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Advanced Materials Research Institute

Science Bridges China Research Profile

Name: **Dr Tim Gough**

Position: **Senior Lecturer**

Institute/division: **School of Engineering, Design & Technology, University of Bradford**

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

Analytic techniques for small and large scale polymer processing flows. .

小型和大型聚合物加工流程的分析技术。

Primary Research interests:

Tim Gough completed a first degree in Mechanical Engineering and a PhD in aerodynamics at the University of Surrey before moving to Bradford to undertake work in two phase separations for the brewing and oil industries. For the last 12 years he has been working in the broad field of polymer processing within the IRC in Polymer Engineering in collaboration with international industry and other academic institutions.

His work at Bradford consists of the application of a range of analytic techniques to small and large scale polymer processing flows. Rheo-optical studies allow the full field stress and velocity fields through a range of geometries to be accurately quantified. These techniques are complemented by in-line and off-line spectroscopic techniques including near and mid FTIR, Raman (polarised and non-polarised) and fluorescence for determination of sample content, orientation and temperature fields.

Some of my research forms part of the £5.5 million EPSRC funded project 'Microscale Polymer Processing – Applying the Tools' grant. This project between the Universities of Bradford, Cambridge, Durham, Leeds, Oxford and Sheffield and major polymer manufacturers aims to follow the processing path of well characterised polymers from synthesis through processing and property evaluation combined with the parallel development of a mathematical and computational protocol.

In collaboration with the University of Durham and CalTech, we also probe polymer processing using synchrotron radiation and neutron beams at international facilities both in Europe and the USA. These studies allow us to quantify the effects of high shear on crystallisation kinetics (x-rays) of monodisperse, bimodal and polydisperse blends and to gain measurements of molecular configuration (neutrons) through dies using a range of novel processing equipment.

The combined use of these techniques allows the full forming process (extrusion and injection moulding) to be fully characterised for model (e.g monodisperse MWDs and their blends) and industrial materials.

In addition I have recently become involved in the application of rheological experiments and simulations to processing and other issues within the pharmaceutical industry (industry funded).

Substantial work with industry has been undertaken in the fields of reactive extrusion and time dependent rheology as well as ongoing smaller collaborations to resolve a wide range of polymer processing issues.

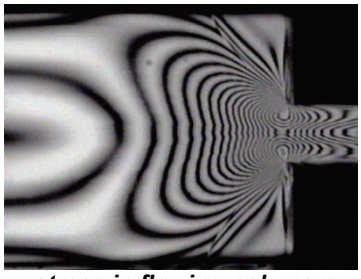
Topics in which you would like to develop collaborative research:

Analytic techniques for flows including rheo-optical and at process spectroscopy

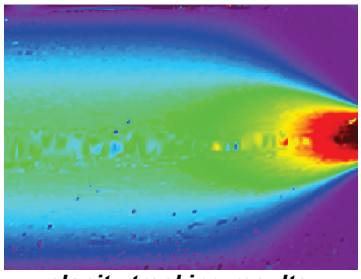
Relevant existing collaborations (academic/clinical/commercial) inside or outside China.

Caltech, Stoneybrook, Grenoble beam line.

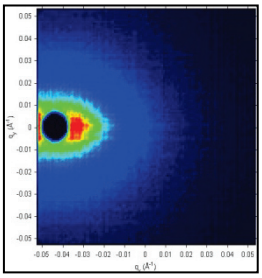
Relevant graphics, figures, pictures:



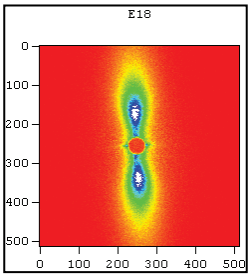
stress in flowing polymers



velocity tracking results



molecular conformation



crystallisation

Publications and other outputs relevant to your interest in this programme

- N Clarke, E de Luca, , G Buxton, LR Hutchings, T Gough, I Grillo, RS Graham, K Jagannathan, DH Klein and TCB McLeish, Chain Deformation in Entangled Polymer Melts at Re-entrant Corners, Macromolecules, 43(3), 1539-1542, 10.1021/ma902324f, 2010
- TCB McLeish, N Clarke, E de Luca, LR Hutchings, RS Graham,T Gough, I Grillo, CM Fernyhough and P Chambon, Neutron flow mapping: Multiscale modelling opens a new experimental window, Soft Matter, 5, 4426-4432, 10.1039/b916288g, 2009
- RS Graham, J Bent, N Clarke, LR Hutchings, RW Richards, T Gough, DM Hoyle, OG Harlen, I Grillo, D Auhl and TCB McLeish, The long chain dynamics in a model homopolymer blend under strong flow: small angle neutron scattering and theory. Soft Matter, 5, 2383-2389, 10.1039/b817440g, 2009
- L Fernandez-Ballester, T Gough, F Meneau, W Bras, F Ania, FJ Balta-Calleja and JA Kornfield (2008). Simultaneous birefringence, small- and wide-angle X-ray scattering to detect precursors and characterize morphology development during flow-induced crystallization of polymers. J. Synchrotron Radiation, v15, pp 185-190.
- JR Howse, RAL Jones, AJ Ryan, T Gough, R Vafabakhsh and R Golestanian (2007). Self-motile colloidal particles: from directed propulsion to random walk. Phys. Rev. Lett. 99 048102.
- J Bent, LR Hutchings, RW Richards, T Gough, R Spares, PD Coates, I Grillo, OG Harlen, DJ Read, RS Graham, AE Likhtman, DJ Groves, TM Nicholson and TCB McLeish (2003). Neutron-mapping polymer flow: Scattering, flow-visualisation and molecular theory. Science, vol. 301, Sept. 19, pp 1691-1695.
- T Gough, R Spares and PD Coates (2005). In-process measurements of full field stress birefringence and velocities in polymer melt flows. Plastics, Rubber and Composites: Macromolecular Engineering, v34(9), pp 393-402.