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Summer 2023 Internship Recap

Carla Ann Navar

08/22/23

Experience Gained

1	2	3	4	5	6
BTO slurry	Acoustic NDE	Fuel Cell	Flat Cell	Other	Future Work
<ul style="list-style-type: none">• Formulation• Printing Iterations• Examination	<ul style="list-style-type: none">• Alumina Green Parts• Pure Copper	<ul style="list-style-type: none">• Assembly• Operation• Inks	<ul style="list-style-type: none">• Assembly	<ul style="list-style-type: none">• CAD• XRF mapping	<ul style="list-style-type: none">• BTO Slurry• NDE

DLP Background

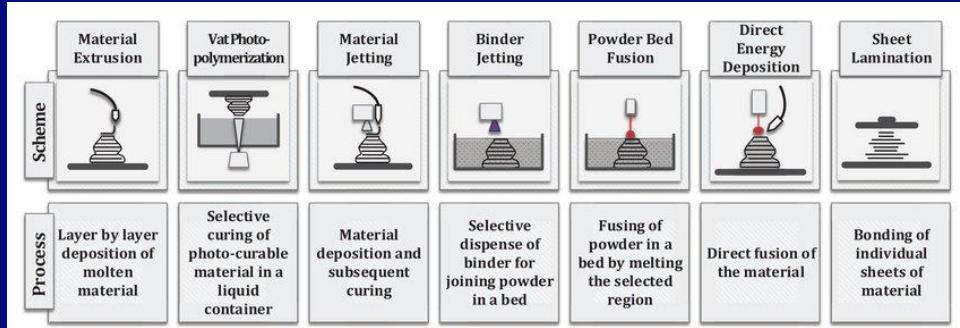
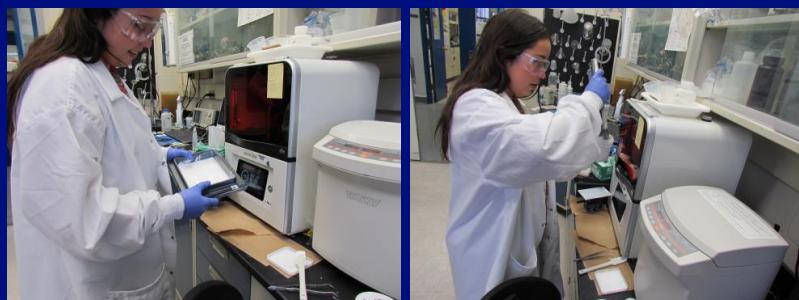


Diagram of types of Additive Manufacturing Processes



Conducting printing iterations

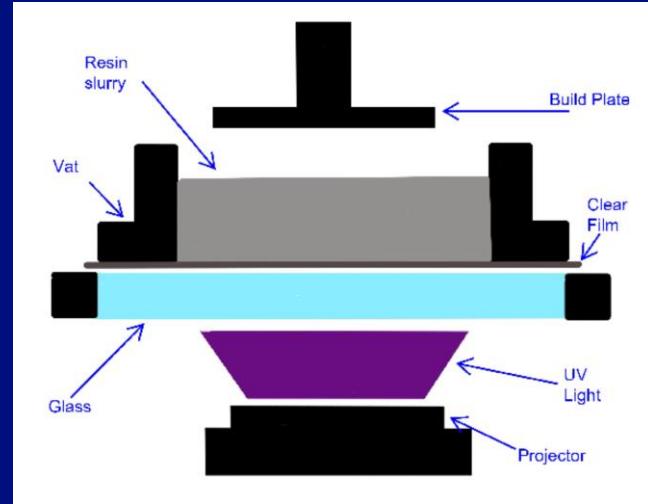
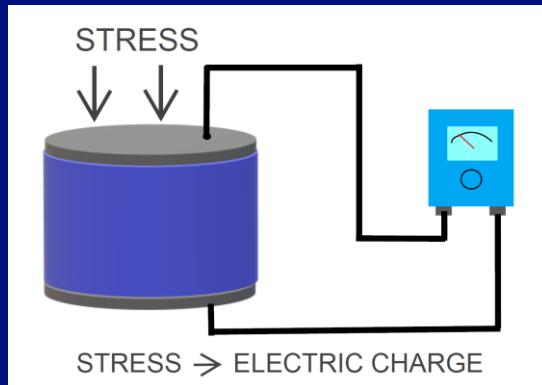


Diagram of DLP printing
(DLP- Digital Light Processing)

BTO Slurry

Project Background:

Achieving high loadings of BaTiO₃ in ceramic slurries can lead to an increase in dielectric constant, high-permittivity and enhanced piezoelectric response.



Piezoelectric effect

70wt%							
	Genesis	BYK	BTO (100nm)	BTO (400nm)	Material	Container Weight	Total Mat Weight
g	62.72	4.48	58.24	98.56	224	64	224.000
wt%	28.0	2.0	26.0	44.0			70

Formulation of 70 wt% BTO

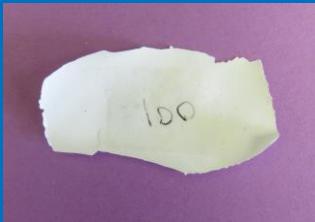


Images of 70 wt% BTO slurry



BTO Slurry Progress

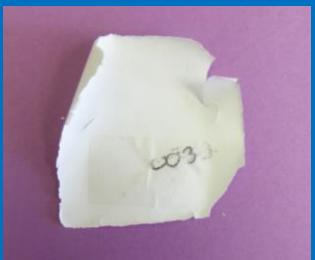
Layer Analysis



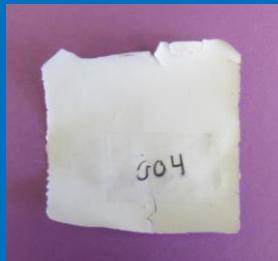
LI:190 IE:340 BE:190



LI:150 IE:320 BE:190



LI:130 IE:350 BE:190



LI:110 IE:350 BE:190

- Printing of 70 wt% BTO
- Parameterization of light Intensity and exposure time
- Unsuccessful adhesion to build plate

Validation Matrix



LI:200 IE:350 BE:205

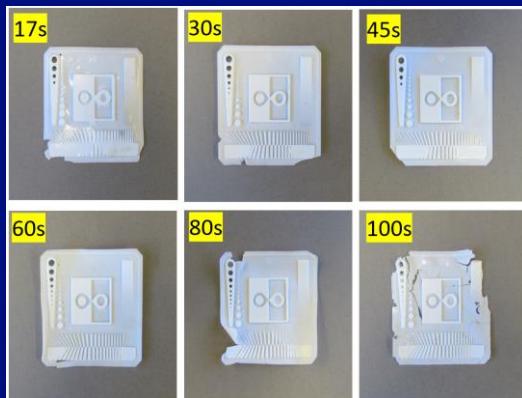


LI:150 IE:320 BE:190

- A validation matrix is used to determine optimal print parameters based on resolution

Acoustic NDE- Alumina

- Formulation of 20% Al_2O_3 ceramic slurry mixture
- Printing iterations of validation matrices to determine adequate parameters for printing



Validation Matrices printed at varying basic exposure times

$$\text{Correlation}(g, h) = \int_{-\infty}^{+\infty} g(\tau + t)h(\tau)d\tau$$

Time of flight found using cross correlation function

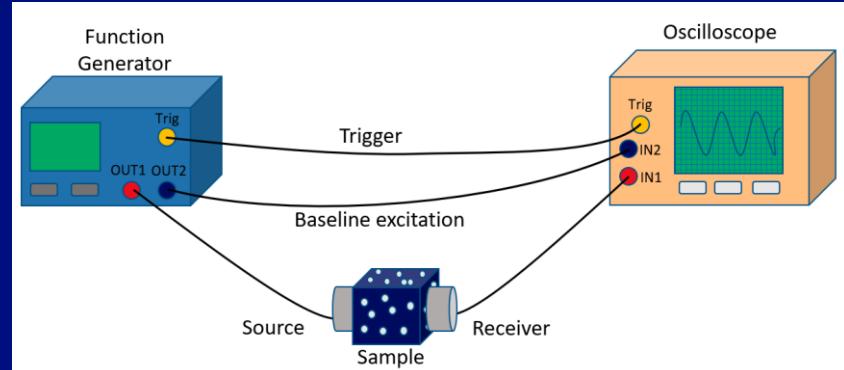
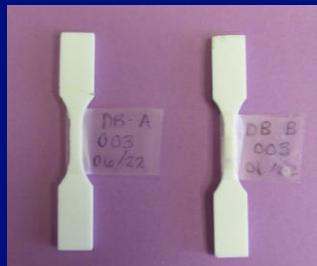


Diagram of Acoustic NDE Set-up

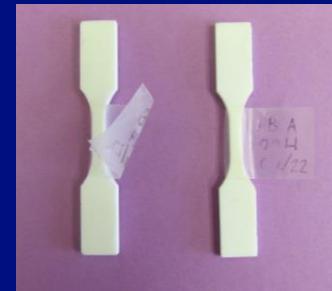
Acoustic NDE- Alumina



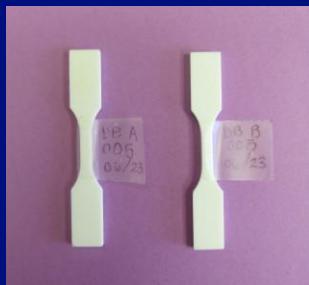
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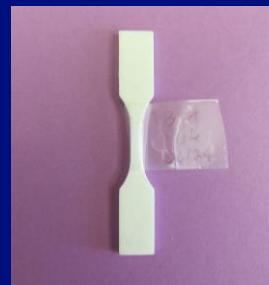
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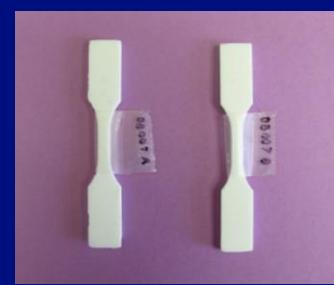
LI:120 IE:30 BE:45



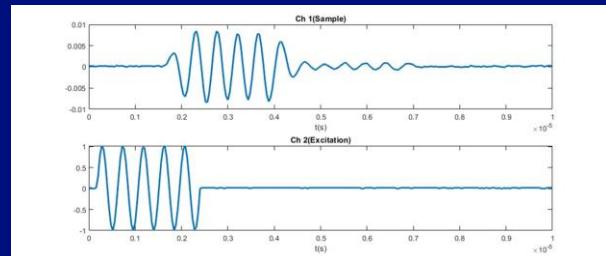
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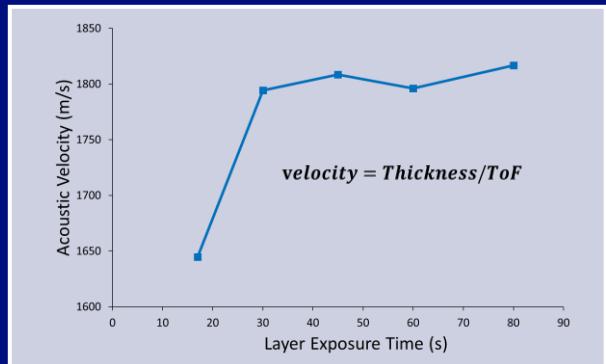
LI:120 IE:30 BE:80



LI:120 IE:30 BE:100



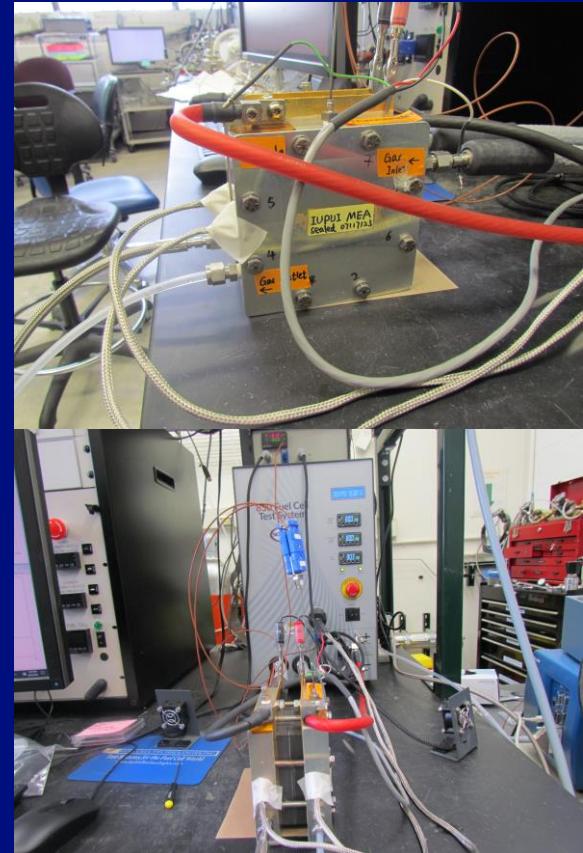
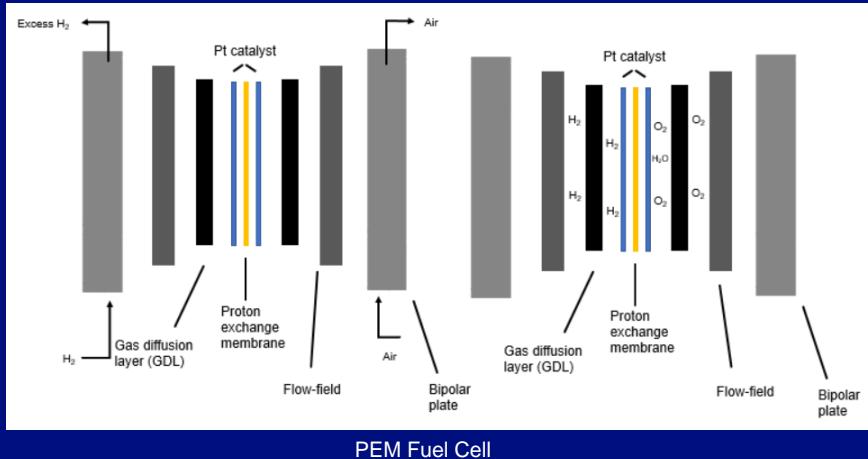
Signal through the sample compared with baseline signal



The acoustic velocity displays degree of polymerization

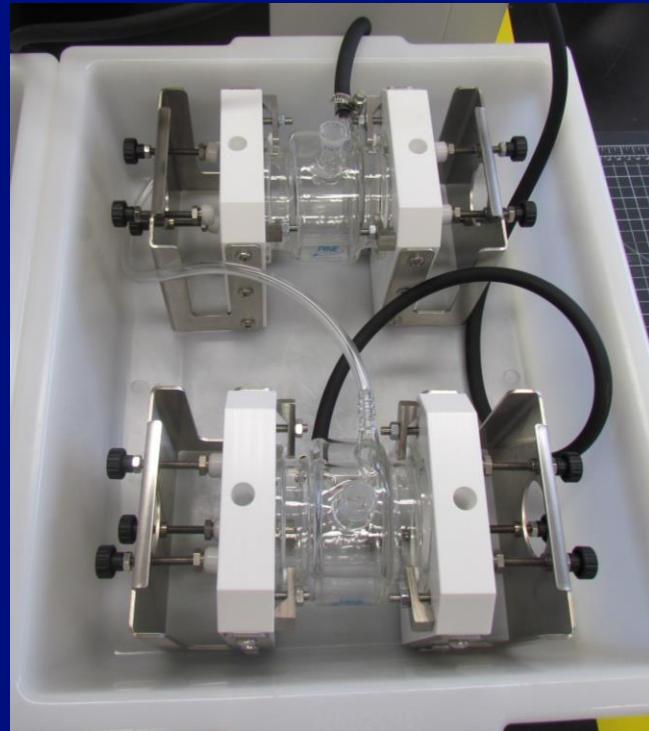
Fuel Cell

- Assembly and operation of PEM fuel cells
- Formulation of catalyst inks
- Manufacturing of electrodes



Flat Cell

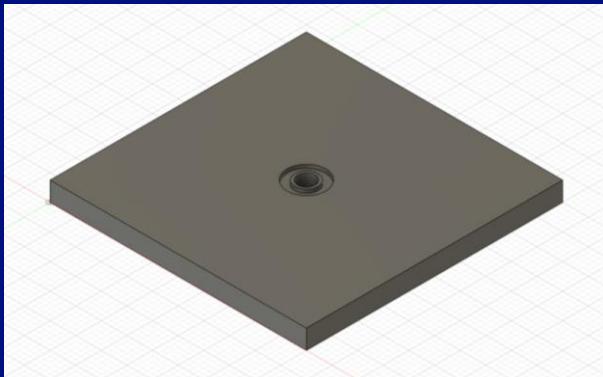
- Assembly and Set-up
- Corrosion on stainless steel



Flat Cells

Other

CAD



CAD of Flat cell end plate

XRF Mapping



Orbis PC used for X-Ray Fluorescence (XRF) Mapping

*XRF Mapping- Create visual representations of the elemental composition of a sample surface

Future Work

- Continue looking for correct printing parameters
- Possible NDE applications to evaluate material properties on BTO

