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Abstract

Magnetic Scaffolds for Bone Cancer Theranostics †

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Cancer is currently the second leading cause of death worldwide and, according to the World Health Organization, it is expected to keep increasing in both incidence and mortality in the coming decades. Regarding bone cancer, the conventional treatments usually employ surgical tumour resection, chemotherapy, and radiotherapy. However, resection may result in critical-sized bone defects, and the latter two have proven inefficient for cancer-cell targeting and lead to unwanted side effects.

Cancer theranostics is a new approach which intends to deliver a system with both diagnostic and therapeutic capabilities. The incorporation of magnetic nanoparticles into additively manufactured bone-regeneration scaffolds enables the creation of tailored magnetic structures with potential applications for cancer theranostics. Therefore, the present study focuses on the development of 3D-printed magnetic scaffolds for bone-cancer theranostics and regeneration.

To attain such structures, hydroxyapatite (HA) particles were integrated in a polymeric matrix composed of chitosan (CS) and poly(vinyl) alcohol (PVA) to form pastes with varying compositions. These pastes were 3D printed using an adapted Zmorph VX 3D printer and a 10 mL syringe with an 18 G needle.

Furthermore, superparamagnetic iron oxide nanoparticles (SPIONs) suspensions were added to the optimised CS/PVA/HA paste at three different concentrations (1.92, 3.77, and 5.54 wt.%). The obtained results indicate that the scaffolds containing 5.54 wt.% of SPIONs, which exhibit the best printability and shape fidelity, highest temperature gradient of 7.5 °C in MHT testing, and good bioactivity after 7 days in SBF, were the most promising for applications in bone cancer theranostics and regeneration.

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