



Title

**METALLURGICAL CHARACTERIZATION OF A POROUS TANTALUM BIOMATERIAL
(TRABECULAR METAL™ MATERIAL) FOR ORTHOPAEDIC IMPLANT APPLICATIONS**

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Purpose/Premise

This study was conducted to determine some of the key metallurgical characteristics of a porous tantalum biomaterial.

Material and Methods

Porous tantalum cylinders were examined and tested for macrostructure, microstructure, microhardness, and tensile strength properties.

Outcomes

The macrostructure consists of a reticulated vitreous carbon skeleton structure that is covered with tantalum through chemical vapor deposition/infiltration (CVD/CVI). This results in a porous tantalum structure that is 99% tantalum and 1% carbon by weight. The test samples had a relative density of $19.1 \pm 0.5\%$ (80.9% porosity) and an average pore diameter of $527 \pm 27 \mu\text{m}$ and an average strut thickness of $122 \pm 6 \mu\text{m}$. The grain size of the tantalum ranged from $5 \mu\text{m}$ to $20 \mu\text{m}$ in diameter and showed an epitaxial morphology. The tantalum surface had a fine micro/nano texture. The microhardness of the tantalum was $243 \pm 6 \text{ HK}_{50\text{gr}}$, the yield strength was $48.2 \pm 5.9 \text{ MPa}$, the ultimate tensile strength was $66.7 \pm 6.1 \text{ MPa}$, and the elastic modulus was approximately 3.1 GPa.

Conclusion/Recommendation

These results show that the material has excellent porosity characteristics, sufficient strength for physiological structural support for a variety of implant applications, and an elastic modulus similar to cancellous bone.

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