SYNTHESIS OF NANOCRYSTALLINE APATITIC BIOCERAMICS FOR BONE TISSUE ENGINEERING AND COMPUTED TOMOGRAPHY STUDIES OF HYBRID ORGANIC-INORGANIC BIOCOMPOSITES

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ABSTRACT

With a growing world population, bone defects resulting from trauma, disease, or surgery are a significant worldwide problem. Currently due to clinical predictability, the autologous bone or autograft is regarded as the "gold standard" for bone defect repair, but complications such as limited supply and donor-site morbidity are stimulating the development of bone substitutes of biological and synthetic origin. The material used as a bone scaffold must satisfy a number of requirements, including biocompatibility, biodegradation with negligible toxicity, appropriate porosity, and mechanical properties, and the ability to integrate with biological molecules or cells to regenerate tissue.

Scaffolds made of synthetic polymers have been studied for bone-tissue engineering applications as they are able to produce materials that exhibit both toughness and plasticity. The most commonly used synthetic polymers are polylactic acid (PLA), poly-glycolic acid (PGA), copolymers of PLA and PGA, polycaprolactone, and polymethylmethacrylate (PMMA). Due to their different mechanical properties and degradation rates, as well as the absence of osteoconductivity, the synergistic combination of calcium phosphate (CaP) as an osteoconductive bioabsorbable ceramic in a polymeric matrix has been explored. Such inorganic-organic hybrids possess an advantage over single components as their interactions at a molecular level can provide interdependent properties while acting as a single-phase material.

The development of new bone-replacement materials and biofunctionalization strategies requires an accurate assessment of the scaffold structure. An established technique that provides three-dimensional information is computed tomography (CT), which is non-destructive and is used for imaging of internal structures based on the density distribution in the materials microstructure.

Herein, the synthesis and characterization of bioceramics, i.e. nanocrystalline hydroxyapatite and magnesium whitlockite, will be firstly described. The preparation of mixed ceramic biocomposites as well as hybrid inorganic(ceramic)-organic(polymer) composites then will be presented outlining their advantages and disadvantages [1-3]. The properties, such as dissolution in the simulated body fluid (SBF) under static conditions, mechanical compression strength before and after the dissolution, and surface hydrophilicity will be discussed. Finally, the assessment of density of the scaffolds and the distribution of ceramics within the polymeric matrix using CT and conventional dental radiography will be presented and discussed.

References:

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