

Science Bridges China Research Profile

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

Biomaterials, particularly hydrogels and cell-conducting materials for soft tissue repair
Biomechanics at human, tissue and cellular scales, particularly dynamic mechanical analysis
Surface engineering of medical devices

生物材料，特别是水凝胶和用于软组织修复的细胞传导材料；
人体，组织和细胞尺度的生物力学，特别是动态力学分析；
医疗器械的表面工程学。

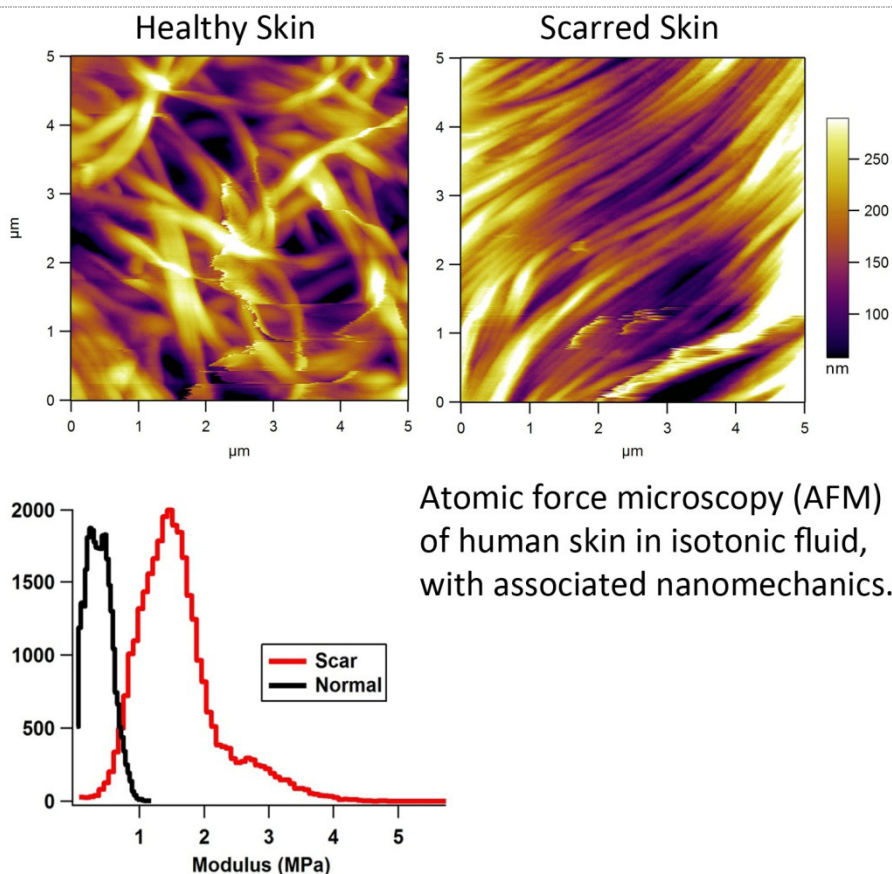
Primary Research interests:

Tissue mechanics - soft tissue characterisation, structure-property relationships, dynamic mechanical analysis, multi-scale modelling

Biomaterials - development of tissue replacement materials, biotribology, surface engineering, orthopaedics

Tissue engineering scaffold materials - hydrogel scaffolds, porous structures, functional scaffolds

Cell-surface interactions - surface characterisation, cell adhesion, cell guiding structures, anti-microbial surfaces, biofilm formation, bio-integration of implants



Atomic force microscopy (AFM) of human skin in isotonic fluid, with associated nanomechanics.

Topics in which you would like to develop collaborative research:

The use of biomaterials in tissue repair tends to rely on precision engineered implants that are very different to the tissues they replace or repair. This can involve procedures that remove significant amounts of healthy tissue, for example total hip replacement. A precision engineering approach can also lead to problems due to stress shielding, wear and immune response.

We have been working on alternative approaches that use materials with mechanical properties much closer to those of natural tissues. These open up possibilities for conservative repair and replacement treatments, and less disruption to the function of the surrounding tissues.

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

Trauson Medical Instrument Co. (China) - development of orthopaedic implants

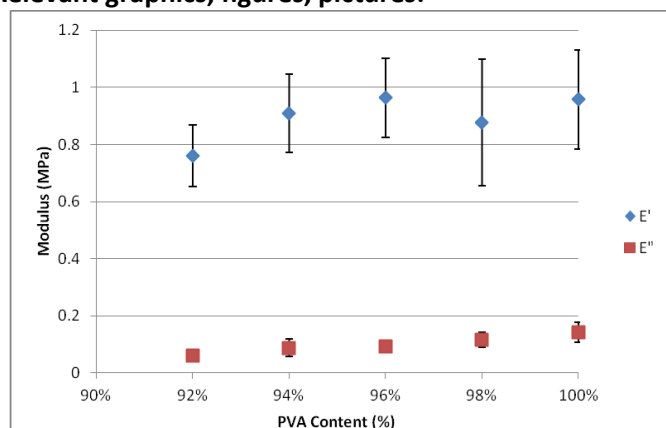
AGT Sciences (UK)- development of cartilage repair products using AGT's proprietary PVA hydrogel formulation

Finsbury Orthopaedics (UK) - collaborative work on joint replacement lubrication

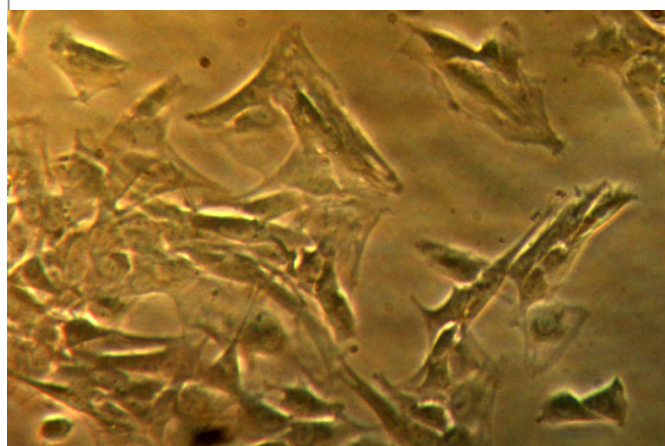
DePuy (UK)- surface engineered joint replacements

Ion Bond (UK) - surface engineering medical devices

Relevant graphics, figures, pictures:



Variation of storage and loss modulus (at a physiologically relevant frequency and compressive stress) with PVA content for a PVA-PVP freeze-thaw hydrogel system.



Chondrocyte attachment on a PVA-PEG hydrogel after 6 hours. Cells show rapid surface spread and migration, with much slower migration into the hydrogel bulk.

Publications and other outputs relevant to your interest in this programme

- 'Mechanical investigations on agar gels using atomic force microscopy: Effect of deuteration' C.A. Grant, P.C. Twigg, M.D. Savage, H.W. Woon and D. Greig, *Macromolecular Materials & Engineering* 196 (2011)
- 'High resolution imaging of bio-molecular binding studies using a novel Widefield Surface Plasmon Microscope', M. Mahadi Abdul Jamil, M. Youseffi, P.C. Twigg, S.T. Britland, S. Liu, C.W. See, M.G. Somekh and M.C.T. Denyer, *Sensors and Actuators B - Chemical* 129 (2008) 566-574
- 'A comparative study of box fusion and screw fixation in arthrodesis for the correction of hallux rigidus using an in vitro biomechanical model', A.A. Faraj, A. Naraen and P.C. Twigg, *Foot and Ankle International* 28 (2007) 89-91
- 'Polyvinyl alcohol hydrogel as a biocompatible visco-elastic mimetic for articular cartilage', C. Grant, P. Twigg, A. Egan, A. Moody, A. Smith, D. Eagland, N. Crowther and S. Britland, *Biotechnology Progress* 22 (2006) 1400-1406
- 'The role of the surface amorphous layer of articular cartilage in joint lubrication', S. Graindorge, W. Ferrandez, E. Ingham, Z. Jin, P. Twigg and J. Fisher *Proceedings of the Institution of Mechanical Engineers Part H - Journal of Engineering in Medicine* 220 (2006) 597-607