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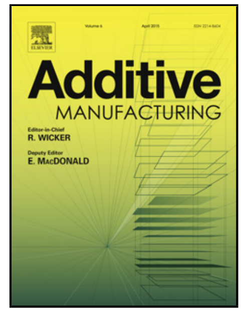

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Cellular Lattices of Biomedical Co-Cr-Mo-Alloy Fabricated by Electron Beam Melting with the Aid of Shape Optimization

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ABSTRACT

With a view to developing a highly biocompatible and highly reliable material for artificial hip joints, cellular lattice structures with high strength and low Young's modulus (E) were designed using computational shape optimization. These structures were fabricated from a biomedical Co-Cr-Mo alloy via electron beam melting. As a starting point for shape optimization, inverse body-centered-cubic (iBCC)-based structures with different porosities and aspects were fabricated. The strength tended to increase with increasing E. Then, the structures were re-designed using shape optimization based on the traction method, targeting a simultaneous increase in yield strength with retention of the low E. The shapes were optimized through minimization of the maximum local von Mises stress and control of E to 3/2 or 2/3 of the original value, while maintaining constant porosity. The re-designed cellular structures were fabricated and subjected to mechanical testing. The E values of the porous structures were comparable to the design values, but the strength of the cellular lattice with E = 2/3 (design value) was lower than expected. This discrepancy was attributed to