Fast Casters – Project Update
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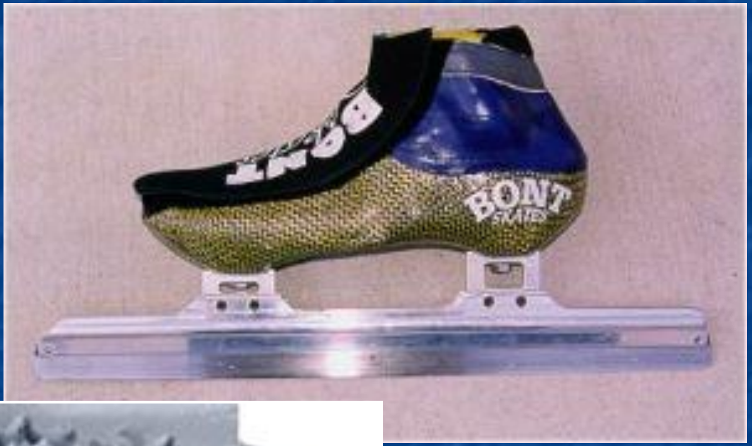
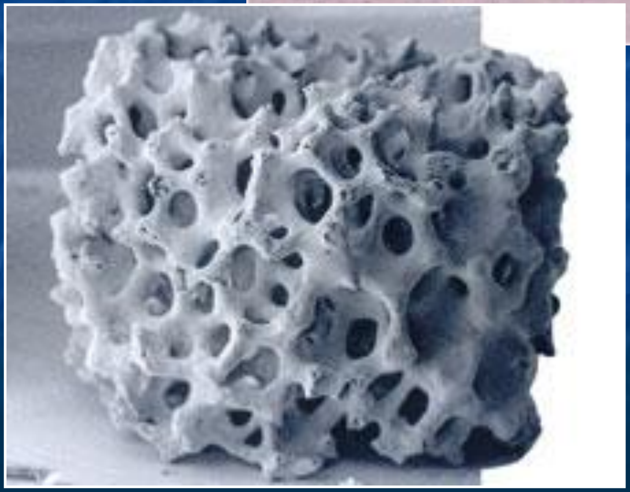
Objectives

- Progress since last update
- New project candidates
  - Technology of speed skate blade
  - 3-D printing of bone scaffolding





Important Material Characteristics in Speed Skates

- Strong, resistant to wear
- Low thermal conductivity
- Able to be sharpened

Titanium vs. Steel Blade

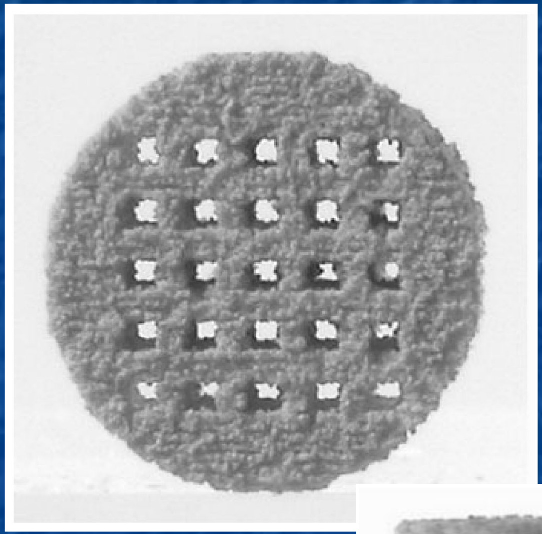
+ Increased durability
  + Needs to be sharpened less often
  - Sharpening takes time and may dull the tools

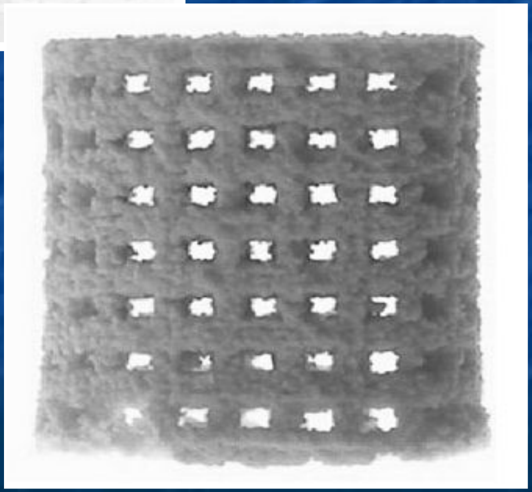
	Steel	Titanium
Thermal Conductivity [W/m-K]	15.2	6.7
Hardness, Vickers	153	349
Cost [USD/lbs.]	$0.18	$4.50

Challenges

- Analyzing advantages and difficulties of using a titanium blade
- Analyzing advantages of casting over forging or water jet cutting
- Finishing the blade

3D Printing of Hydroxyapatite Bone Scaffolds





Seitz et al, Wiley Periodicals

- Objective
  - 3D porous hydroxyapatite scaffold for bone replacement customized from patient's CT scans

The Process

CT scan from patient

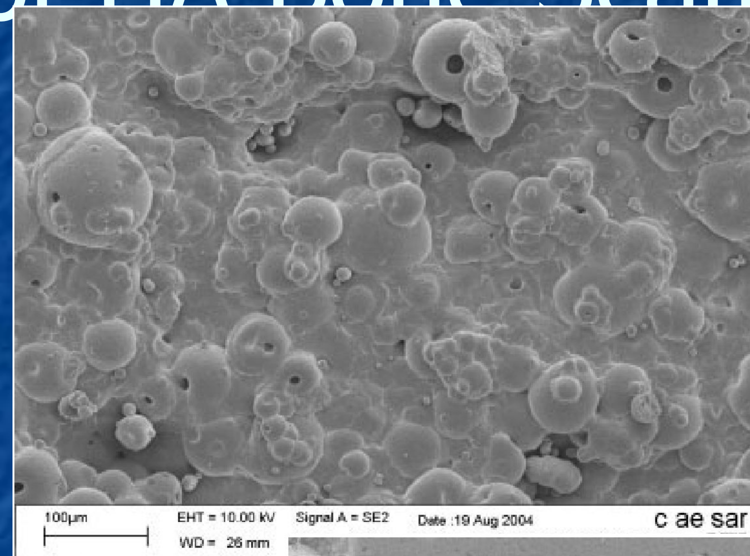
CAD image of bone replacement

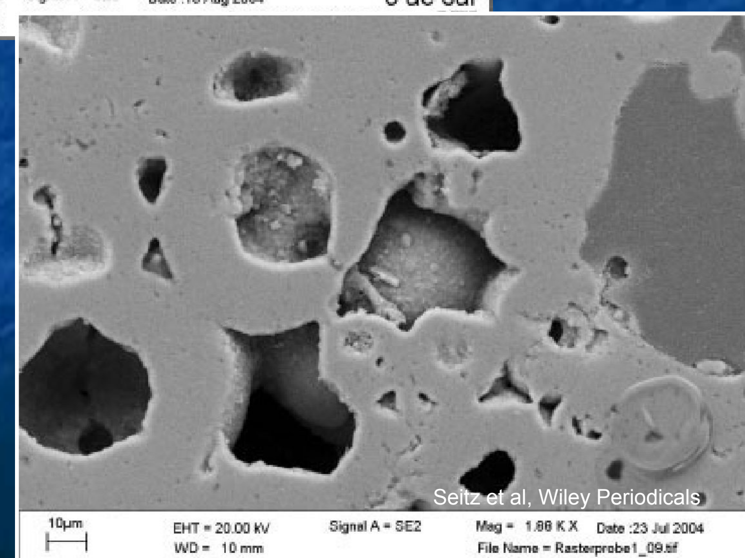
Bone scaffold fabricated from 3D printer

Surgeons implant customized scaffold into patient

Requirements of HA Bone Scaffolds

- Porosity
- Strength
- Interconnected channels
- Channel size
- Biocompatibility
- Bone ingrowth

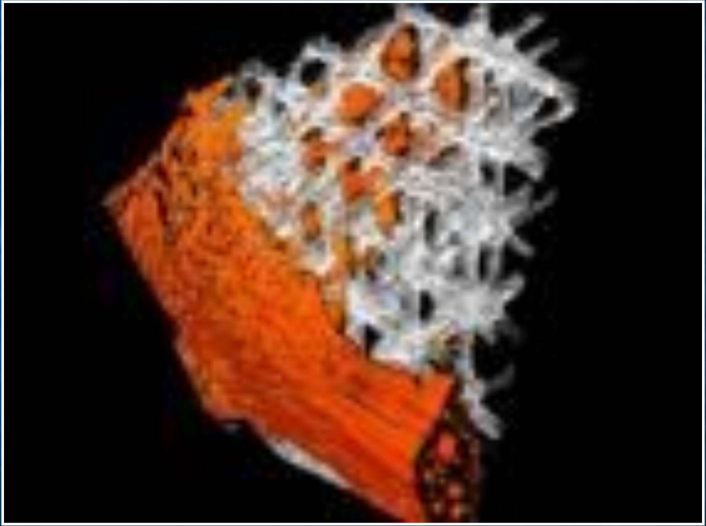




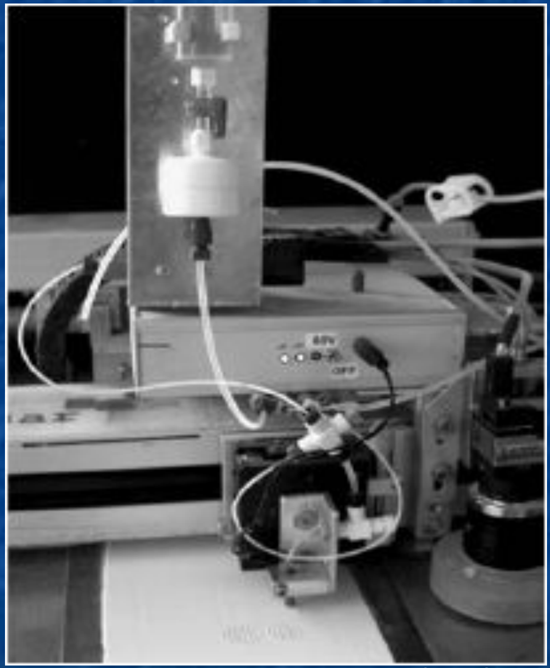
Seitz et al, Wiley Periodicals

Hydroxyapatite

- $Ca_{10}(PO_4)_6(OH)_2$
- Chemically similar to the component of bones
- Supports bone ingrowth
- Biodegrades in the body over time
- HA in powder form



Why HA Bone Scaffolds Would Benefit from 3D Printing

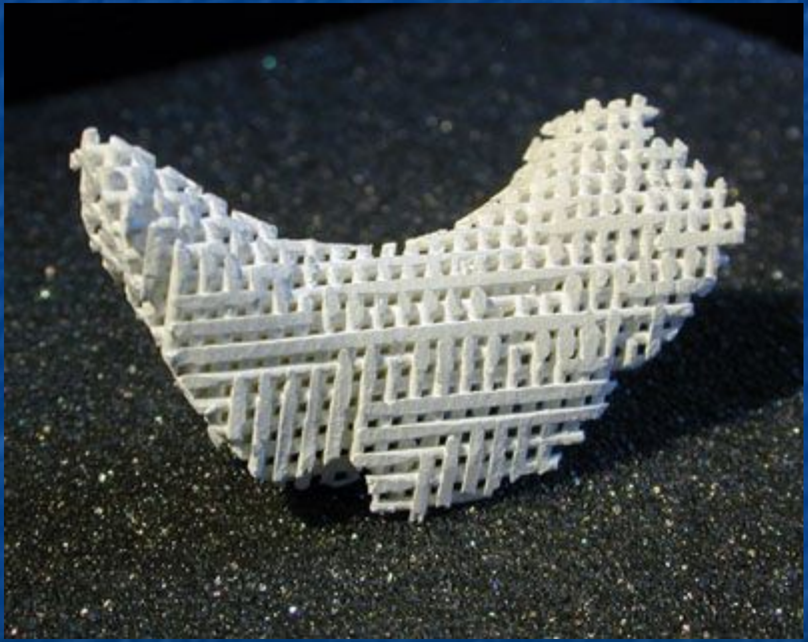


Leukers et al, Journal of Mat. Sci.

- Rapid prototyping
- Quick customization using CT scan of patient
- Complexity of scaffold

Challenges of 3D Printing Hydroxyapatite Scaffolds

- HA particle size
- Acceptable binder
  - polymeric
- Small enough size resolution
- Time constraints
- Sintering
  - Shrinkage
- Cell culture



The Game Plan

- Explore different combinations of hydroxyapatite and biocompatible materials
- Uniaxial tension/compression tests
- SEM imaging of microstructure
- Different channel geometries

Questions/Comments?

Backup/Extra Information

Material Candidates

Spray-dried hydroxyapatite granulates with polymeric additives V5.2 and V12

Polymeric binder Schelofix dissolved in water (10 and 14wt%)

- Hermann Seitz, "Three-Dimensional Printing of Porous Ceramic Scaffolds for Bone Tissue Engineering", Wiley Periodicals, 2005.