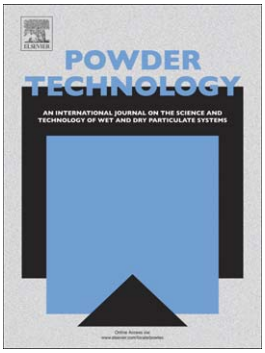

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Powder metallurgical processing of low modulus β-type Ti-45Nb to bulk and macro-porous compacts

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Abstract

Low modulus Ti-45Nb is a promising new alloy for bone implant applications owing to its excellent biocompatibility combined with bone-adapted mechanical performance. The present work demonstrates the applicability of powder metallurgical processing, i.e. hot pressing (HP) and spark plasma sintering (SPS), for the compaction of gas-atomized alloy powder under preservation of the main β-phase. Additional milling of the gas-atomized powder leads to irregular shapes and is effective for a significant refinement of the β-phase grains but causes increased oxygen contents.

The yield strength of nearly fully dense samples increased from ≈450 MPa for samples made from gas-atomized to ≈900 MPa for samples made from additionally milled powder while the Young's modulus remains low.

Exemplarily, the production of macro-porous Ti-45Nb samples with 30 % porosity by means of hot pressing with NaCl as space holder is demonstrated. At this porosity level Young's modulus values ≤ 5 GPa can be obtained. Also for macro-porous samples the use of additionally milled powder was beneficial for achieving increased strength values of ≈140 MPa. Mechanical performance data comparable to those of healthy spongy bone are obtained.

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keywords: beta-Ti alloy, macro-porous, hot pressing, spark plasma sintering, ultrafine-grained, space holder method