PhD THESIS

FABRICATION OF 3D PRINTED SCAFFOLDS BASED ON STRONTIUM-CONTAINING HYDROXYAPATITE COMBINED WITH POLY(E-CAPROLACTONE) AND GELATIN METHACRYLOYL FOR BONE GRAFTING APPLICATIONS

Abstract

Current treatments of bone defects rely on the long-established bone grafts, including autografts, as well as allografts, and xenografts, but the clinical application of these substitutes is hindered by drawbacks. Biomaterials-made scaffolds can be used as alternative solutions. Our goal was to develop novel 3D printed composite scaffolds, with biomedical applications in treating osteoporosis affected bone, based on strontium doped hydroxyapatite (SrHA). The motivation is based on Sr ions capability to increase osteoblast proliferation and diminish osteoclast activity. We used composite materials that combine the advantages of each component into a superior multi-layered 3D printed scaffolds comprised of 70% wt. PCL and 30% wt. SrHA obtained through extrusion technique, as well as 10% w/v GelMA and 5% w/v SrHA obtained through digital light processing technique, both with different Sr concentrations. Two kinds of SrHA, dissimilar in shape (cvasi-spherical and rod-like), were synthesized via distinct methods, precipitation (PR) and hydrothermal (HT), and thoroughly characterized. Also, for each type of SrHA, we employed a large interval of Sr content, namely the Sr/(Ca + Sr) molar percentage of 1, 5, 10, 20, and 30%. Overall, PR-obtained SrHA performed better in the case of PCL and SrHA scaffolds. These distinctions were attributed to inherent characteristics of the ceramic component. All the Sr-containing biomaterials displayed superior characteristics compared to their Sr-free analogs. Therefore, the designed scaffolds highlighted encouraging prospectives for SrHA-based materials with antiosteoporosis activity.