Doping β-TCP ceramics to improve their stability in use of bone substitute implants

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Calcium phosphate bone substitute

Calcium phosphate bioceramics are widely studied as bone substitutes due to their interesting biological properties and their similarity to the natural bone composition. Indeed, they are able to form bone bonds without inflammations or infections.

Among them, β-tricalcium phosphate (β-TCP, β-Ca₃(PO₄)₂) is known for its excellent biological compatibility and resorbability. Owing to its high resorption properties in human body, it is foreseen to be used as temporary support for natural tissue colonization in bone repair applications.

Manufacturing of β-TCP bone substitute

β-TCP powder → Shaping → Densification (> 1000°C) → Shrinkage

Densification issues:

- Limited sintering temperature and mechanical properties
- Phase transformation that induces:
  - Lattice expansion
  - Microcracks
  - Shrinkage reduction
  - Density decrease

Possible solution: doped β-TCP

Adding cationic dopant(s) during the co-precipitation synthesis of β-TCP can increase its thermal stability and prevent the phase transformation into α-TCP

Cationic dopants

- Mg²⁺: increase β-TCP stability
- Ag⁺: antibacterial properties

Possibility of co-doping to combine different dopants properties

Expectations

- Synthesis of co-doped β-TCP
- Insertion of the dopants inside the β-TCP structure
- Increase of the beta phase thermal stability
- Manufacturing of dense β-TCP pieces without cracks
- Improvement of the biological and mechanical properties of these pieces

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