Magnesium Foam to Regrow Bone: Creating Porous Magnesium Scaffolds For Bone Tissue Regeneration

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Objectives

(1) Create a process to design magnesium bone scaffolds for tissue regeneration
(2) Show that this process can create magnesium castings that have different surface patterns

Motivation

Magnesium composites are of prime interest in bone engineering scaffolds as they have been shown to be fully bioresorbable and have mechanical properties similar to bone. After implantation, the scaffold slowly degrades allowing new bone tissue to form in its place. However, a process to consistently create porous magnesium scaffolds with variable properties, such as porosity and tortuosity, has proven difficult. A process is needed to untap the potential of using magnesium for bone tissue regeneration to help individuals suffering from critical size bone injuries.

Approach

In this proof of concept experiment, magnesium scaffolds were first designed with CAD. These designs were 3d printed using abs. The printed designs were then infiltrated with a proprietary substance that serves as a mimic of the interconnected porous network. Abs was melted away leaving the mimicked porous network that as then infiltrated with magnesium in a furnace with magnesium. The molded porous network was then removed leaving a magnesium casting matching the original CAD design.

Results

The developed process was able to successful reproduce porous structures similar to their CAD counterparts. However, the molding material was not strong enough to hold in 80% of the cases tested. In these samples, the molding material held the desired shape, but fell apart in the handing of them.

Conclusions

The developed process was able to successful reproduce porous structures similar to their CAD counterparts. However, the molding material was not strong enough to hold in 80% of the cases tested. In these samples, the molding material held the desired shape, but fell apart in the handing of them.

Future Work

• Change composition of proprietary substance to make stronger and less brittle, allowing more castings to be formed.
• Test mechanical properties of scaffolds of different pore size to find optimization nearest to bone.
• Begin cell growth and proliferation tests on magnesium scaffolds.

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