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ABSTRACT - ORAL Synthesis of Doped Biphasic Calcium Phosphate for bone substitutes applications

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Among the synthetic bone substitutes commonly used in medicine, two types of calcium phosphates are primarily employed: β -tricalcium phosphate (β -TCP, β -Ca₃(PO₄)₂) and hydroxyapatite (HA, Ca₁₀(PO₄)₆(OH)₂). The choice of biomaterial depends on the type of surgical procedure being considered, due to significant differences in resorption rate in human body, β -TCP being more resorbable. However β -TCP, presents the particularity to transform to α -TCP at 1150°C, a metastable allotrope. This allotropic transition causes an expansion of the crystal lattice and the formation of microcracks. Furthermore, the α -TCP phase, being more soluble in biological environments, leads to an accelerated and uncontrolled resorption of the bone substitute, thereby limiting its clinical use. It is why it is necessary to stabilize the β -TCP phase.[1]

Previous studies have shown that the incorporation of metallic cations can stabilize the β -TCP phase up to 1400°C which allows the sintering of parts avoiding the transformation.**[2]** HA, on the other hand, has superior mechanical properties compared to β -TCP, but its resorption is much slower, which qualifies it as a permanent bone substitute.

This study aims to synthesize by chemical precipitation route doped biphasic biomaterials combining the advantages of both phases: moderate resorption while maintaining mechanical properties suitable for bone substitution. Doping makes it possible to sinter and densify at temperatures appropriate for both HA and β -TCP. To control the synthesis, several biphasic calcium phosphates (both doped and undoped) were developed: syntheses with different doping levels as well as a comparison with solid-state synthesis. The resulting powders are compared in terms of physicochemical properties and thermal stability.

[2] Dr. Somers Nicolas. Dopages de Phosphate Tricalcique Beta et Mise En Forme de Macroporeux Par Robocasting, thèse UPHF 2021.

^[1] Emmanuelle RGUITI - CONSTANTIN. Frittage, Propriétés mécaniques et fonctionnalisation de biocéramiques mono et biphasées. (UPHF, 2011).