Dental Physical Sciences Dental Institute

GENERAL PRESENTATION

Barts and The London School of Medicine and Dentistry

- **Complete denomination**: Dental Physical Sciences, Dental Institute Barts and The London Queen Mary University of London
- **Location: London UK,**
- **Director**: Professor Robert Hill
- **Contact person: Professor Robert Hill**
- **Working Group involvment**: **WG1**
- **Staff**: **12 Faculty and 26 Ph.D Students plus two Laboratory Managers**
- **Research topics**: Novel Calcium Phosphate Cements Based on Bioactive Glass as Reactive Precursors, Bioactive Glass, Coatings and Scaffolds, Polyalkenoate Cements,Apatites and Glass-Ceramics. Bone and Tooth Formation.
- **Researchers expertises**: XMT, NMR, Bone Biology, XRD, FTIR
- DSC, Commercialisation and Intellectual Property.

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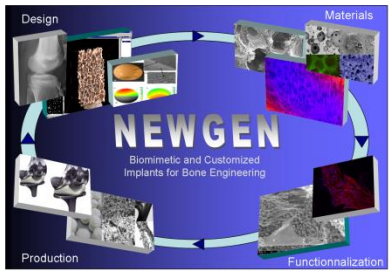
Dental Institute Francis Bancroft Building QMUL Mile End
E1 4NS London UK,



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BIOMATERIALS/NEWGEN TOPICS

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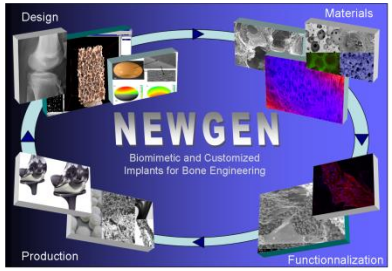
Bioactive Glasses - Design and synthesis including optimised processing windows for viscous flow sintering.

Role of therapeutic ions (Strontium, Colbalt, Zinc Strontium and Fluoride.

Solid State NMR Characterisation of Biomaterials.

Calcium Phosphate Cements

Role of Stress and Environmental Factors on Bone.



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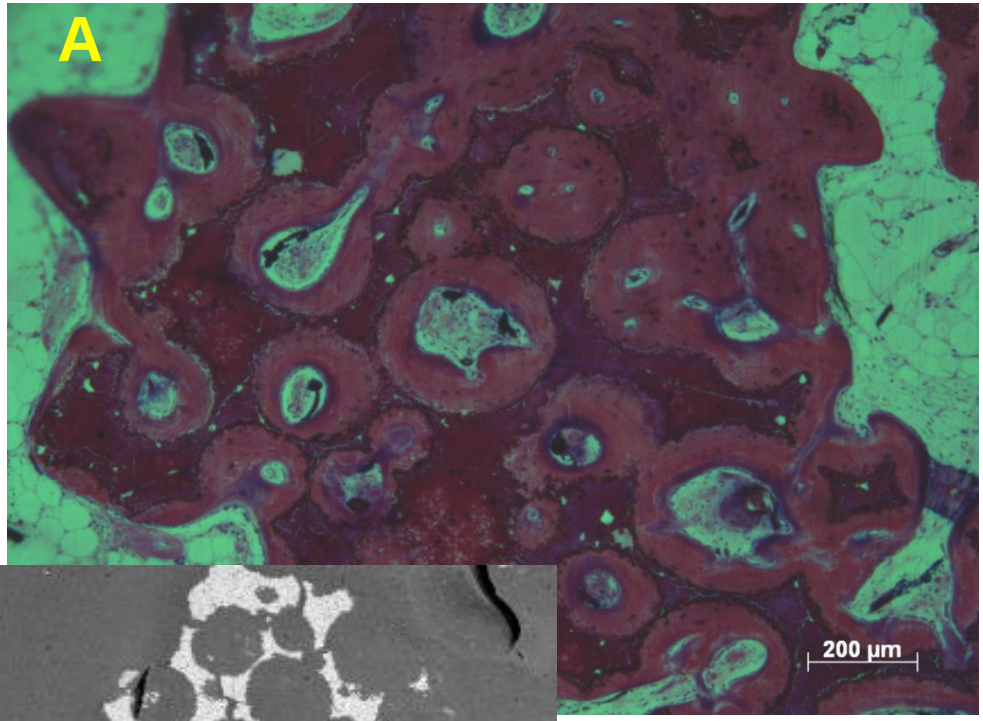
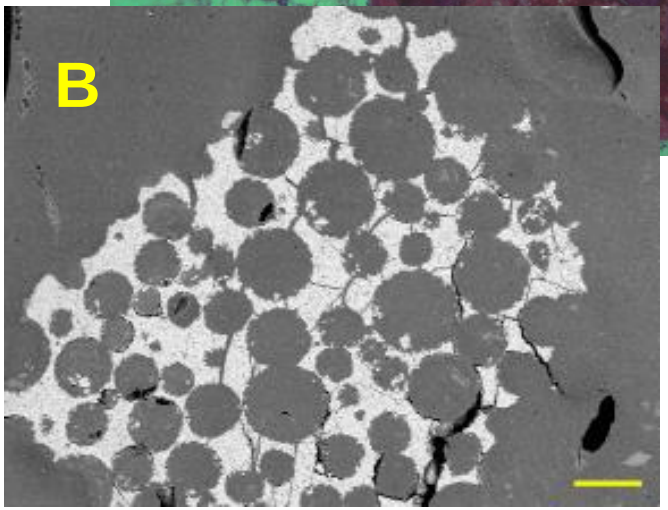
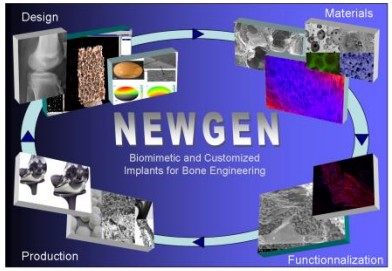
Porous Bioactive Glass Scaffolds

Bioactive glass compositions with Large processing windows have been synthesised. These glasses contain strontium that upregulates osteoblasts and in addition have high phosphate contents.
When produced asa porous constructs show excellent new bone Formation.



A -ovine implanted construct at 6 weeks. Micrograph from G.Blunn.
B – SEM of Porous granule.





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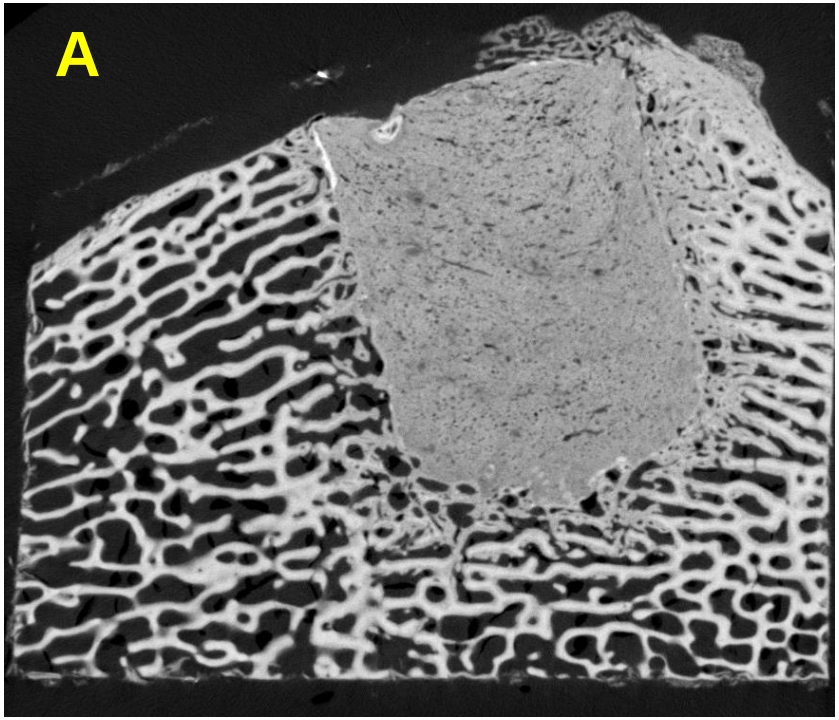
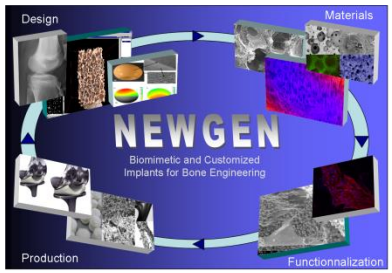
Novel Bioactive Glass (BG) Based Cements

- BGs used as reactive precursors to form an in situ setting calcium phosphate cement (CPC) when mixed with water.
- Injectable.
- Excellent osseointegration.
- Can be tailored to different applications
- Applications as bone cements and substitutes for trauma, spinal fusion, Vertebroplasty, Kyphoplasty etc.



A =XMT of Ovine Implanted CPC at three months.
B= Histological section of same sample.



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XMT FACILITIES

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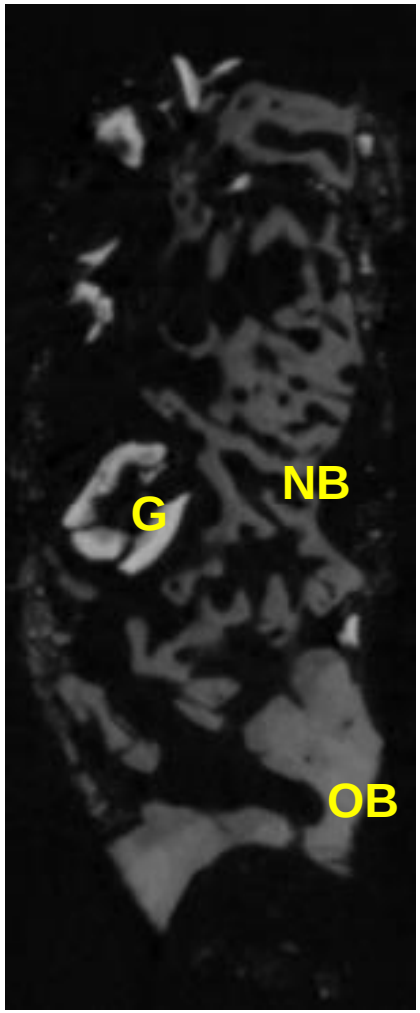
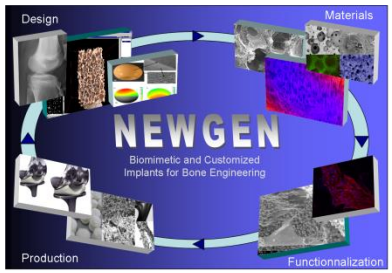
We have all the normal equipment found in a well funded Materials Laboratory, plus specialized facilities for:

MuCAT X-ray Microtomography (XMT) was invented in our Deptby Professor Jim Elliott.
We continue to develop the technique and build our own machines in house.

These machines can quantify absolute mineral levels in bone. Can correct for beam hardening and detector artifacts. Plus give good resolution on relatively large specimens.



XMT of Trevined core taken from a Human Alveolar socket three months after placement of a Strontium Bioactive Glass.
OB =Old Bone
NB = New Bone
G =Glass particle



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NMR FACILITIES

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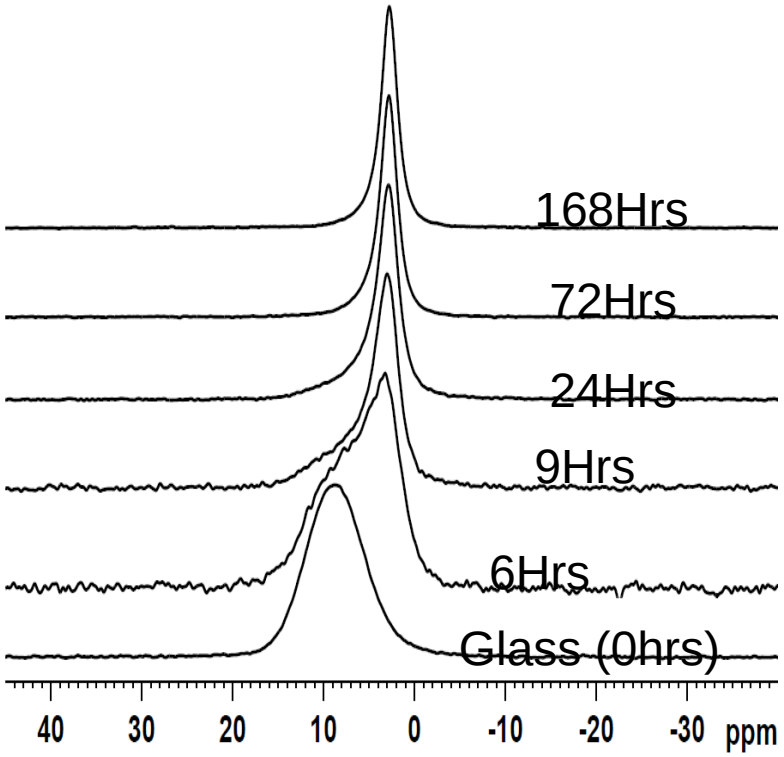
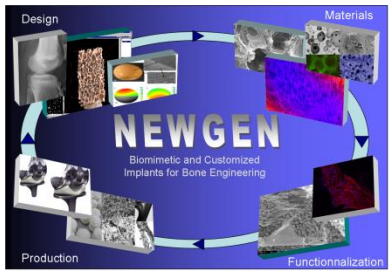
Solid State Nuclear Magnetic Resonance Spectroscopy (ssNMR) This is useful for distinguishing between octacalcium phosphate and hydroxyapatite and between hydroxyapatite and fluorapatite.
Octacalcium phosphate is frequently mis identified as hydroxyapatite.
One of the advantages of NMR is it is quantitative.
Not only do we have the facilities we also have the staff expertise (Dr Natalia Karpukhina)

The figure shows a series of ^{31}P MAS-NMR spectra for a BG showing the conversion to an apatite like crystal phase with a chemical shift of 2.8ppm. Deconvolution of the spectra enables kinetic data to be obtained.



Chemical Shift (ppm)



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DSC FACILITIES

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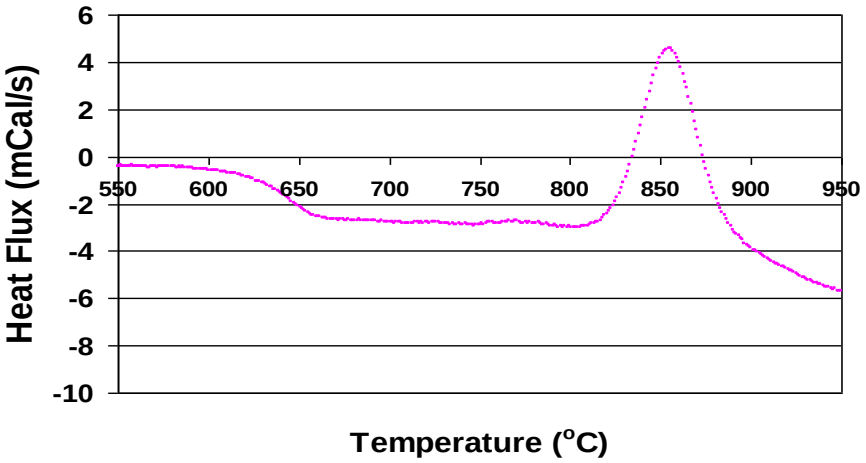
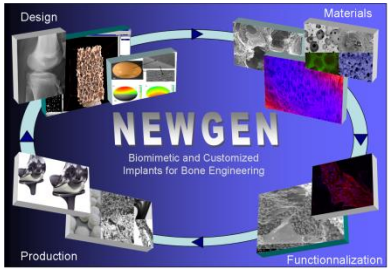
High temperature Differential Scanning Calorimetry (DSC) is invaluable in characterizing glasses and obtaining the glass transition(Tg), the onset crystallization temperature (Tcon) and peak crystallization temperatures.
DSC is used to study the crystallization kinetics and designing compositions that can be viscous flow sintered without crystallization occurring in order to fabricate porous scaffolds.



DSC trace for a BG optimised for viscous flow sintering. Note the large processing window between Tg and Tcon



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