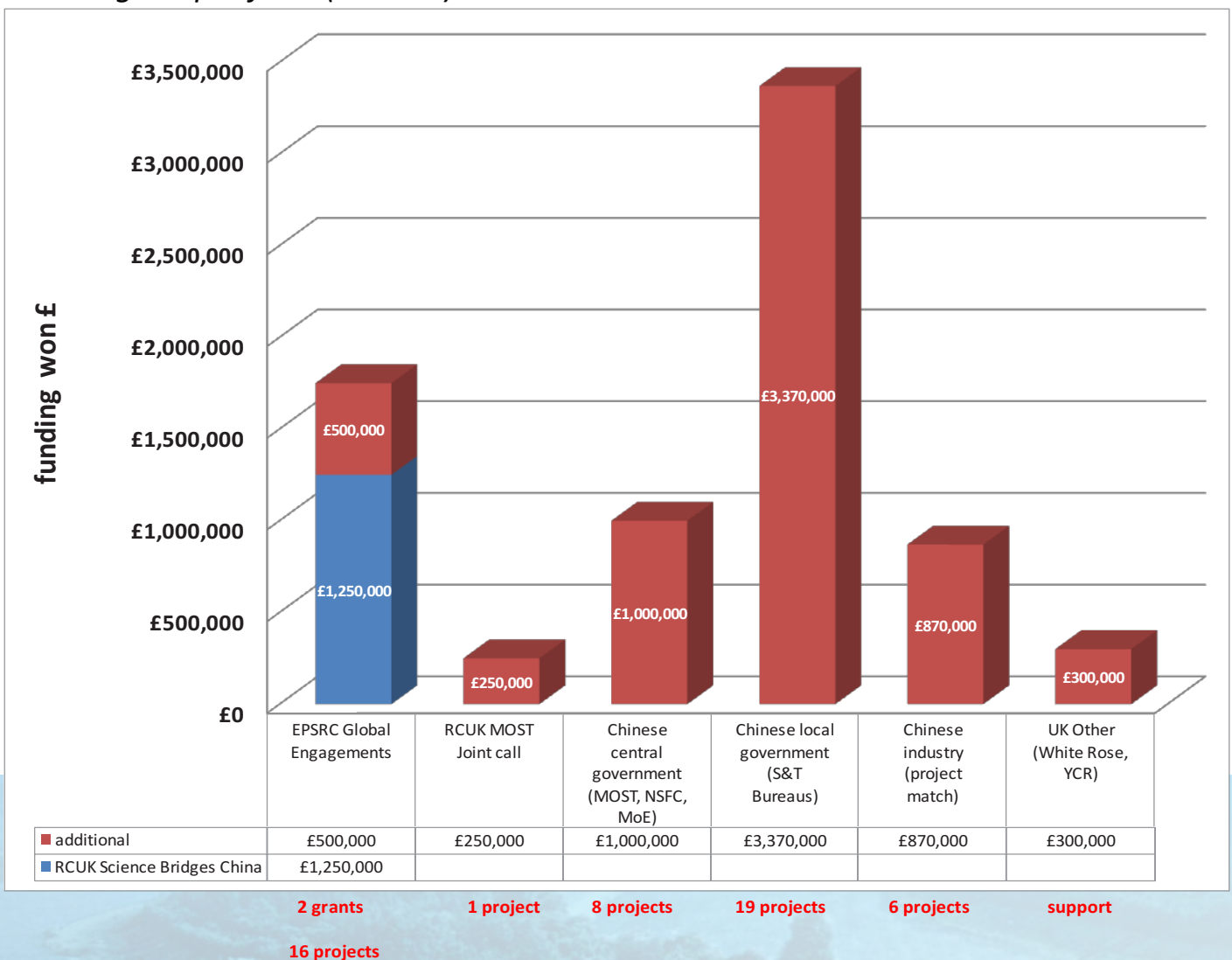
**EPSRC Global Engagements** supports and further builds:

Collaborative Research Programmes,

- Researcher Exchanges, - *a major emphasis*
- Joint research students,
- high level Research Workshops



**Growing the platform (to 2013):**



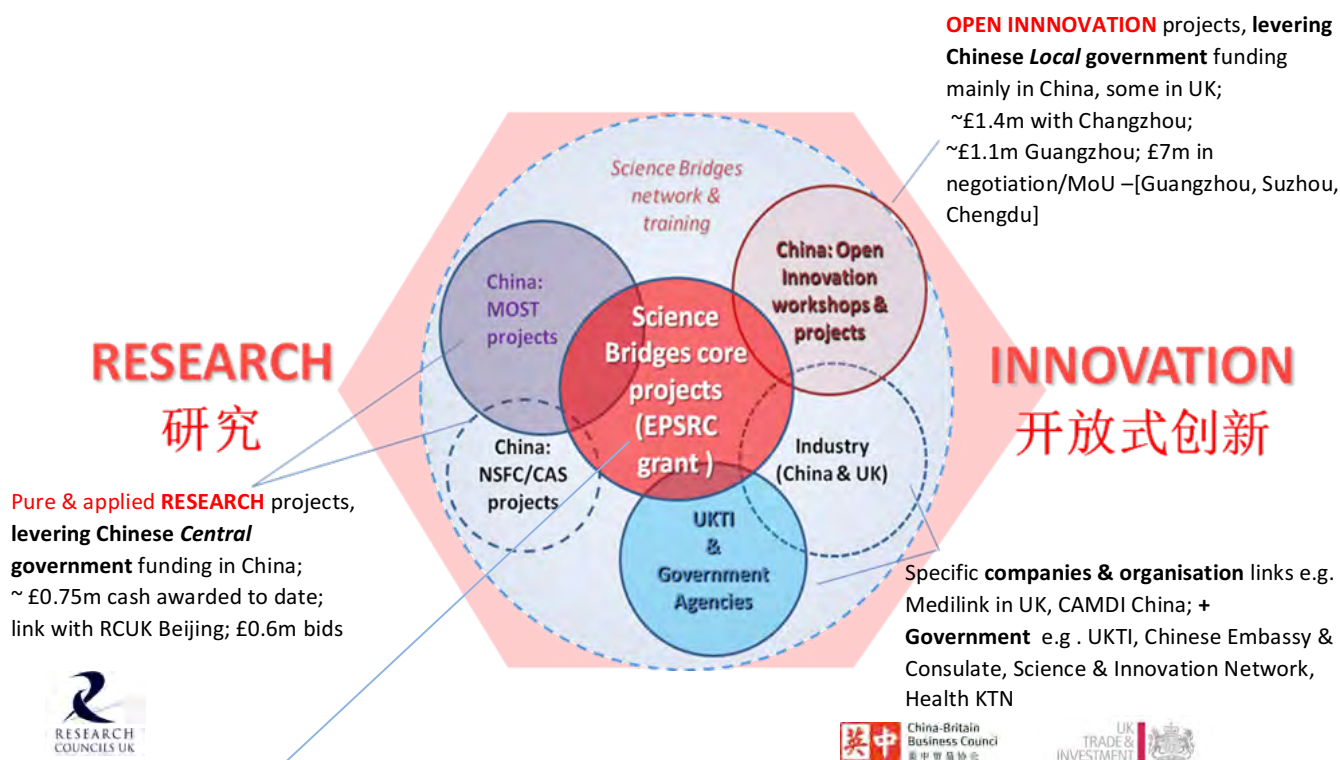
# RCUK Bradford Science Bridges China – Outline of Activities in the grant period

## + EPSRC Global Engagements Programme

### RCUK Bradford Science Bridges China - Scope

The Bradford RCUK Science Bridges China (SBC) programme consists of collaborative research, development and open innovation in pharmaceuticals and healthcare. It brings together scientists and companies from the UK and China to develop new therapies, medical diagnostics, materials and devices.

The 3 year £1.25m RCUK-funded programme commenced on 30 June 2009. It builds upon a successful range of activities by members of the Bradford team in China over more than a decade, has an advisory board consisting of UK and Chinese members and links strongly with funding bodies and government agencies or Ministries in the UK and China. Our **EPSRC Global Engagements** programme (April 2012-March 2013) builds on this excellent foundation, building a Research Community.



**Pure & applied RESEARCH** projects, leveraging Chinese **Central government** funding in China; ~£0.75m cash awarded to date; link with RCUK Beijing; £0.6m bids

**OPEN INNOVATION** projects, leveraging Chinese **Local government** funding mainly in China, some in UK; ~£1.4m with Changzhou; ~£1.1m Guangzhou; £7m in negotiation/MoU –[Guangzhou, Suzhou, Chengdu]

Specific **companies & organisation** links e.g. Medilink in UK, CAMDI China; + **Government** e.g. UKTI, Chinese Embassy & Consulate, Science & Innovation Network, Health KTN



#### CORE PROJECTS:

##### Pharmaceutical Sciences:

Drug development & delivery for diabetes, cancer, malaria;  
Traditional Chinese Medicine data mining & therapies;

*Key Collaborators: SIMM CAS, Tsinghua University, IMM CAS, Jilin University, TMMU Chongqing, Zhejiang TCM University, Nanjing University, XiangXue Pharma*

##### Advanced Materials - Medical technology:

Polymer biomaterials/ bioresorbables/ nanocomposites for medical devices & drug delivery;

*Key Collaborators: Sichuan University (SKLPME and NERCB); BUCT Beijing; ICCAS Beijing, Changchun IAC CAS*

# Science Bridges China – a Strategic Platform

Science Bridges China provides a strategic platform for the University, and for the UK by creating Opportunities with China by high level RKT people links

**EPSRC Global Engagements** further provides Research Programmes, Researcher Exchanges, Joint research students, & high level Research Workshops

## Science Bridges Chinese Collaborators & People Bridges (人与人的桥梁)

**Collaborators by Province:**

- Heilongjiang:** • Nankai University, • Tianjin University, • The 6th Military Institute, Chinese Military Science, • Beijing Institute of Chemical Industry, • MoST; NFSC; MoE
- Jilin:** • Jilin university, • Changchun Institute of Applied Chemistry Chinese Academy of Sciences, • Shenyang Pharmaceutical university
- Liaoning:** • Prof Phil Coates, Honorary Professor, Beijing University of Chemical Technology & Molecular Sciences Forum Professor at Institute of Chemistry, Chinese Academy of Science, Beijing
- Shandong:** • Paul Thorning, member of the Healthcare Joint Economic Trade Committee
- Shanghai:** • Prof Peter York, Honorary Professor at Shanghai Institute Material Medica, Chinese Academy of Science, • Dr Qun Shao leading an RCUK Summer School, Shanghai Chinese Academy of Science
- Guangdong:** • Science Bridges China/ UKTI special event at the UK Pavilion, World Expo, Shanghai, 2010; Signing ceremonies at Expo for agreements with: Changzhou local government & Sichuan University
- Changzhou:** • Shanghai Institute of Materia Medica, Chinese Academy of Science, • China Pharmaceutical University, • Fudan University, • Jiaotong University, • Shanghai TCM university, • Zhejiang TCM university, • China Medical City, • Suzhou Biobay, • Changzhou Science & Technology Bureau
- Guangzhou:** • Dr Qun Shao, Paul Thorning & Prof Peter York lead the first Changzhou Open Innovation Workshop, 2009
- Chengdu:** • Prof Phil Coates, made Honorary Professor, and Leading International Professor and Famous Overseas Scholar, Sichuan University, Chengdu
- Sichuan:** • Sichuan University, • Huaxi Medical University, • The Third Military University, • Chengdu Science & Technology Bureau
- Hong Kong:** • Hong Kong University of Science & Technology (HKUST), • Hong Kong Chinese University, • Guangzhou Science & Technology Bureau, • Xiangxue Pharmaceutical Group

**Events and Meetings:**

- Prof Laurence Patterson, ICT, made Honorary Visiting Professor, TMMU Chongqing
- Researcher exchanges
- Meeting the Mayor of Chengdu
- Opening the 2nd Advanced Materials for Healthcare Research Workshop, & launching the UK-China Advanced Materials Research Institute in Chengdu, 2012
- Dr Qun Shao and Paul Thorning lead 1st Guangzhou Diagnostics Open Innovation Workshop, 2011

**UK-CHINA amri**  
Advanced Materials Research Institute

Founder members:  
Polymer IRC, led by Bradford, with Durham, Leeds, Sheffield;  
Sichuan University, BUCT, ICCAS, CIACCAS, SIMM CAS  
~ 200 academic members

We gratefully acknowledge the support of:



+ University of Bradford RKT Centres in Advanced Materials Engineering, Polymer Micro & Nanotechnology, Pharmaceutical Engineering Science, Visual Computing, Skin Sciences

# 1. Translational Research Projects to 2012

## 1.1 RCUK-funded 'core' translational research projects

in healthcare: life sciences (drug discovery & delivery) based mainly in Bradford:

<b>Science Bridges China Core Projects</b>				
Project Title	UoB	Partner	Running Period	Amount from grant
Identification of Key Ingredients in Complex Chinese Medicines, to Develop New Therapies for Global Markets	<b>Dr Qun Shao</b>	<b>Prof Guan Luo</b> and Dr. Liangqiong Lin, Tsinghua University	Oct 2009 – June 2012	~£50k
A Mechanistic Investigation of TCM Therapies for Type 2 Diabetes October 2010 – June 2012	<b>Dr Qun Shao</b>	<b>Prof Jiwen Zhang</b> , Shanghai Institute of Material Medica, CAS <b>Prof Luwei Xiao</b> , Zhejiang Chinese Medicine University <b>Prof Jingkai Gu</b> , Jilin University	Oct 2010 – June 2012	~£50k
Seeding of plug flow crystalliser using a micro channel reactor	Dr Nicholas Blagden, Dr Qun Shao	<b>Prof David Wei</b> , Tianjin University	Aug 2011 – July 2012	~£20k
The Development of Agents Targeting the Hypoxic Tumour Cell Phenotype	<b>Prof Laurence Patterson</b> , Dr Klaus Pors	<b>Prof Weishou Fang</b> , Institute of Material Medica, Chinese Academy of Medical Sciences & Beijing Union Medical College	Nov 2010 – Oct 2012	~£60k
The development of FormylPeptide Receptor antagonists as a New Class of Antiproliferative Agents	<b>Prof Laurence Patterson</b> , Dr kamyar Afarinkia, Dr Viqui Vinader, Dr Rob Falconer	<b>Prof Xiuwu Bian</b> , Southwest Hospital, Third Military Medical University	Nov 2010 – Oct 2012	~£80k
Improved Anti-Malarial Treatment through Enhanced Bioavailability of Artemisinin December 2010 – June 2012	<b>Prof Laurence Patterson</b> , Dr Wendy Hulse	<b>Jiwen Zhang</b> , Shanghai Institute of Material Medica, CAS <b>Prof Jingkai Gu</b> , Jilin University <b>Prof Peter York</b> , Crystec Ltd	Dec 2010 – June 2012	~£75k

## 1.2 RCUK-funded mini-core projects to 2012

based mainly in China, mainly advanced materials engineering (medical devices & technology), with some life sciences projects, run in collaboration with Bradford:

<b>Science Bridges China Core Projects</b>				
Project Title	UoB	Partner	Running Period	Amount from grant
Ultrasound-assisted Physical or Chemical Interaction from Melts	Prof Anant Paradkar, Dr Adrian Kelly, Dr Elaine Brown and <b>Prof Phil Coates</b>	Dr Hong Wu, <b>Prof Shaoyun Guo</b> , Sichuan University	Oct 2010 – June 2012	80k RMB (~£8k)
Electrically Conductive Polyurethane/Carbon Nanotubes Composites for Medical Microdevices	<b>Prof Phil Coates</b> , Prof Hadj Benkreira, Dr Raj Patel, Dr Ben Whiteside, Dr Fin Caton-Rose	<b>Prof Hesheng Xia</b> , Dr Guoxia Fei, Sichuan University	Oct 2010 – June 2012	80k RMB (~£8k)
Poly(vinyl alcohol)-based Composite Products for Drug Delivery	<b>Prof Phil Coates</b> , Dr Leigh Mulvaney-Johnson, Dr Ben Whiteside	<b>Prof Qi Wang</b> , Dr Ning Chen, Dr Li Li and Prof Jie Zhang, Sichuan University	Oct 2010 – June 2012	80k RMB (~£8k)
Solid Phase Processing of Polymer Blends and Nanocomposites	<b>Prof Phil Coates</b> , Dr Fin Caton-Rose, Dr Michael Martyn	Dr Xiaowen Zhao, <b>Prof Lin Ye</b> , Sichuan University	Oct 2010 – June 2012	80k RMB (~£8k)
Targeted polymeric micelles for anti-cancer drug delivery	Dr Kamyar Afarinkya, Prof L Patterson, <b>Prof Phil Coates</b>	<b>Prof Zhongwei Gu</b> , Dr. Yu Nie, Sichuan University	June 2011 – June 2012	50k RMB (~£5k)
Investigation of polymer micro-needles by micro-injection molding	Dr Ben Whiteside, Prof Anant Paradkar, Dr Adrian Kelly, <b>Prof Phil Coates</b>	<b>Prof Dongyun Ren</b> , Prof Yajun Zhang, Mr Xiang Lin, Mr Ling Xue, Beijing University of Chemical Technology	Aug 2011 – Aug 2012	50k RMB (~£5k)
Precise Microfabrication and Micro-Nanoscale Combination of Polymeric Microspheres for Promoting Cell Growth	<b>Prof Phil Coates</b> , Dr Colin Grant, Dr Ben Whiteside	<b>Prof Zhihua Gan</b> , Dr Xudong Shi, Institute of Chemistry, CAS	Aug 2011 – Aug 2012	50k RMB (~£5k)
Structure and Properties of Micro-moulded Poly(ε-caprolactone) and its miscible blends	<b>Dr Tim Gough</b> , Dr Ben Whiteside, Prof Phil Coates	<b>Prof Yongfeng Men</b> , Dr Ying Gao, Dr Yuqing Lai, Dr Zhiyong Jiang, Dr Lingzhi Liu, Changchun Institute of Applied Chemistry, CAS	Aug 2011 – Aug 2012	50k RMB (~£5k)
Toughening of Polylactide with Bioelastomer for Biomedical Application Research Team	Dr Mike Martyn, Dr Tim Gough, <b>Prof Phil Coates</b>	Prof Liqun Zhang, Hailan Kang, <b>Prof Dongmei Yue</b> , Beijing University of Chemical Technology	Aug 2011 – Aug 2012	50k RMB (~£5k)
Epigenetic Mechanisms of Tissue Development and Regeneration	<b>Prof Vladimir Botchkarev</b>	Dr. Guo-Liang Xu, The State Key Laboratory of Molecular Biology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences	Nov 2011 - Jun 2012	50k RMB (~£5k)

### 1.3 Chinese government-funded internationally collaborative projects to 2012

- successful joint bids to MOST & NSFC international programmes, run in China; - successful bids to MOE, run in the UK and China:

Science Bridges China: Chinese Research Councils Funded Projects/Awards					
Project Title	UoB	Partner	Running Period	Funding Body	Amount
Enhance the Bioavailability of Artemisinin by Combined Drug Delivery Techniques to Limit the Emergence of Malaria Resistance	Prof Laurence Patterson	Jiwen Zhang, Shanghai Institute of Materia Medica, CAS	May 2010 – Dec 2012	MOST	1m RMB
Development of methods for the assessment of TCM's disease/syndrome and efficacy as well as data mining	Dr Qun Shao	Prof Guoan Luo, Tsinghua University	May 2010 – Dec 2012	MOST	1m RMB
Preparation and Micromolding of Polymer Nanocomposites for Medical Applications	Prof Phil Coates	Qi Wang, Sichuan University	May 2011 – Dec 2013	MOST	1m RMB
				Sichuan Province	1m RMB
Fundamental studies on the preparation and micro-processing of polymer functional micro-devices	Prof Phil Coates, Prof Hadj Benkreira, Dr Ben Whiteside, Dr Michael Martyn, Dr Adrian Kelly, Dr Tim Gough	Prof Qi Wang, Prof Hesheng Xia, Prof Jie Zhang, Dr Yan Liu, Dr Ning Chen, Dr Shibing Bai, Dr Guoxia Fei, Ms. Zhengkun Hua, Sichuan University	Jan 2011 – Dec 2013	NSFC	1.6m RMB
Overseas Famous Scholar	Prof Phil Coates	Sichuan University	2010 -2015	MOE	1m RMB
High-End Foreign Professor	Prof Phil Coates	Sichuan University	1 July 2010 – 30 June 2013	Sichuan University	100k RMB
China Scholarship Council awards	Prof Phil Coates	Prof Yinghong Chen, Sichuan University	Jan 2011- Jan2012	MOE	~150k RMB
China Scholarship Council awards	Prof Phil Coates	Prof Qi Yang, Sichuan University	March 2011-March2012	MOE	~150k RMB

**Research Workshops in Advanced Materials for Healthcare** have been run by the Bradford team in Beijing (Nov 2011) and Chengdu (April 2012) aimed at joint bids to MOST or NSFC international programmes – as a result in April 2012, 3 bids were submitted the 2012 RCUK-MOST Joint Call for Healthy Ageing Populations:

- **Biomaterials for Joint Soft Tissue Repair - Improving Health in Older Age: University of Bradford/ State Key Laboratory of Polymer Materials Engineering, Sichuan University / Institute of Chemistry, Chinese Academy of Sciences Beijing/ Sheffield University/ Durham University- FUNDED**
- **Elderly specific transdermal patch design to improve patient compliance in dementia patients:** University of Bradford/ Shanghai Institute of Materia Medica, Chinese Academy of Sciences/ Jilin University/ Peking University First Hospital/ The First People's Hospital of Changzhou.
- **An exploration of chemopreventive TCM and tumour targeted novel ultrapotent chemotherapeutic agents in tissues from UK and China cancer patients:** University of Bradford/ Southwest University Chongqing / Southwest Hospital, Third Military Medical University, Chongqing/ Huaxi Hospital, Sichuan University, Chendgu), St James' Hospital, Leeds University/ Bradford Royal Infirmary.

**2. Chinese local government-funded 'open innovation' (OI) workshops** run by the Bradford team in China, leading to projects for *proof of concept applications*, are based mainly in China. Projects are typically 2 year duration, with expectation of particular commercial milestones being met.

**2.1 Changzhou** Science & Technology Bureau hosted two OI workshops, with ~£1.2m funding in China.

Science Bridges China Open Innovation Projects							
	Project Title	UoB	UK partners	Chinese Partner 1	Other Chinese Partners	Amount	Funding to UK
<b>Changzhou 1 Dec 2009</b>	Repair of Oral and Periodontal Defects using Regenerative and Antimicrobial Strategies Delivered by Novel Tissue Scaffold	Dr Richard Telford, Dr Qun Shao	University of Leeds Neotherix Ltd	Prof Jiwen Zhang, Shanghai Institute of Materia Medica, CAS	Dr Juan Du, Changzhou Sanwei Industry Institute  Prof Jingkai Gu, Jilin University	~£200k	£61.4k [r00132]
	The Development of Nanoparticulate Curcumin with Enhancers from TCM for Treatment of Cancer and Alzheimer's Disease	Prof Anant Paradkar		Prof Yihu Qiao, Nanjing University	Dr Zhifeng, Changzhou City Hospital	~£200k	£57k [r00117]
	A Suite of Platform Technologies for Masking the Undesirable Taste of TCM and Western	Prof Laurence Patterson,	Dr Stefan Ogrodzinski, Biostatutes	Prof Yi Feng, Shanghai University of	Changzhou Yabang Pharmaceuticals Co Ltd	~£200k	£60k [r00172]

	Medicines in Liquid Form	Dr Qun Shao		Traditional Chinese Medicine			
<b>Changzhou 2</b> <b>April 2011</b>	Translational research on dental pulp stem cells in orthopaedic implants	-	Prof Xubin Yang, Leeds University	Changzhou Kanghui Medical Innovation Co. Ltd		~£50k*	~£50k
	Development of new hydrocolloid for improved wound treatment	Prof Anant Paradkar	Prof Kadem Al-Lamee, Arterius Ltd; Mr Richard Snell, Altrika Ltd	Ms Ping Li, Changzhou Nanfang Medical Application Factory Co. Ltd	Prof Huayu Tian, Changchun Institute of Applied Chemistry, CAS	~£50k*	~£50k
	Stem cell application	Dr Gill Westgate	Mr Richard Snell, Altrika Ltd	Prof Delin Zhu, Jiangsu Heze Biotech Ltd	Prof Peibiao Zhang, Changchun Institute of Applied Chemistry, CAS	~£50k*	~£50k

- Each project in phase 2 has ~£150k match funding from each Changzhou company involved, finance entirely in China.

**2.2 Guangzhou I** – November 2011 (awards announced April 2012) – Guangzhou Science & Technology Bureau (BioIsland) have hosted one workshop in the grant period, led by our team. This has provided £1.1m across 7 projects, with match funding required from Chinese industrial collaborators)

Project Title	UoB	UK partners	Chinese Partner	Amount
Development of Candidate Vaccines Against Viral Disease using Advanced Adjuvant Technology		Jon Sayers, University of Sheffield	South China United Vaccine Institute	1.8m RMB
Development of cancer biomarker immunoassay using novel antibody mimetics		Darren Tomlinson, Leeds University	Raybiotech, Inc. Guangzhou	2m RMB
Multi-Analyte-Virus-Chip (MAVIC)		Tom Gibson, ELISHA Systems Ltd	Guangzhou IRD Medicine Co., Ltd	2m RMB
Biosensor Systems for Cancer Biomarkers and Bacteria		Tom Gibson, ELISHA Systems Ltd)	Guangzhou Wondfo Biotech Co., Ltd	1.5m RMB
Development of Novel Reagents for Virus Detection and Antiviral Therapeutics		Darren Tomlinson, Leeds University	Guangzhou Institutes of Biomedicine and Health	1.3m RMB
Automatic System for Measurement of Neural Respiratory Drive and Muscle Function		Mohammed Benaissa, Sheffield University	Guangzhou Respiratory Medical Science Ltd. Co	1.2m RMB
Clinical Trial and Evaluation of a Computer Aided Diagnostic System for Breast Cancer Screening	Hassan Ugail		Guangzhou Huayin Medical Laboratory Centre, China	1.2m RMB

Note that the Open Innovation projects may be set up without Bradford University being a collaboration partner, to help develop the range of collaborators. White Rose University members are supported by the White Rose University Consortium for Open Innovation workshop costs.

**2.3 Guangzhou II** – this Workshop was **Yorkshire Cancer Research** funded – ran in July 2012:

	Project title	UK/China collaborators	Awarded amount from GDD	Guangzhou company match funding
1	Swept laser source for ultra-high resolution optical coherence technology	Guangzhou FemtoView Optoelectronics Technology Co. Ltd./ Sheffield University	£200K	£200K
2	Development of an MMP-based diagnostic system for cancer	Guangzhou Zhongke Kaisheng Medical Technology Co. Ltd; Sun Yat-sen University/University of Bradford	£200K	£200K
3	Development of automated detection system of multi-gastric cancer markers protein chip	Guangzhou Raybiotech Inc., Guangzhou South China biochip research institute /Leeds University	£150K	£150K
4	Development of an Immune colloidal gold kit for testing for malaria based on a non antibody binding protein	Guangzhou Hexin Biotechnology Co. Ltd./ Leeds University	£120K	£120K
5	Developing tumour marker detection kits using novel nABP materials	Daan Gene/Leeds University	£100K	£100K
6	Kit for mobilisation and isolation of haematopoietic stem cells (HSC) for use in therapy	Sun Yat-sen University/University of Hull	£100K	£100K

**2.4 Guangzhou III** - a third Guangzhou Workshop is being supported by Yorkshire Cancer Research (2013).

### 3 International Conferences & Meetings to 2012

We have over 120 international conference presentations associated with the Science Bridges China programme in the grant period, including plenaries, keynotes, invited papers; the international meetings include the following:

103<sup>rd</sup> AACR Annual Meeting 2012, Chicago  
AAPS, Los Angeles, 2009  
AAPS, Washington, 2011  
Academy of Pharmaceutical Science Annual Conference (Pharmsci UK), Nottingham, 2011  
Canadian Society of Rheology, Montreal, 2011  
Drug Delivery and Formulation Asia Summit, 2011  
20<sup>th</sup> ICCE, Beijing 2012  
2nd International Conference on Nanomechanics and Nanocomposites, Beijing, 2010  
8<sup>th</sup> International Congress of Pharmaceutical Sciences, Brasil, 2011  
6th International Conference on Micro Manufacturing (ICOMM), Tokyo, 2011  
IUPAC Macro World Polymer Congress, Virginia Tech, 2012  
NexGen China Conference, Shanghai, 2012  
Polymer Process Engineering'09, Bradford, 2009  
Polymer Process Engineering'11, Bradford, 2011  
Polymer Processing Society International, Banff, 2010  
Polymer Processing Society International, Marrakesh, 2011  
Polymer Processing Society International, Niagara, 2012  
Polymer Processing Society International, Pattaya, 2012  
Science Bridges China Research Workshop, Beijing, 2011  
Science Bridges China Research Workshop, Chengdu, 2012  
Society of Plastics Engineers, ANTEC, Chicago, 2009

*We have participated in a wide variety of international meetings, in addition to those indicated above, including:*

Academy of Pharmaceutical Science Annual Conference, Nottingham, UK 2010  
Academy of Pharmaceutical Science Annual Conference, Nottingham, UK, 2009  
Academy of Pharmaceutical Sciences China-India Event (Joint event with Nottingham), 2009  
Annual Conference of Consortium of Globalisation of Chinese Medicine, Hongkong, 2010  
Annual Meeting of the European Society for Dermatological Research, Venice 2012  
Beijing Health Innovation Forum (Chinese Medicine), 2009  
Beijing Health Innovation Forum (East-West convergence), 2010  
Beijing Health Innovation Forum (International co-operation) 2011  
Beijing Health Innovation Forum (Technology Transfer Case Studies) 2012  
Beijing HIP annual conference, Beijing, 2010  
Chinese Association of Medical Device Industries (CAMDI) International conference, 2009  
CCCMHPIE Healthcare Industries Forum 2011  
CMEF Woundcare Forum, Shenzhen, 2010  
Globalisation for Chinese Medicine Annual Conference, Hongkong, China, 2011  
ICONTOX, Lucknow India, 2010  
International Translational Medicine Symposia, Chongqing, 2010  
JETC Healthcare Working Group, 2009  
JETC Healthcare Working Group, 2010  
Medilink Y&H Ltd Emerging Markets Forum, 2011  
Ministerial Briefing Event, Beijing 2011  
MOST open innovation briefing event 2011  
Nanotechnology convention, Beijing, 2009  
Shanghai BioForum, 2011  
UK Life Sciences day, Shanghai Expo, Shanghai 2010  
UKTI China Sector briefing event  
UKTI innovation with China event 2011  
UKTI R2D BioBridge International Conferences in Beijing, Suzhou, Shanghai) 2011  
UKTI R2D BioBridge International Conferences in Shanghai, 2011  
UKTI R2D healthcare innovation forum, 2010  
UKTI/Medilink Woundcare mission (Beijing, Shanghai, Guangzhou), 2010  
7th World Meeting on Pharmaceuticals, Biopharmaceuticals and Pharmaceutical Technology, Malta, 2009



## 4 SHARED INTELLECTUAL PROPERTY to 2013

There are shared IP agreements for all of the above projects (open innovation and research); plus separate IP with:

- Sichuan University/ Bradford - High conducting polymer carbon nanotube composites
- Neotherix/ University of Leeds - Tissue Engineering –Photodynamic Therapy
- A Paradkar – hot melt extrusion – patent filed
- P York, Bradford /SIMM - artemisinin anti-malarial treatment using supercritical fluids - patent being developed.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

(43) International Publication Date  
5 July 2012 (05:07:2012)

(10) International Publication Number  
WO/2012/089998 A2

(51) International Patent Classification:  
BIOC 06/00 (2010:01)

(21) International Application Number:  
PCT/GB2011/060775

(22) International Filing Date:  
28 December 2011 (28.12.2011)

(25) Filing Language:  
English

(26) Publication Language:  
English

(30) Priority Data:  
2011011646.5 29 December 2010 (29.12.2010) CN  
1108101.9 16 May 2011 (16.05.2011) GB

(71) Applicant (for all designated States except US):  
UNIVERSITY OF BRADFORD (GB), Richmond Road, Bradford, West Yorkshire BD7 1DP (GB); SICHUAN UNIVERSITY (CN), No. 24 South Section 1, Yihuan Road, Chengde 610065 (CN)

(72) Inventor and (73) Invention/Applicant (for US only):  
SHENG, Xia He (CN), Sichuan University, No. 24 South Section 1, Yihuan Road, Chengde 610065 (CN); COATES, Philip David (GB), Polymer (PCC) Polymer (PCC), School of Engineering, Design & Technology, University of Bradford, Bradford BD7 1DP (GB); XIE, Li Dong (CN), Sichuan University, No. 24 South Section 1, Yihuan Road, Chengde 610065 (CN); XIA, Fei Gao (CN), Sichuan University, No. 24 South Section 1, Yihuan Road, Chengde 610065 (CN); CHUNG, Gung Qo (CN), Sichuan University, No. 24 South Section 1, Yihuan Road, Chengde 610065 (CN)

(74) Agent:  
GIBBONS, Stephen Philip, Intellectual Property, Business Office, The Bank Creative Business Park, Eastingwood, York YO61 3FE (GB)

(81) Designated States (unless otherwise indicated, for every kind of regional protection available):  
AE, AG, AL, AM, AU, AT, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GR, GT, HK, HN, HU, IL, IN, JP, KE, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MY, NZ, PA, PE, PG, PH, PK, PL, PT, QA, RO, RU, RW, SC, SD, SE, SG, SK, SI, SJ, ST, SV, TN, TH, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

(84) Designated States (unless otherwise indicated, for every kind of regional protection available):  
AR, BO, BR, GB, GM, KE, LU, US, MW, MZ, NA, RW, SD, SI, SZ, TZ, UG, ZM, ZW; Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM); European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GR, GB, GR, HU, IE, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR); OAPI (BF, BI, CF, CI, CG, CM, GN, GD, GP, MR, NE, SN, TD, TG)

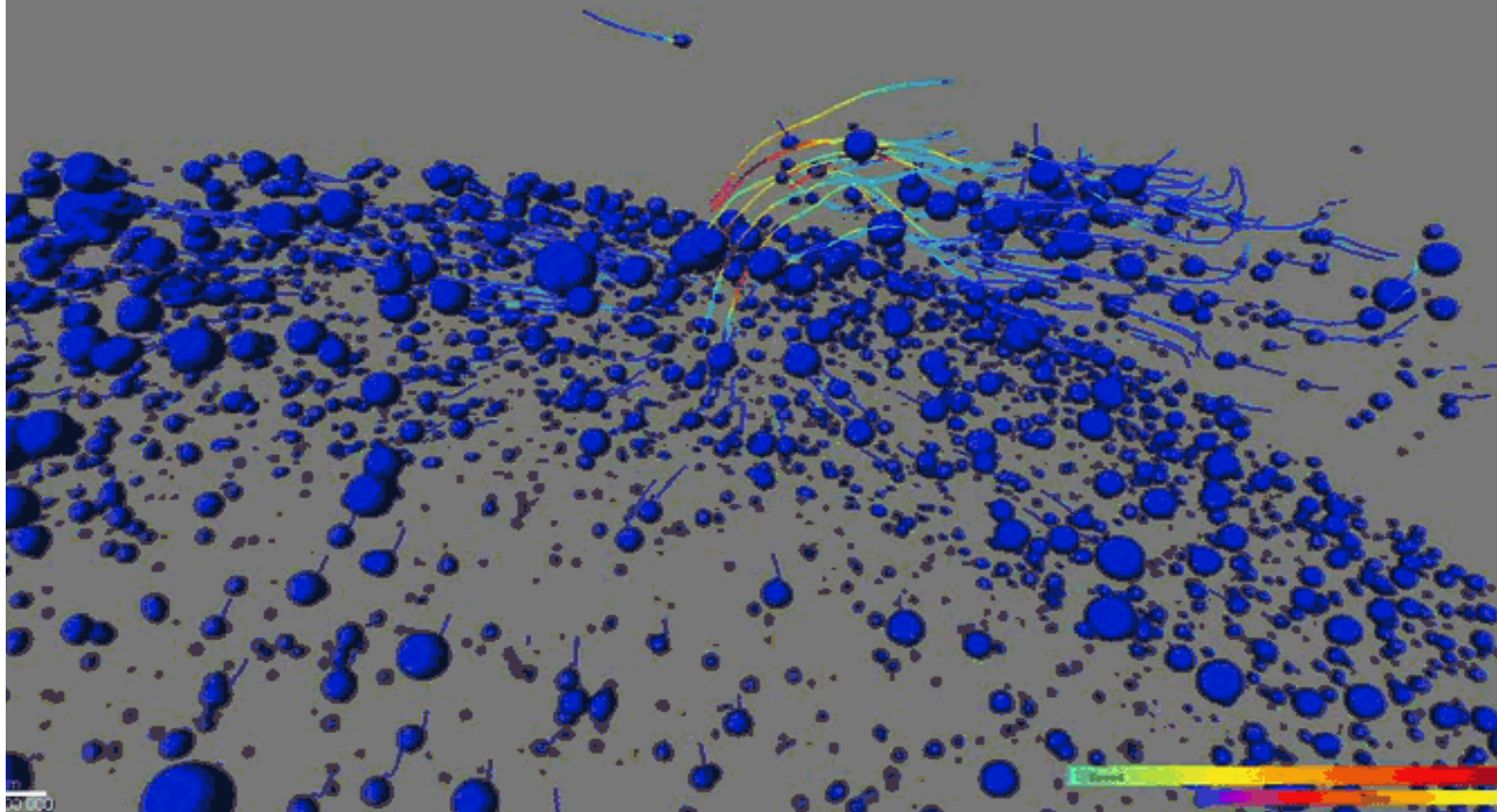
Published: without international search report and/or to be republished upon receipt of that report (Rule 48.2(a))

WO/2012/089998 A2

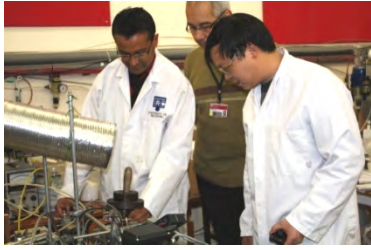
(56) Methods to improve the electrical conductivity for moulded plastic parts

(57) Abstract:  
Disclosed herein are the methods to improve the electrical conductivity for micro-moulded plastic parts containing carbon nanotubes. The polymer/carbon nanotube composition suitable for polymer micro-moulding including 80 - 99.95 wt% of a polymer pellet or powder, 0.2 wt% of antioxidant, 0.2 wt% of dispersant agent and 0.02-20 wt% of carbon nanotubes with a diameter of 0.5 - 200 nm and a length of 200 nm - 200 μm are firstly prepared through such extrusion. The plastic micro-pipes are prepared by micro-moulding of the polymer/carbon nanotube composite including micro-extrusion, micro-injection and hot embossing at optimal processing conditions and then are subject to a post thermal treatment to enhance the electrical conductivity. The post thermal treatment methods include electric heating, microwave, infrared or plasma heating. The methods disclosed can be used to prepare electrical conductive biomedical implanted plastic micro devices for minimally invasive surgery, biomedical sensors, microfluidics, drug delivery devices, automated pipetting systems, breathing tubes, LED devices etc.

synchrotron studies of drug elution (Jiwen Zhang, SIMMCAS)



**Some views of our activities, 2009-12:**



Working together at Bradford



discussions in Chengdu High Technology Zone



Changzhou team signing at Shanghai Expo



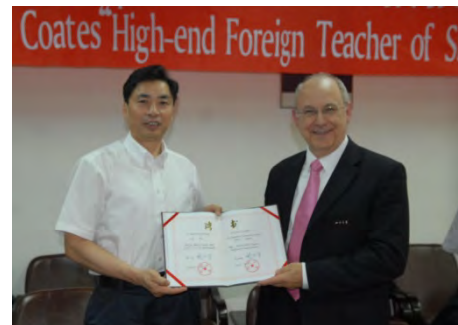
Dr Futao Chen (centre) Chinese Embassy visits our Polymer Micro & Nano Technology Centre



Science Bridges Launch, Royal Society London, with Chinese Embassy & Sophie Laurie, RCUK



Prof Peter York addresses the Changzhou Open Innovation Workshop, Dec 2009



President Xie of Sichuan University, appoints Prof Coates to the highest level foreign professor post, 2010



UK-China-India Pharma Meeting, Nottingham



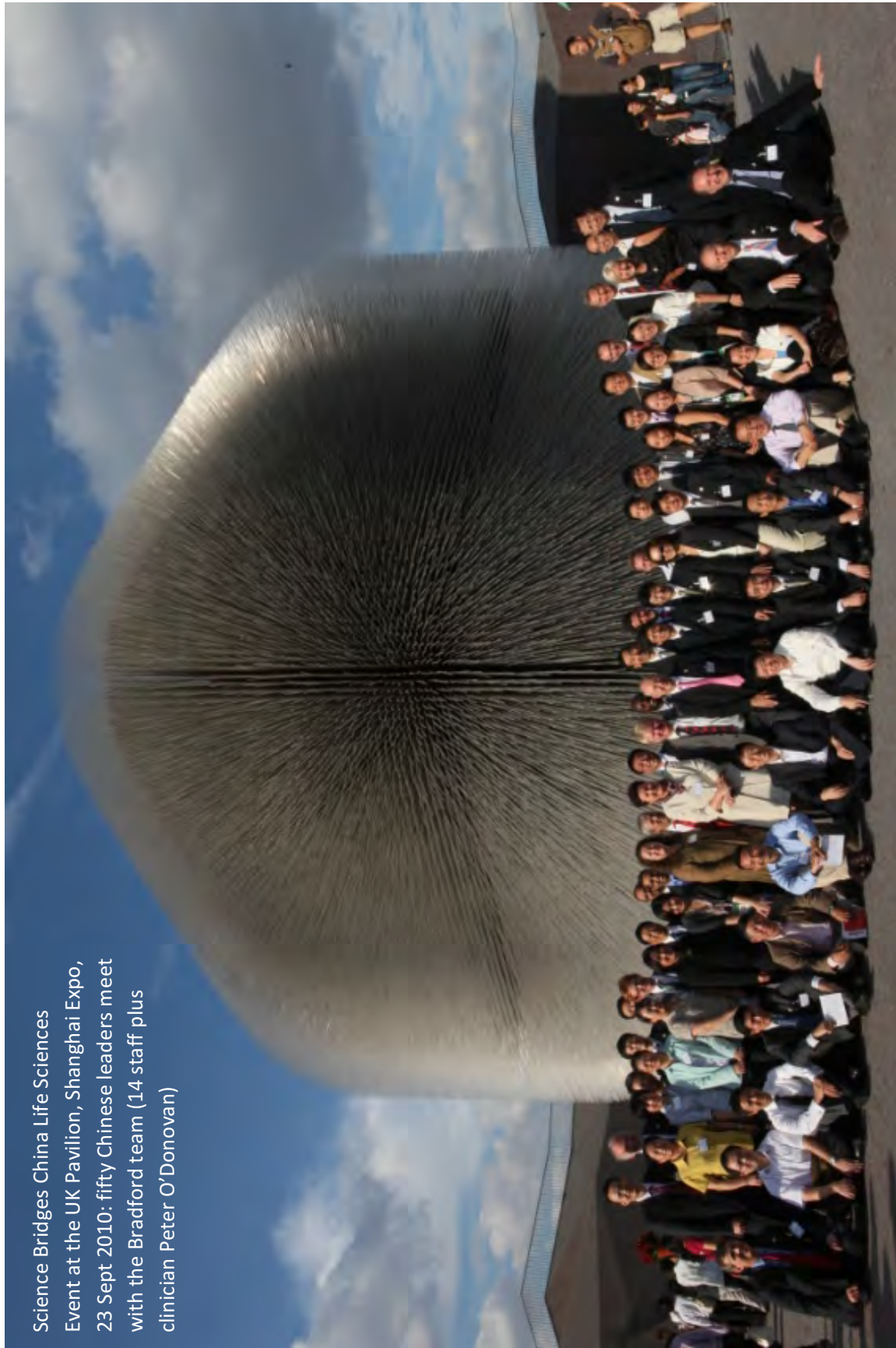
Bradford-SIMMCAS sign agreement



some of the many meetings with Academician Professor Xu Xi of SKLPME, Sichuan University



Science Bridges China Life Sciences  
Event at the UK Pavilion, Shanghai Expo,  
23 Sept 2010: fifty Chinese leaders meet  
with the Bradford team (14 staff plus  
clinician Peter O'Donovan)



# The UK Polymer Interdisciplinary Research Centre

A simple philosophy:

Aim to be the best at what we do

Build bridges - science, technology and people

Cross the bridges!



*don't give up - collaboration is worth it!*

Delivering 21st century polymer-related research and knowledge transfer aligned with UKRI strategic aims, we provide researchers with an environment in which ideas and innovations can flourish. We build locally, nationally and globally (with 3 Joint laboratories in China), to help develop fundamental understanding, meet societal needs and benefit our industry sector. We work with over 100 companies, and have an excellent track record of delivery.

Early career 'rising star' researchers are particularly important to us - we have in the past few years run over 60 Researcher Exchanges with overseas partners, including our collaborators in other UK universities, to help develop longer term research strengths and international relationships.

Our 'process structuring' research addresses a wide range of sectors, including advanced healthcare, precision engineering devices, electronics, transport, construction products and consumer goods. We are at the leading edge of advanced manufacturing technologies, including process instrumentation, process modelling and control. We uniquely reach across

polymer synthesis, polymer physics and engineering and pharmaceuticals processing. Polymers are vital materials - too good to waste - they are chemically rich, made from the amazingly rich oil (only a small fraction of which is turned into polymers, which contain the same calorific value as the oil they are derived from); it makes no sense to scrap polymers having invested in making these important and highly useful materials. We are consequently much involved in 'green processing' and in promoting the Circular Economy approach which aims to promote recycling, re-use, and to move away and from the traditional make-use-dispose economic model.

We strongly welcome interdisciplinary collaborations in the UK and worldwide.

**Professor Phil Coates FEng  
Director, Polymer IRC**

The Polymer Interdisciplinary  
Research Centre  
University of Bradford  
Bradford BD7 1DP  
[www.polyeng.com](http://www.polyeng.com)  
[p.d.coates@bradford.ac.uk](mailto:p.d.coates@bradford.ac.uk)

# Polymer Interdisciplinary Research Centre

polymer  
**IR** 30  
2019

