Bio-based Hydroxyapatite Powder for Stereolithography of Bone Scaffolds

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By manufacturing customized bone implants based on medical imaging, additive manufacturing provides a personalized solution to the needs of patients requiring bone grafting. Many materials have been investigated as bone substitute, such as metal (e.g., titanium alloys), plastics (e.g., polymethyl methacrylate - PMMA) or ceramics (e.g., calcium phosphates). The main advantage of calcium phosphate ceramics over other materials is their bioactivity, which promotes the osseointegration. Among them, hydroxyapatite (HA) is the most studied because of its similarities with natural bone.

The production of implants based on synthetic hydroxyapatite by various additive manufacturing techniques has been reported many times. However, few studies deal with 3D printing of bio-based hydroxyapatite from animal bones. Unlike synthetic hydroxyapatite, bio-based hydroxyapatite contains substitution elements (e.g., Mg^{2+}, Na^{+}, K^{+} …) - involved in osteogenesis mechanisms - which enhance osseointegration of the graft. Vat photopolymerization techniques are based on the local curing of a polymeric resin containing the ceramic powder and a photo-initiator. In the medical field, SLA is well renowned for its high-dimensional accuracy, the surface quality of the printed parts, and its ability to print very small structures.

The present study displays the first results on stereolithography (SLA) of bio-based hydroxyapatite (extracted from bovine bones) to produce bone scaffold.