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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Department of Materials Science – CENIMAT/ I3N

Liquid Crystalline Inverse Opals

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Objectives

The present work proposal envisages the production of new synthetic bone analogues (Fig.1) combining the HCP geometry of Inverted Colloidal Crystals (ICC) or Inverse Opal (Fig.2), 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 – New synthetic bone substitute.

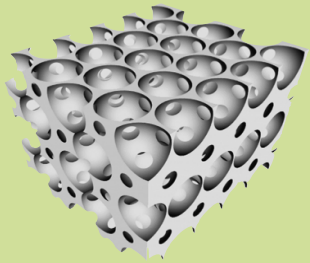

Fig.2 – ICC scaffold model. Adapted from *Takagi K. et al., J. Eur Cer Society. 2010.*

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.3);

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)

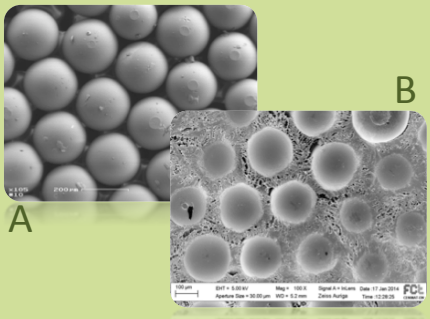

Fig.3 – SEM image of: A) HCP microspheres lattice; B) CC infiltration by a polymeric solution.

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.4). 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.

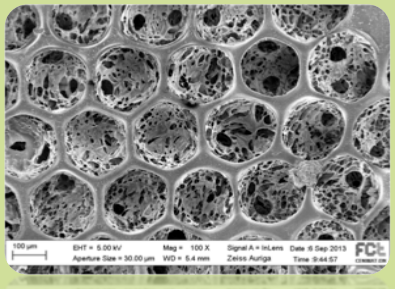

Fig.4 – SEM image of an ICC Chitosan scaffold.

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