Science Bridges China Research Profile

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Position: **Lecturer**

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

Ultrasound velocity and attenuation measurement of process variation in extrusion injection moulding and micromoulding including temperature and moulding cycle dynamics; Ultrasound velocity and attenuation measurement of material characteristics including viscosity, density, filler level and distribution, blend composition, drug loading and degradation.
Thermal measurements in extrusion using a unique combination of technique; Thermal and energy related studies of extrusion.   High power ultrasound for process optimisation.

挤出注塑和微米注塑中的加工差异中的超声声速和衰减的测量。包括温度和成型周期的动态变化。
材料特性，包括粘度，密度，填充量和分布，共混组合物，载药量和退 化中的超声速度和衰减测量。
挤压中的使用独特技术组合的温度测量。
挤压相关的温度和能量。
用于过程优化的高功率超声波。

Primary Research interests:

Ultrasonic technology provides a robust, adaptable and non-invasive in-process measurement that can be widely applied. Work at Bradford encompasses investigations into extrusion, micromoulding, injection moulding, including GAIM/WAIM, and processes allied to rotational moulding. Changes in the velocity, attenuation and reflection coefficients of ultrasonic waves are related to the state and conditions of the materials through which they propagate, allowing exploration of temperature and pressure conditions, melt viscosity and density change, blend ratios, inclusion and distribution characteristics of fillers or other additives, degree of cure, and morphological changes during solidification. Ultrasonic characteristics can be applied to measurement of process dynamics and material properties. Optimally, ultrasound technology is used in conjunction with other measurement techniques including temperature and pressure, process spectroscopy and optical imaging in order to illuminate the conditions inside the process. Since it can be applied non-invasively, the technology is ideal for process-sensitive materials. Ultrasound propagation responds quickly to process and material changes and therefore is well suited to reactive or rapidly changing processes. Data can also be readily collected over long periods of time so it is highly appropriate for continuous process condition monitoring without adverse effect on the process.   High power ultrasound is used to promote flow during processing and to enhance mixing and blending of filled and unfilled polymer melts.

During processing, melt temperature varies across the flow front, and there may be rapid temporal fluctuations. Research carried out at Bradford has investigated the effects of screw design, throughput, machine thermal conditions and material viscosity on melt temperature.   A suite of measurement technologies is applied, incorporating thermocouple meshes, ultrasound, infrared, fluorescing dyes and more conventional thermocouple technology, in combination with computer modelling. Energy consumption and thermal efficiency of polymer extrusion is assessed.

Topics in which you would like to develop collaborative research:

High power ultrasound- application and effects on material properties
In-process measurements – ultrasound, ultrasound combined with NIR and Raman spectroscopy, ultrasound combined with dielectric measurements, temperature, energy, tomography.
Process characterisation - thermal investigations, energy consumption

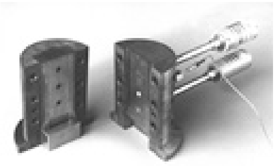
Relevant existing collaborations (academic/clinical/commercial) inside or outside China.

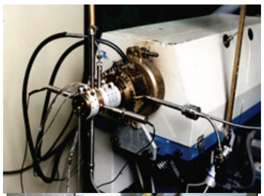
Queens University Belfast

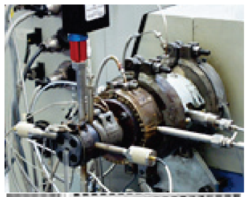
University of Ghent

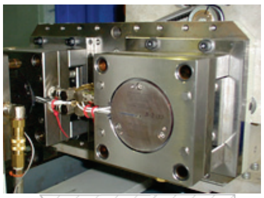
Polysense (EU FP7)

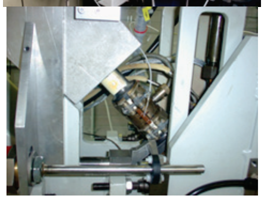
Relevant graphics, figures, pictures:

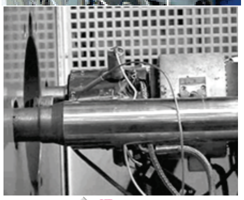


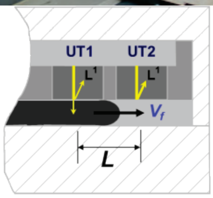


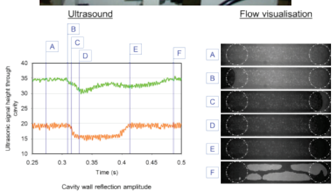


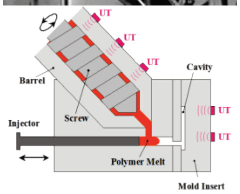


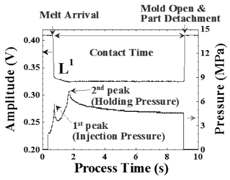


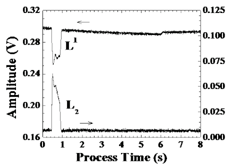


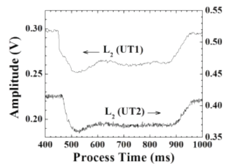


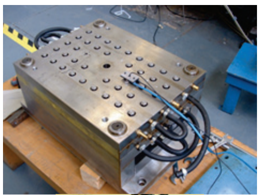


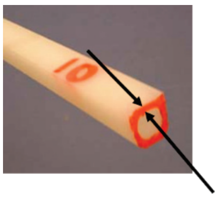


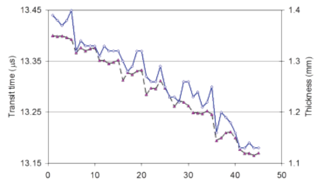


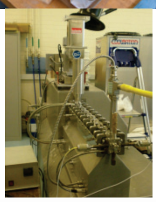


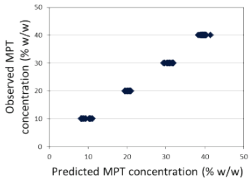


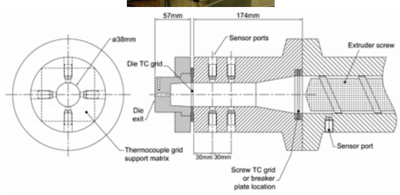


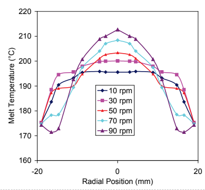


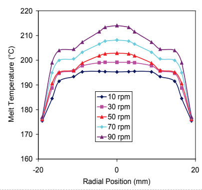












Publications and other outputs relevant to your interest in this programme (up to 5)

BR Whiteside, R Spares, EC Brown, K Norris, PD Coates, M Kobayashi, C-K Jen, C-C Cheng, Optical imaging metrology for micromoulding cavity flows and products, Plastics, Rubber and Composites, 37:2-4, 57-66 (2008)

A Polynkin, L Bai, JFT Pittman, J Sienz, L Mulvaney-Johnson, E Brown, A Dawson, P Coates, B Brookshaw, K Vinning, J Butler, Water assisted injection moulding: development of insights and predictive capabilities through experiments on instrumented process in parallel with computer simulations, Plastics, Rubber and Composites, 37:2-4, 131-141 (2008)

AL Kelly, EC Brown, K Howell, PD Coates, Melt temperature field measurements in extrusion using thermocouple meshes, Plastics, Rubber and Composites, 37:2-4, 151-157 (2008)

J Vera-Sorroche, AL Kelly, EC Brown, PD Coates, N Karnachi, E Harkin-Jones, K Li, J Deng Thermal optimisation of polymer extrusion using in-process monitoring techniques, Applied Thermal Engineering, in press http://dx.doi.org/10.1016/j.applthermaleng.2012.04.013

C Abeykoon, PJ Martin, AL Kelly, EC Brown, A review and evaluation of melt temperature sensors for polymer extrusion, Sensors and Actuators A: Physical, V182, P16–27, August 2012