

# LA-UR-23-30328

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**Title:** Summer 2023 Internship Recap

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# Summer 2023 Internship Recap

Carla Ann Navar

08/22/23

# Experience Gained

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## BTO slurry

- Formulation
- Printing Iterations
- Examination

2

## Acoustic NDE

- Alumina Green Parts
- Pure Copper

3

## Fuel Cell

- Assembly
- Operation
- Inks

4

## Flat Cell

- Assembly

5

## Other

- CAD
- XRF mapping

6

## Future Work

- BTO Slurry
- NDE

# DLP Background

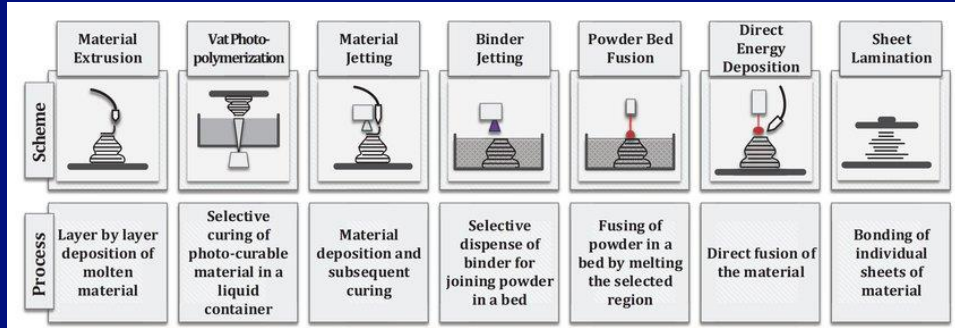


Diagram of types of Additive Manufacturing Processes

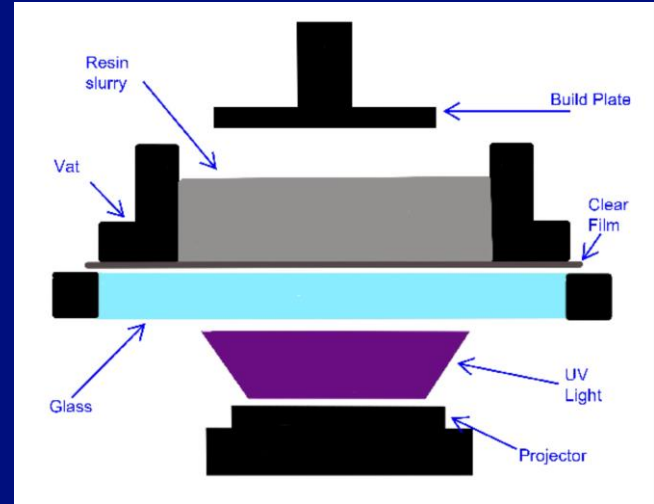
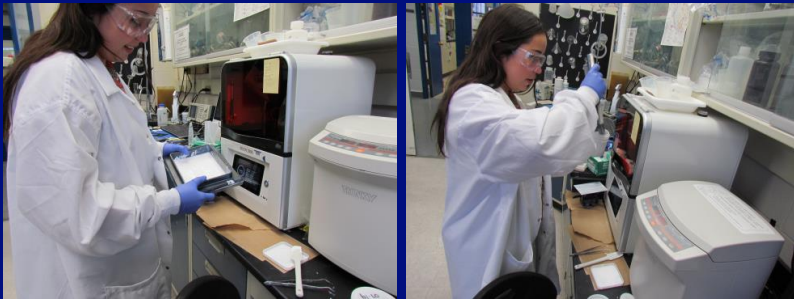


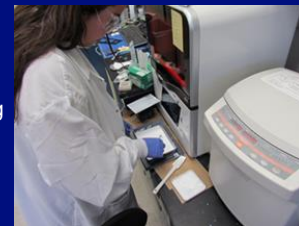
Diagram of DLP printing  
(DLP- Digital Light Processing)



Conducting printing iterations

# BTO Slurry

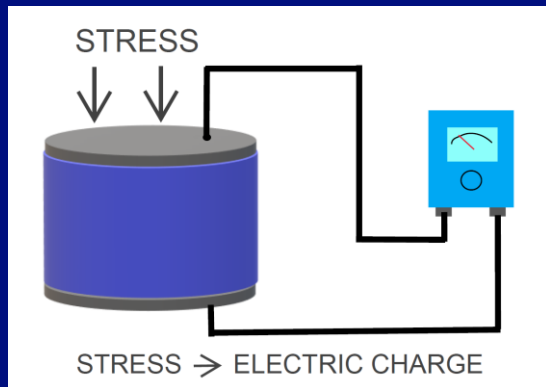
Project Background:  
Achieving high loadings of BaTiO<sub>3</sub> in ceramic slurries can lead to an increase in dielectric constant, high-permittivity and enhanced piezoelectric response.



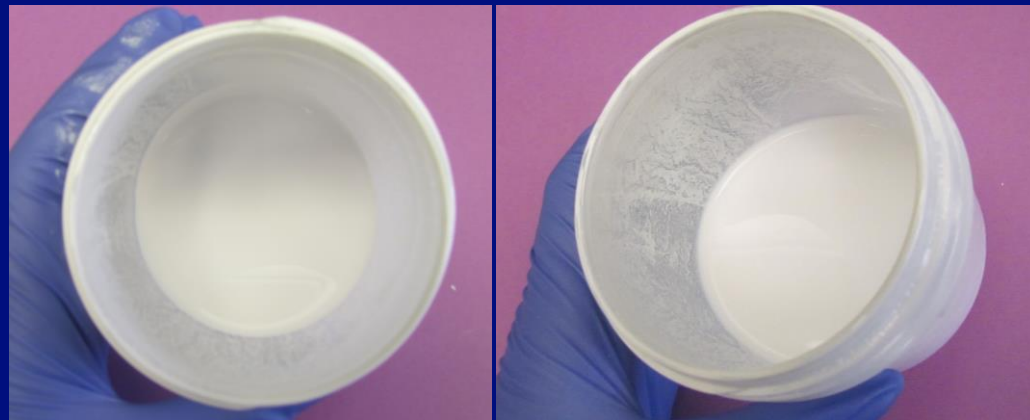
Removing print from slurry

70wt%									
	Genesis	BYK	BTO (100nm)	BTO (400nm)	Material	Container Weight	Total Mat Weight	Container+Mat	btwt%
g	62.72	4.48	58.24	98.56	224	64	224.000	288	
wt%	28.0	2.0	26.0	44.0					70

Formulation of 70 wt% BTO



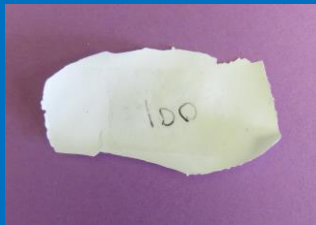
Piezoelectric effect



Images of 70 wt% BTO slurry

# BTO Slurry Progress

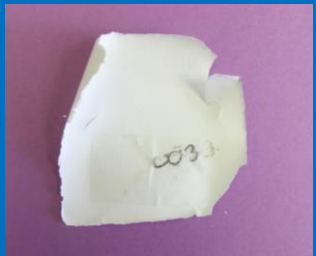
## Layer Analysis



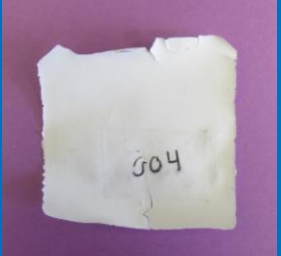
LI:190 IE:340 BE:190



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

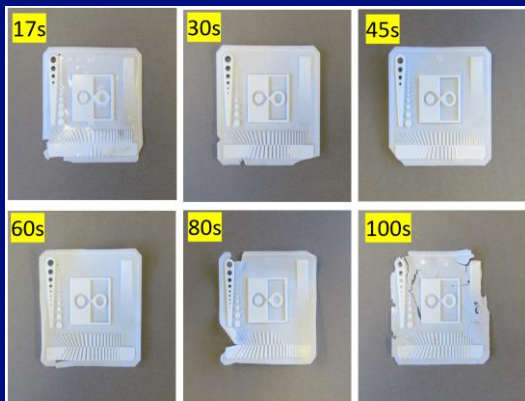


LI:150 IE:320 BE:190

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

# Acoustic NDE- Alumina

- Formulation of 20%  $\text{Al}_2\text{O}_3$  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

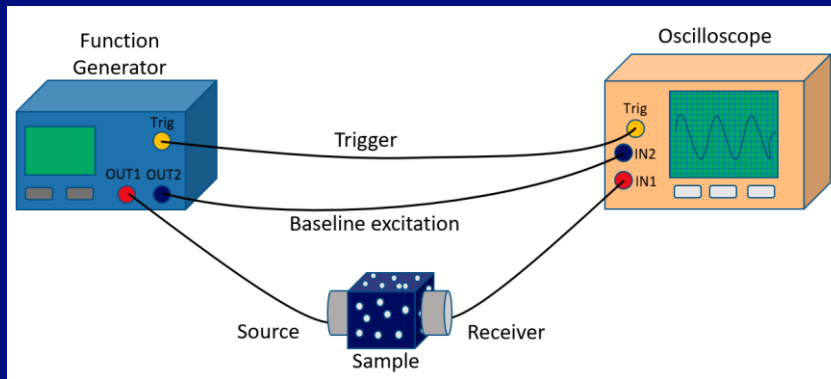
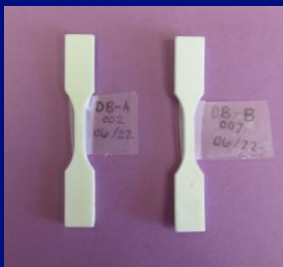


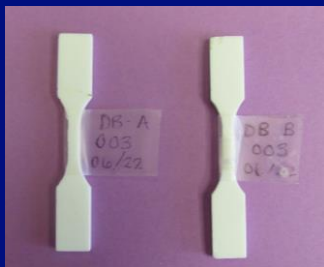
Diagram of Acoustic NDE Set-up



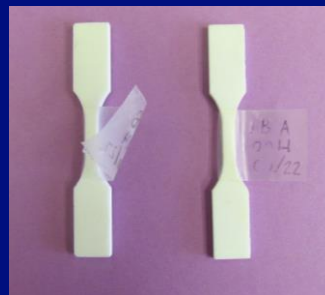
# Acoustic NDE- Alumina



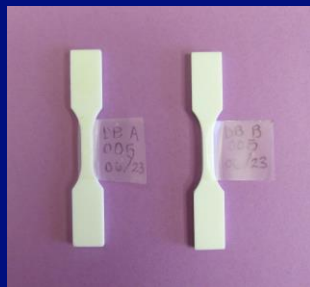
LI:120 IE:30 BE:17



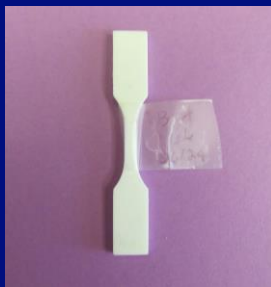
LI:120 IE:30 BE:30



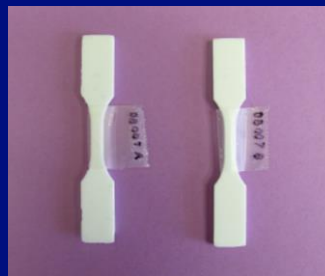
LI:120 IE:30 BE:45



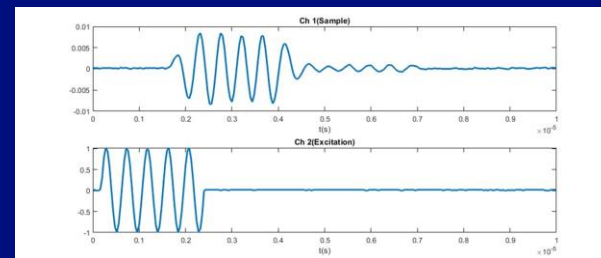
LI:120 IE:30 BE:65



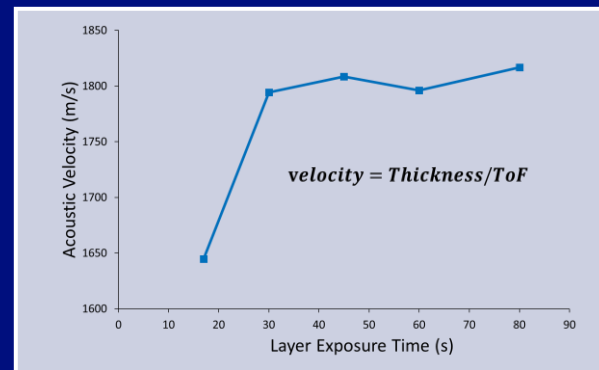
LI:120 IE:30 BE:80



LI:120 IE:30 BE:100



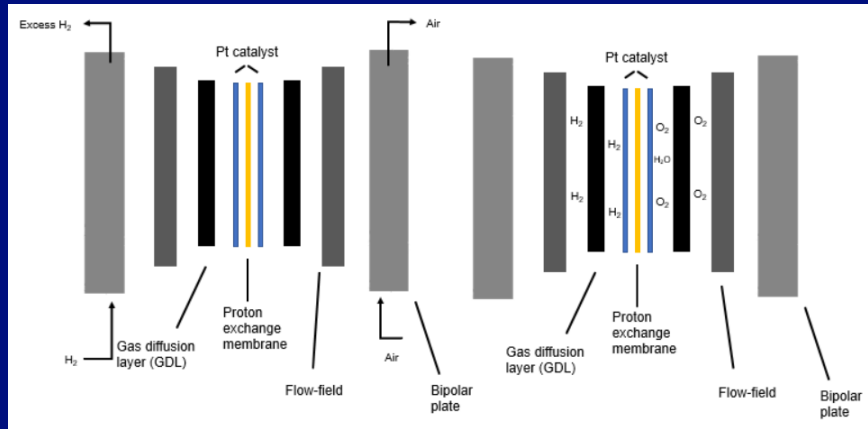
Signal through the sample compared with baseline signal



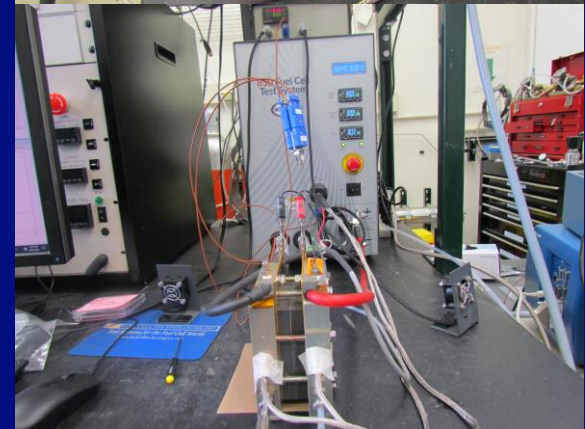
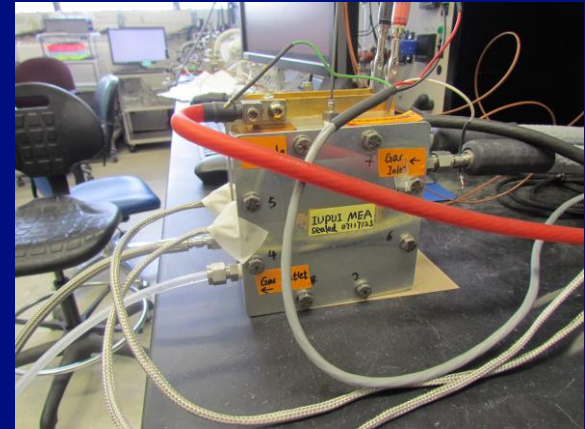
The acoustic velocity displays degree of polymerization

# Fuel Cell

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



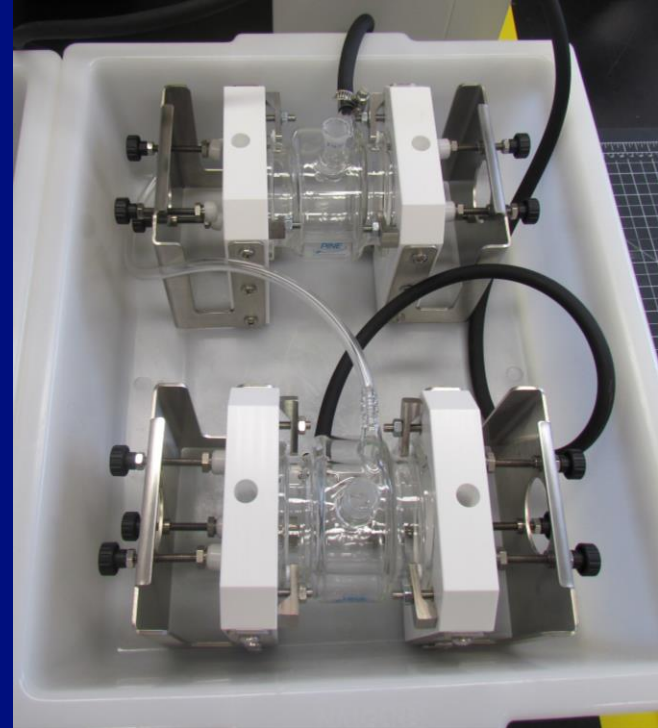
PEM Fuel Cell



PEM Fuel Cell

# Flat Cell

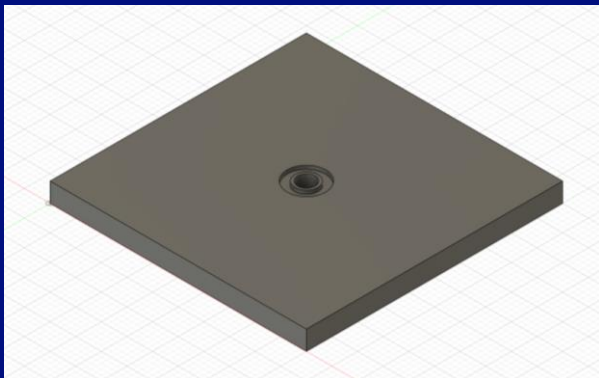
- Assembly and Set-up
- Corrosion on stainless steel



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



