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Additive Manufacturing of Titanium Metamaterials for Tissue Engineering

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Abstract : Distinct properties of porous metamaterials have been largely processed for biomedicine requiring a three-dimensional (3D) porous structure engaged with fine mechanical features, biodegradation ability, and biocompatibility. Applications of metamaterials are (i) porous orthopedic and dental implants; (ii) in vitro cell culture of metamaterials and bone regeneration of metamaterials in vivo; (iii) macro-, micro, and nano-level porous metamaterials for sensors, diagnosis, and drug delivery. There are some specific properties to design metamaterials for tissue engineering. These are surface to volume ratio, pore size, and interconnection degrees are selected to control cell behavior and bone ingrowth. In this study, additive manufacturing technique selective laser melting will be used to print the scaffolds. Selective Laser Melting prints the 3D components according to designed 3D CAD models and manufactured materials, adding layers progressively by layer. This study aims to design metamaterials with Ti6Al4V material, which gives benefit in respect of mechanical and biological properties. Ti6Al4V scaffolds will support cell attachment by conferring a suitable area for cell adhesion. This study will control the osteoblast cell attachment on Ti6Al4V scaffolds after the determination of optimum stiffness and other mechanical properties which are close to mechanical properties of bone. Before we produce the samples, we will use a modeling technique to simulate the mechanical behavior of samples. These samples include different lattice models with varying amounts of porosity and density.

Keywords : additive manufacturing, titanium lattices, metamaterials, porous metals
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