Science Bridges China Research Profile

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

Solid polymer behaviour, including large deformations, constitutive models, finite element modelling, fracture and polymer nanocomposites.

固体聚合物的特性，包括大变形，本构模型，有限元建模，骨折和聚合物纳米复合材料。

Primary Research interests:

Solid phase polymer mechanics.

Example projects include: Apt-Pack, multi-partner Europe-wide project on polymer packaging, funded by the European Commission

QBOX, multi-partner UK-based project in collaboration with the Universities of Oxford and Queen's Belfast on oriented polymer nanocomposites, funded by the EPSRC.

Collaboration with the National Physical Laboratory and ANSYS on the implementation of nonlinear viscoelastic models for polymers into finite element code.

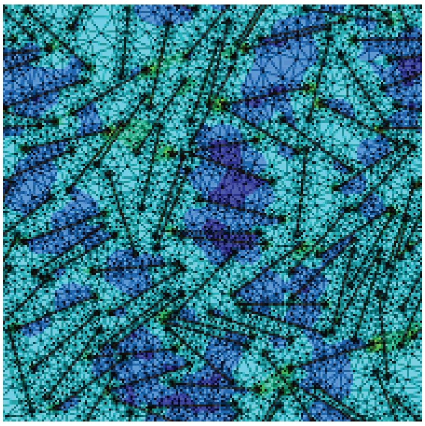
Example in more detail: QBOX EPSRC funded project: This project is devoted to polymer clay nanocomposites, where the reinforcement is in the form of clay platelets a few nm thick with other dimensions of the order of hundreds of nm. We are exploring the combined effect of molecular orientation in the polymer matrix and of the nanoreinforcement. This is to be studied in part via the use of multiscale modelling. The nanocomposite material is modelled by inserting stiff elements within a matrix that is itself a model of deforming polymer. The system is then analysed using the commercial finite element package ABAQUS to give stress and strain fields. To give a representative model, platelet elements are inserted at random, but using an algorithm that prevents them overlapping. A large number of these random realisations is created and the results averaged; this is a more efficient scheme than creating a single model, as it would need to be very large to be representative. A number of issues can be addressed using this approach. The orientation of the platelets may in practice be random in the initial material, but on processing to produce oriented polymer matrix, they will become aligned preferentially in the direction of the stretch. It is also observe that platelets are often curved. The modelling approach has been used to explore both these effects, with the relative increase in stiffness shown in the accompanying graph as a function of the degree of reinforcement.

Topics in which you would like to develop collaborative research:

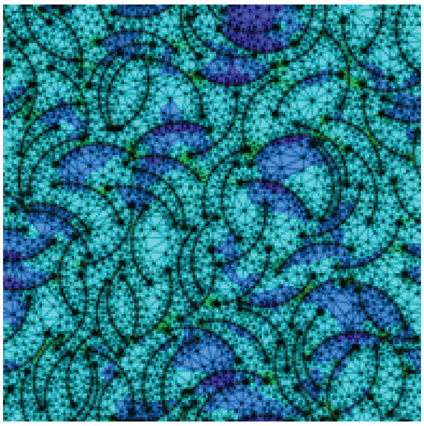
Solid phase polymer deformation modelling and processing.

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

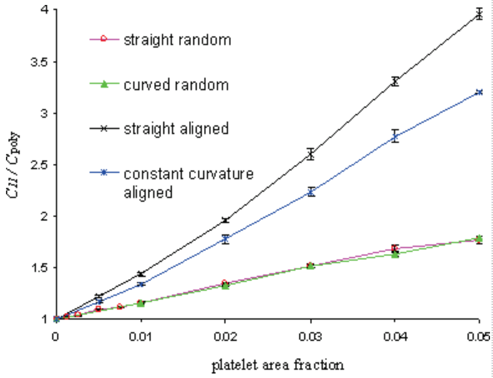
Relevant graphics, figures, pictures:



Model using straight platelets



Model using curved platelets



Effect on stiffness C_{11}

Publications and other outputs relevant to your interest in this programme

- Sweeney J, Spares R, Caton-Rose P and Coates PD A unified model of necking and shearbanding in amorphous and semicrystalline polymers, Journal of Applied Polymer Science, **106** 1095-1105 2007.
- Sweeney J, Naz S, Coates PD, Modeling the Tensile Behavior of Ultra-High-Molecular Weight Polyethylene with a Novel Flow Rule Journal of Applied Polymer Science 121, 2936-2944, DOI 10.1002/app.33844, 2011
- Sweeney J, , Naz S, Coates PD Analysis of the essential work of fracture method as applied to UHMWPE. Journal of Materials Science, 45 448-459 DOI 10.1007/s10853-009-3961-2, 2010
- Sweeney J, Spares R, Woodhead M, A Constitutive Model for Large Multiaxial Deformations of Solid Polypropylene at High Temperature Polymer Engineering and Science, 49, 1902-1908, DOI: 10.1002/pen.21426., 2009
- Sweeney J, Naz S, Coates PD Viscoplastic Constitutive Modeling of Polymers—Flow Rules and the Plane Strain Response, Journal of Applied Polymer Science, 111 1190-1198, DOI 29080, 2009