

The Royal Academy of Engineering

Research Fellowship

Bioactive scaffolds for bone regeneration

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Introduction

Bone can heal itself if the defect is small, otherwise it needs help. My work centres around the development of templates that can temporarily actively stimulate the body's bone healing mechanisms.

Aims

- To create an ideal scaffold for bone regeneration that will act as a template and stimulate bone growth in 3D;
- To optimise scaffolds from the atomic to the macro level with respect to cell response;
- To develop novel methods for the quantification of scaffold pore networks and cell response.

Materials, scaffold synthesis, image analysis and cell response

Materials

Bioactive glass bonds to bone, dissolves in the body and stimulates bone growth as the released ions stimulate bone growth at the genetic level. Previously, ideal scaffolds had not been developed.

Scaffold synthesis (sol-gel foaming process)

Sol + foaming with gelling agent and surfactant → porous gel. Heat treatment → porous bioactive scaffold

3D image analysis

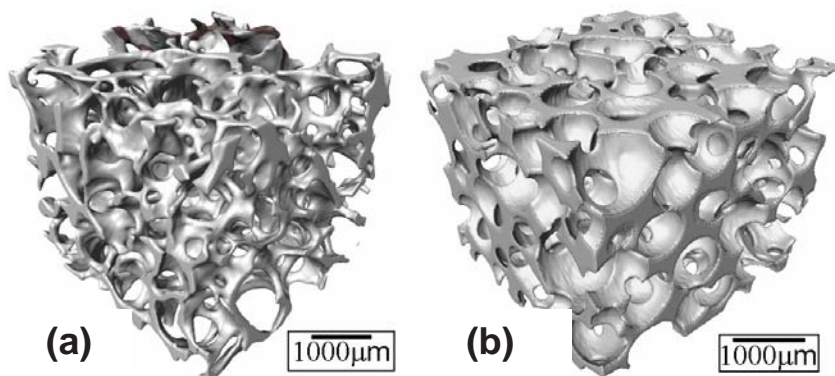


Fig.1. μ CT images of (a) porous bone, (b) bioactive glass foam scaffold

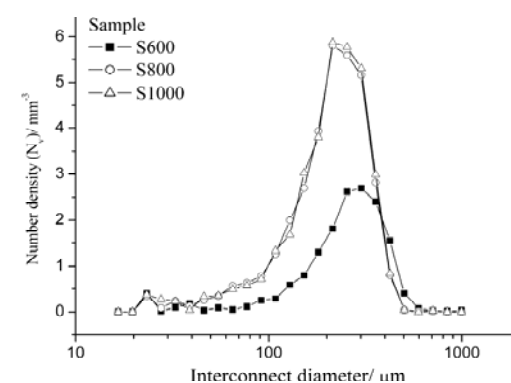
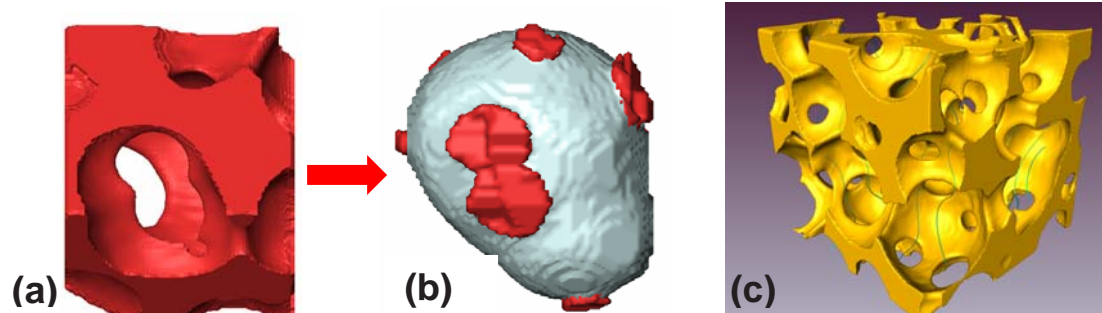


Fig. 2. Interconnect size distributions obtained from 3D image analysis

3D image analysis



Fig, 3 (a) μ CT image of a single pore, (b) the same pore after application of 3 algorithms to identify the pore and the interconnects, (c) μ CT image with streak lines showing predicted

Cell Response

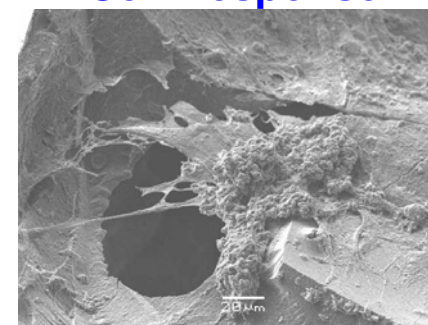


Fig. 4. SEM of bone cells laying down bone matrix on a bioactive glass scaffold