Mechanical properties of titanium alloy with cellular structures fabricated by additive manufacturing

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Porous titanium and its alloys have been considered as promising replacement for dense implants, as they possess low elastic modulus comparable to that of compact human bones and are capable of providing space for the in-growth of bony tissues to achieve better fixation. Recently, the additive manufacturing (AM) method has been successfully applied to fabricate cellular meshes and foams of titanium alloys. Compared with the traditional fabrication methods, the AM method offers advantages of accurate control of complex cell shapes and internal pore architectures, thus attracting extensive attention. In this talk, we focus on the mechanical properties under quasi-static and cyclic loading conditions of AM titanium alloy cellular structures aimed for use as bone substitutes and orthopaedic implants. The effects of the AM processes, material type, cell shape, graded porosity distribution and post treatments on the quasi-static mechanical properties and the fatigue behavior of AM titanium alloy cellular structures are reviewed. The processing-microstructure-property relationship of AM components is discussed in detail. The potential commercial applications of AM titanium alloy cellular structures are presented.