3D-PRINTING VIA BINDER JETTING AND CONSOLIDATION OF NANO ALUMINA BONE SCAFFOLD PROTOTYPES

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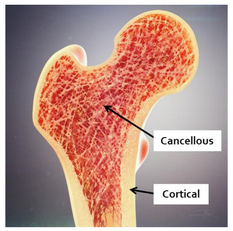
ABSTRACT



Bone Type	Cortical	Cancellous
Compressive Strength	100-230 MPa	2-12 MPa
Porosity	3-12%	50-90%

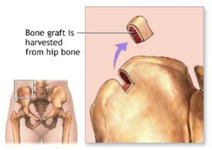
Main problems with current bone grafting and replacement methods:

- **Inability to tailor the shape of the graft to match the injury site or patient**
- **Inability to produce a porous structure with high mechanical strength**

Results using binder jetting provided in this study:

- **Novel nano-powder coating procedure**
- **A cubic 70% dense sample with strength of 186 MPa**
- **A complex scaffold shape with strength of 28 MPa**

Current Sources of Bonegrafts

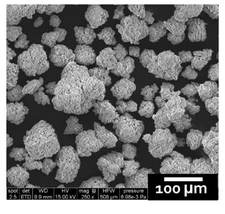


MATERIALS & METHODS

Material: Alumina , Al_2O_3

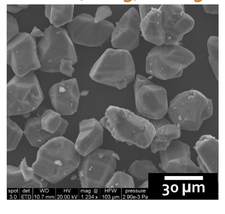
Alumina was chosen for its biocompatibility as well as its availability in various particle shapes and sizes for printing

Materion



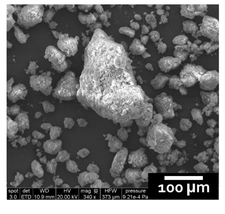
Avg particle size: 80 µm

AA-18/AA-3/AA-1.5



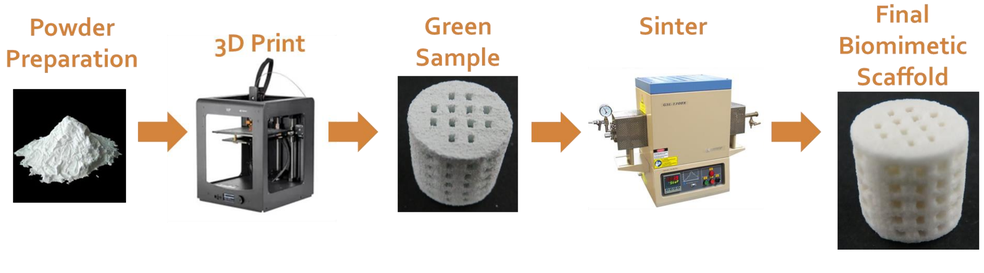
Avg particle sizes: 18 µm, 3 µm and 1.5 µm

ALCOA

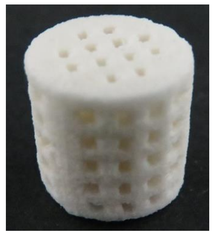


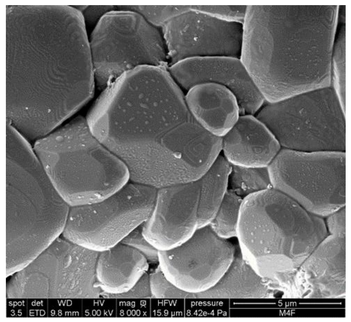
Avg particle size: 45 µm

Patent pending on powder preparation process



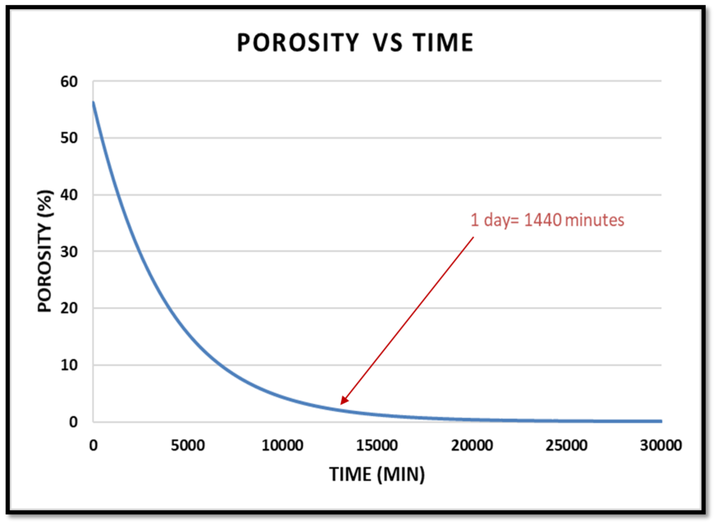
RESULTS & CONCLUSION





- **Complex Alumina Structures were produced with properties that mimic bone**
- **The highest density achieved was 70% in the cubic sample**
- **The final grain size is ~5um, impossible with micron sized powders**

FUTURE WORK



Using the constitutive sintering equation, it was determined that in order to get close to full density in this material it would take 9 days of sintering

- **Try different materials; hydroxyapatite**
- **Try different polymer for the powder preparation process**
- **Optimize the sintering cycle**
- **Try different sintering techniques**
- **Expand model-based prediction tool**

BIBLIOGRAPHY

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