

Research Profile

Name: Professor Phil Coates

Position: Director, Polymer IRC; Director RCUK Bradford Science Bridges China

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

Structuring of polymers, composites and nanocomposites by processing; in-process measurements oriented polymers; biomaterials; specialist processing including micromoulding, solid phase orientation processing and reactive processing; polymer rheology; computer modelling of processing and products; expertise in running large scale interdisciplinary research programmes

通过加工技术达成聚合物，复合材料和纳米复合材的结构化；过程测量（光学，流变光，热量，超声波，光谱，散射；定向聚合物；生物材料；包括微米铸模成形，固相取向加工和反应处理等的专门加工；聚合物流变；加工及制品的计算机建模；运行大型跨学科研究项目的专长。

Primary Research interests:

Professor Phil Coates is a Physics graduate (Imperial College), with PhD research on solid phase deformation processing of polymers (Leeds). Phil is Director of the internationally recognised Polymer Interdisciplinary Research Centre (IRC).

Main research projects include:

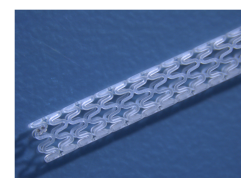
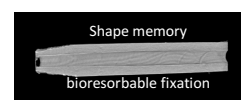
Healthcare: • bioresorbable shape memory materials for bone and soft tissue fixation • micromoulded precision products • enhanced design & modelling of tools for minimally invasive surgery • novel extrusion manufacturing of drugs • joint repair;

Basic science: • Molecular architecture effects on processing • in-situ process characterisation of polymers • ultra-high strain rate rheometry • rheo-optical studies of extrusion and co-extrusion • SANS of deuterated melts • shear enhanced crystallisation • AFM of polymers, biomedical materials, tissue and nanocomposites;

Novel & efficient processing: • Micromoulding process developments and measurements • solid phase orientation processing – die drawing • processing of nanocomposites • multi-feed reactive extrusion grafting • fluid-assisted injection moulding • injection moulding control • extrusion quality control • additives compounding • thermal alloy tooling;

In-process measurements: include • process ultrasound, • at- process UV & Raman spectroscopy, • at-process colour measurement, • process energy, • temperature fields • rheo-optical, • in-situ beam studies of structure;

Modelling: • multi-scale modelling for nanocomposites • fibre orientation measurement and prediction in injection moulding • FEA of process and products

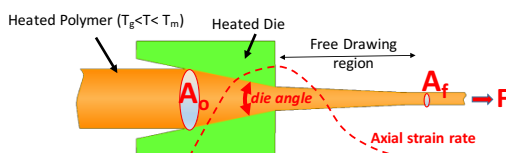
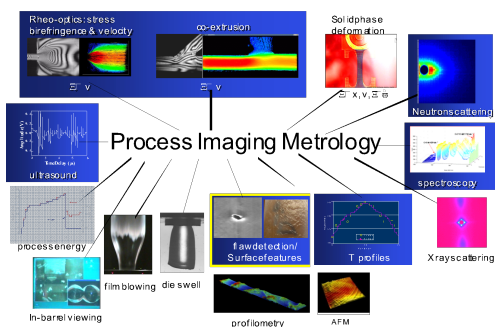


Topics in which you would like to develop collaborative research:

Tailored Polymers, polymer nanocomposites or polymer blends which can have their morphology developed during processing, to achieve properties which are suitable, for example, for medical devices and therapies e.g. (a) bone analogues, fixation systems, scaffolds, stents, drug eluting products,. Potential processes include: (i) micromoulding, (ii) injection moulding, (iii) extrusion, (iv) solid phase orientation; (v) reactive processing; with (vi) materials characterisation (during processing and off line) and (vii) computer modelling and control of quality.

Relevant existing collaborations (academic/clinical/commercial) inside or outside China.

Include: **China:** Science Bridges China projects with *Sichuan University (+MOST, NSFC, MoE international projects), *Beijing University of Chemical Technology, *Institute of Chemistry CAS Beijing, Institute of Applied Chemistry CAS Changchun; HKUST. *Bradford - Joint International laboratory. **UK:** Leeds, Durham, Sheffield, Newcastle, Nottingham, Queens Belfast, Oxford, Cambridge, Warwick, UCL. **Industry:** over 150 companies collaborating, including: Arterius, Autodesk, Invibio, Sabic, Sinopec, Smith & Nephew, Surgical Innovations, Xplore.

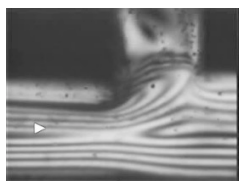
Relevant graphics, figures, pictures:

'Process structuring':

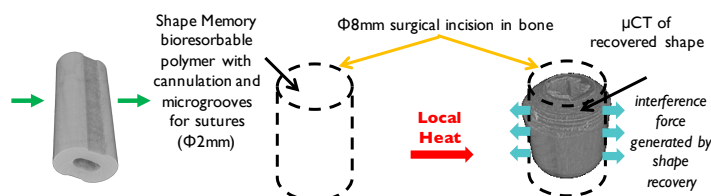
(i) Die drawing – solid phase orientation processing
With Dr Fin Caton-Rose & team

(ii) Micromoulding
with Dr Ben Whiteside & team

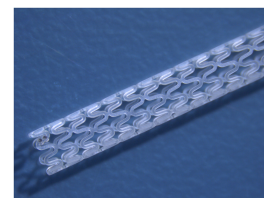
Some of the in-process measurements we undertake



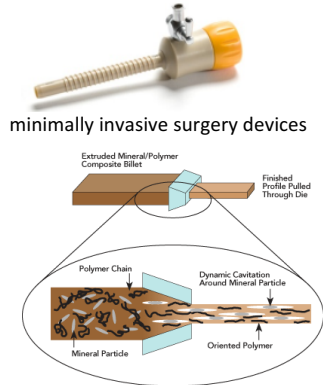
Rheo-optical: flow birefringence
with Dr T Gough, Dr M Martyn

SOME MEDICAL/BIO MEDICAL RESEARCH AREAS:

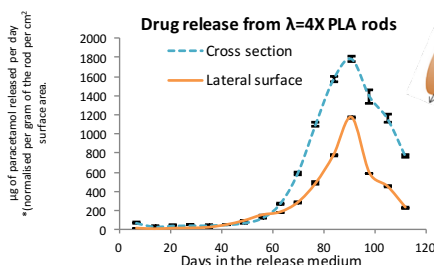
Shape memory polymers for tissue fixations



oriented polymer stents

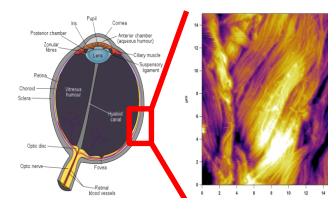
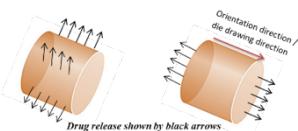


minimally invasive surgery devices



Oriented polymers for anisotropic drug delivery
with Prof Paradkar & Dr Kelly)

Cavitated low density oriented polymers for structural products



Atomic Force Microscopy of
collagenous tissue sclera, white of
eye (Dr C Grant)

Publications and other outputs relevant to your interest in this programme

- Bent, L. R. Hutchings, R. W. Richards, T. Gough, R. Spares, P. D. Coates, I. Grillo, O. G. Harlen, D. J. Read, R. S. Graham, A. E. Likhtman, D. J. Groves, T. M. Nicholson and T. C. B. McLeish, Neutron-Mapping Polymer Flow: Scattering, Flow visualization and Molecular Theory, *Science*, 301, 1691-1695 (2003)
- A. L. Kelly, T. Gough, B. R. Whiteside, P D Coates, High Shear Strain Rate Rheometry of Polymer Melts, *JAppPolySci*, 114, 864-873, (2009)
- Li L; Mulvaney-Johnson L; Chen N; Wang Q; Coates PD Small scale injection moulding of modified poly(vinyl alcohol), 39 (9), 411- 418, 1465-8011, *Plast Rubb Comp*. 2010
- 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*, 12/2013; 3(46):24132-24139. DOI: 10.1039/C3RA43640C 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(ε-caprolactone) and Its Miscible Blends with Poly(vinyl methyl ether) *Macromolecules*, Vol. 46, No. 17, pp. 6981-6990; DOI: 10.1021/ma401052x. 2013
- Jiajia Xue, Rui Shi, Yuzhao Niu, Min Gong, Phil Coates, Aileen Crawford, Dafu Chen, Wei Tian, Liqun Zhang Fabrication of drug-loaded anti-infective guided tissue regeneration membrane with adjustable biodegradation property *Colloids and Surfaces B: Biointerfaces*, 18March. DOI: 10.1016/j.colsurfb.2015.03.031, 2015
- Li, Zhengqiu ; Zhao, Xiaowen ; Ye, Lin ; Coates, Phil ; Caton-Rose, Fin ; Martyn, Michael, 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