

Mechanical Properties of Hollow Sphere Structures for Biomedical Implants

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ABSTRACT

The knowledge of the mechanical properties of packed hollow spheres is essential for constructing lightweight hollow sphere structures with an adjustable strength to weight ratio. This characteristic feature makes stainless steel hollow sphere structures a potential candidate for bone implants as well as for other structural applications. Young's modulus measurements on hollow sphere structures performed with compression tests were combined with ultrasonic and nanoindenter techniques to distinguish between cell wall and structural properties. The influence of different manufacturing routes and starting materials on the microstructure and the mechanical properties were also investigated. Changes in density, cell wall thickness or steel coating show a strong influence on the mechanical properties like Young's modulus or yield strength. With these adjustments a tailored stress distribution with regard to the adjacent bone seems to be possible. A steel coating for improving the mechanical properties can also be used as base material for the coating of a bioactive hydroxyapatite layer.