SCIENCESPRINGDAY

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Department of Materials Sciences – CENIMAT/ I3N

Liquid Crystalline Inverse Opals

Carlos João

PhD student

Supervisors:
Prof. João Paulo Borges
Prof. Jorge Carvalho Silva

- MSc in Biomedical Engineering, FCT-UNL, 2010.
- Field of work: Biomaterials and Tissue Engineering.

Polymeric and Mesomorphic Materials Group
at DCM/FCT/UNL and Cenimat / I3N

i3N

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Objectives

The present work proposal envisages the production of new synthetic bone analogues combining the HCP geometry of Inverted Colloidal Crystals (ICC) or Inverse Opal (Fig.1), which provides an ideal environment for osteoblast growth, and the supramolecular organization of liquid crystals existent in bone.

For this purpose chitosan liquid crystalline solutions and gels (chiral nematic or cholesteric mesophases) will be used to produce the composite matrix of the scaffolds. These mesophases are present in collagen type I and are responsible for the complex architecture of bone and for its mechanical properties.

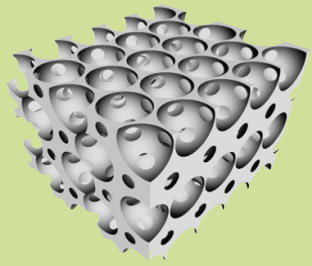

Fig.1 – ICC scaffold model. Adapted from *Takagi K. et al., J. Eur Cer Society. 2010.*

Methodology

The work plan comprises the following tasks:

Production of liquid crystalline Inverted Colloidal Crystals (LC-ICC)

- Production of uniform polymeric microspheres; fabrication of HCP lattice (Colloidal Crystal mold – CC); development of inverse opal structure (Fig.2);

Characterization and mechanical properties modeling

- Morphology (SEM, X-ray diffraction, FTIR) and mechanical evaluation (compression and flexural tests); Mechanical properties modeling through computational finite element method;

Biological evaluation.

- In vitro studies (cytotoxicity, cell morphology, functional assessment)

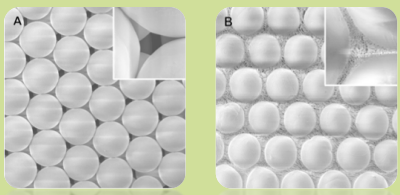

Fig.2 – SEM image of: A) HCP microspheres lattice; B) CC infiltration by a polymeric solution. Adapted from *Choi S-W et al., Advanced Materials. 2009.*

Expected Results

Inverse opals exhibiting a uniform pore size, interconnected network and a biodegradable matrix will be produced as scaffolds for bone tissue engineering (Fig.3). The composite matrix will be composed of chitosan and calcium phosphate ceramics (hydroxyapatite, β-tricalcium phosphate or biphasic mixtures).

Chitosan, like collagen I (found in the bone extracellular matrix) has the ability to form liotropic chiral nematic mesophases in acidic media. Chitosan-based inverse opals produced from the mesophases of this biopolymer will be able to mimic the structure of the extracellular matrix in bone.

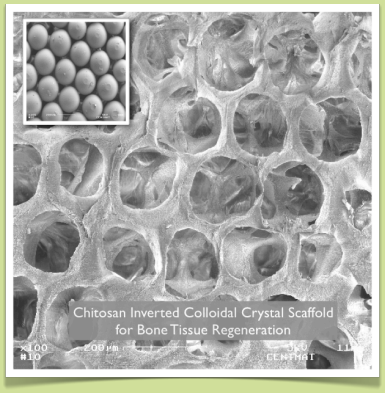

Fig.3 – SEM image of an ICC Chitosan scaffold.

Funding:

PhD Scholarship ref: SFRH/BD/80860/2011

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA