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Development and characterization of TPMS hydroxyapatite scaffolds

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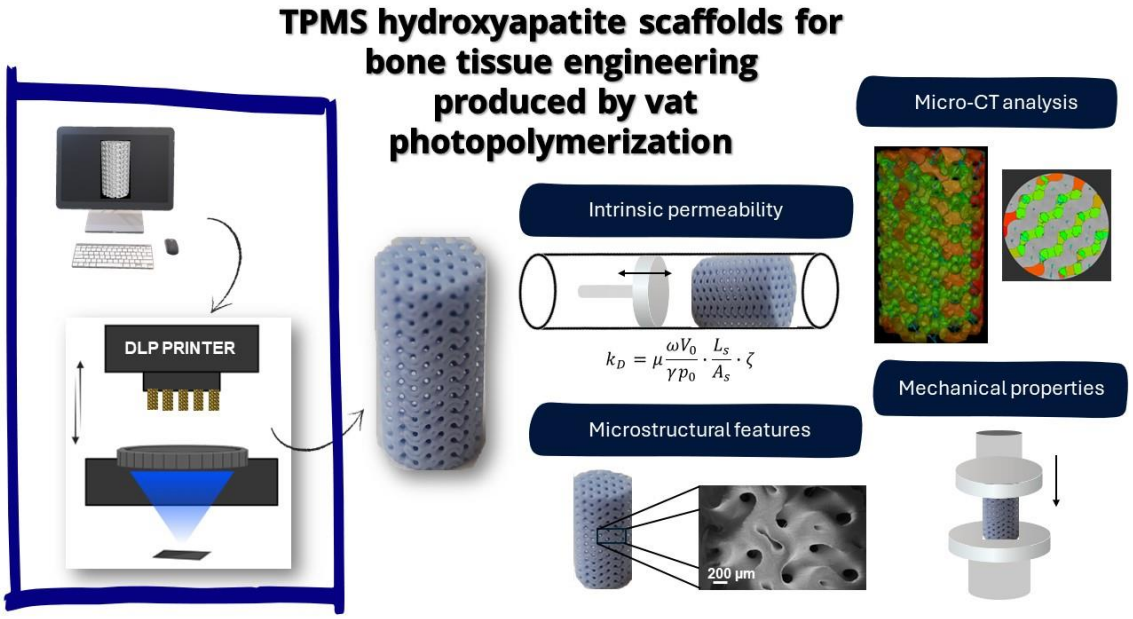
Project: Development and characterization of TPMS hydroxyapatite scaffolds



Abstract

The anatomical and functional loss of bone tissue is one of the most debilitating problems in the world. The application of additive manufacturing technologies and computational methods can lead to the creation of scaffolds with microstructure and mechanical behavior comparable to those of bone, thus being potentially suitable to promote tissue regeneration. My PhD research activity aims to tackle this challenge by developing hydroxyapatite scaffolds with triply periodical minimal surfaces (TPMS). Specifically, three types of scaffolds with Diamond, Gyroid

and IWP geometry were designed and fabricated using vat photopolymerization. These structures were adopted due to their interconnected geometries with a smooth surface, zero-mean curvature and large surface areas. Microstructural and morphological investigations were carried out, with focus on pore characteristics. Intrinsic permeability obtained by acoustic measurements was assessed to be in the range of 5.8×10-10 to 1.4 ×10-9 m2, which is comparable to that of human cancellous bone. Young's modulus and compressive strength, experimentally determined from crushing tests, were within 3.1-7.6 GPa and 8-36 MPa, respectively. Overall, the produced scaffolds show promise for bone repair and deserve further investigation (e.g. influence of the different structures on bone cell behaviour and extension to other materials such as bioactive glasses).