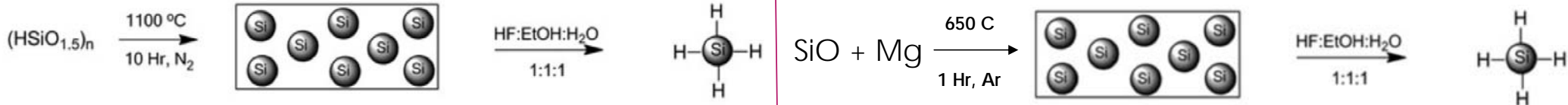


# Magnesium Thermal Reduction of Silicon- Monoxide

BY: BRANDON FIELDS

MENTOR: DR. ANDREA GOFORTH

# Goforth Lab Processes



# Step 1: Anneal

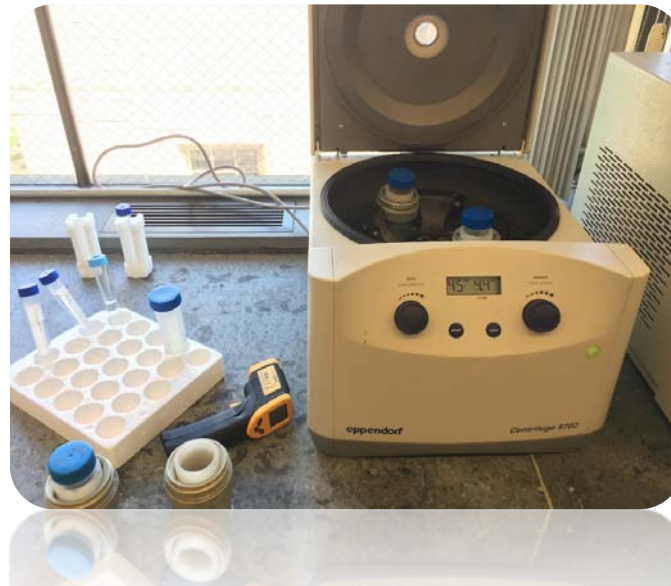
- ▶ Theoretical:  $\text{SiO} + \text{Mg} \rightarrow \text{Si} + \text{MgO}$
- ▶ Actual:  $\text{SiO} + \text{Mg} \rightarrow \text{Si} + \text{SiO} + \text{MgO} + \text{Mg}_2\text{SiO}_4$



Times: 30 minutes, 60 minutes  
Temperatures: 500, 550, 600, 650 (Degrees Celsius)

## Step 2: Wash

- ▶ Substances before HCL: Si, SiO, Mg, MgO, Mg<sub>2</sub>SiO<sub>4</sub>
- ▶ Substances after HCL: Si & SiO



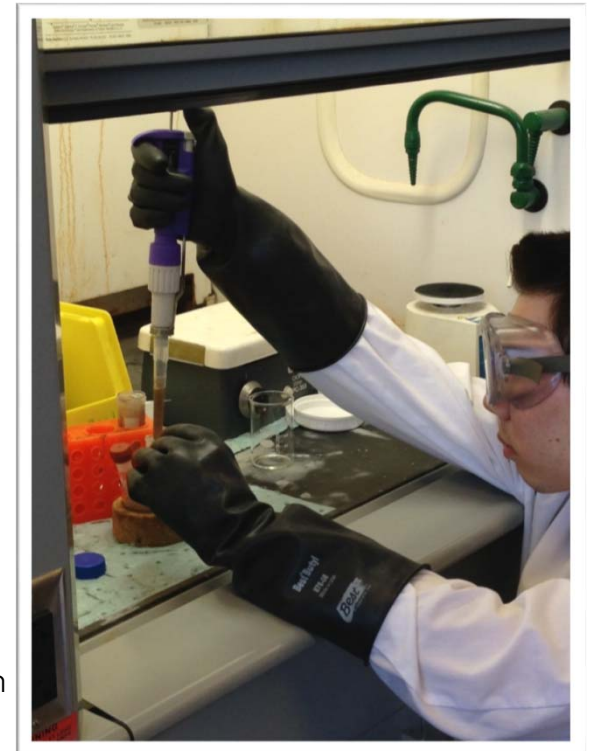
Spin Parameters: 40  
minutes at 4400 rpm

## Step 3: Etch

- ▶ Substances before HF: Si & SiO
- ▶ Substances after HF: Crystalline Silicon!



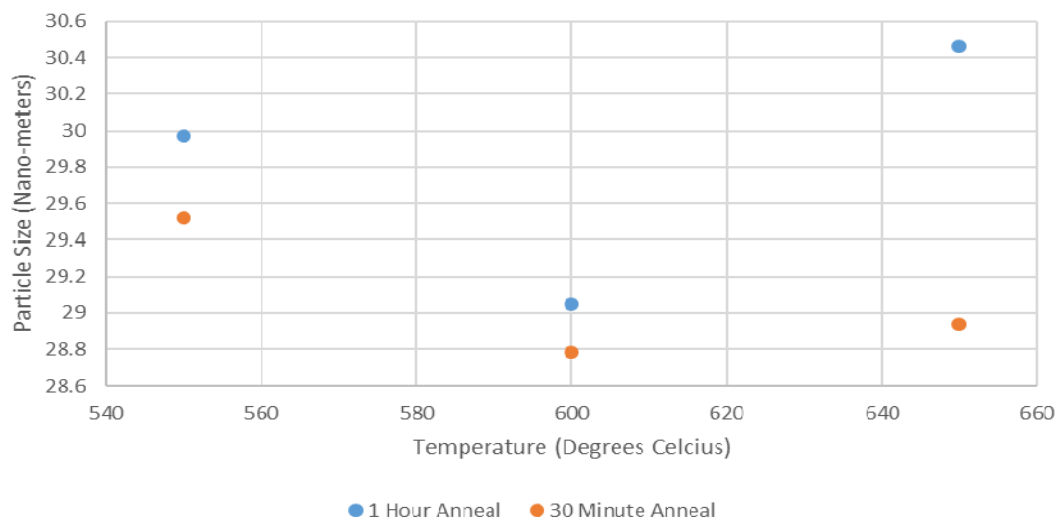
A Final Sample dispersed in THF



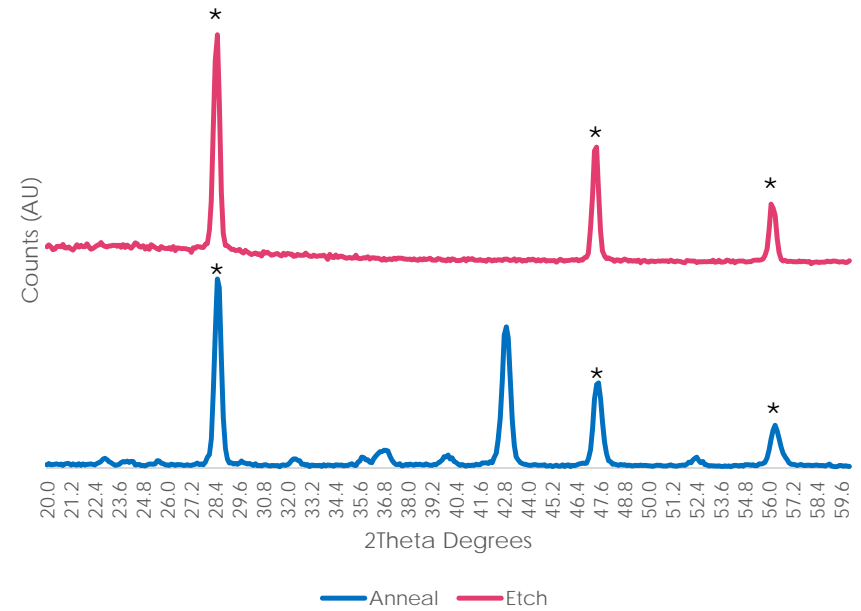
Extraction of Silicon from the HF solution

# Results

Particle Size (nm) v.s. Temperature (C)

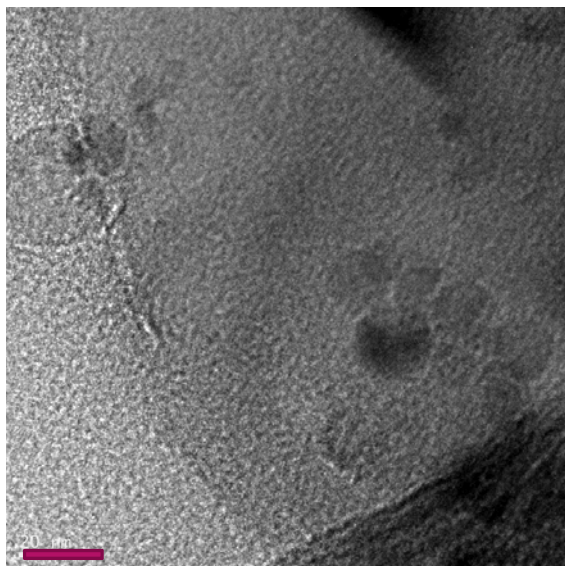


6 out of 8 samples provided Data

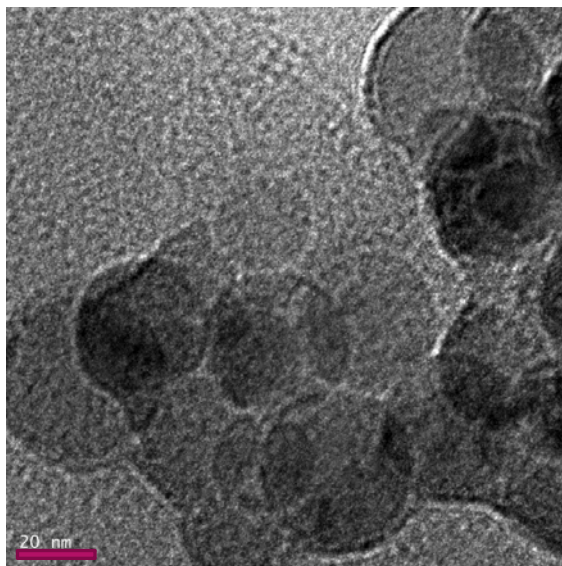


X-Ray Diffractometer used to measure particle size

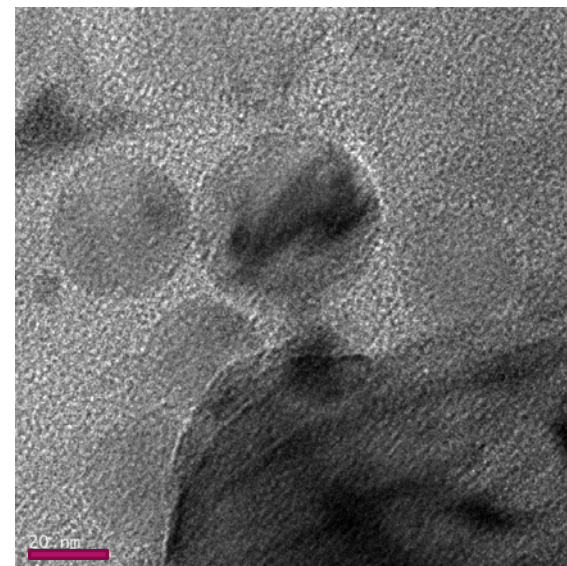
# TEM Sample Imaged: 1 Hour Anneal at 650 C



\*20 nm Scale Bars



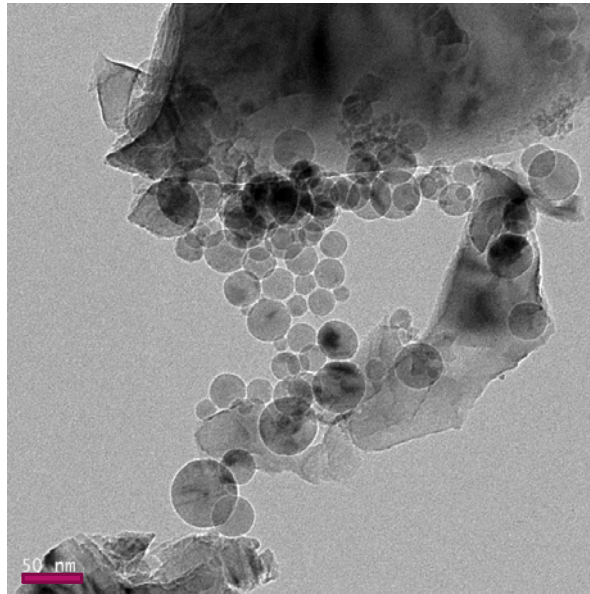
\*20 nm Scale Bars



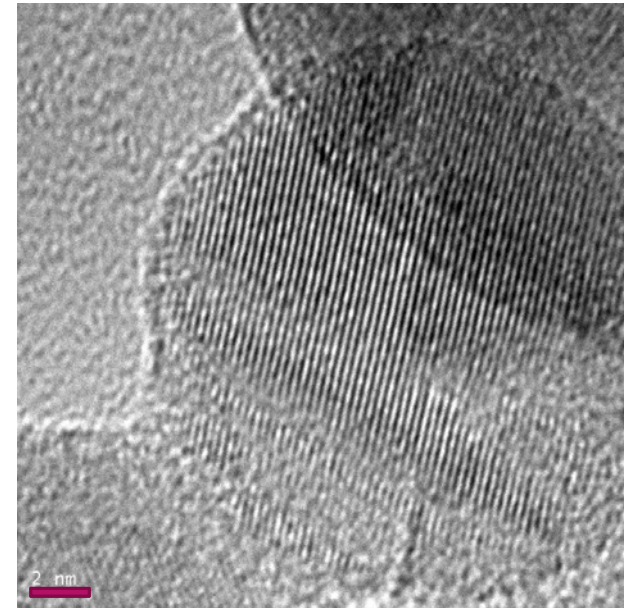
# Modified Process

## Changes Made:

- ▶ Increased Anneal Time
- ▶ Increased Anneal Temperature
- ▶ Increased Etch Time
- ▶ Different Solvent
- ▶ Ball Milled Sample Before Etch



\*50 nm Scale Bar



\*2 nm Scale Bar



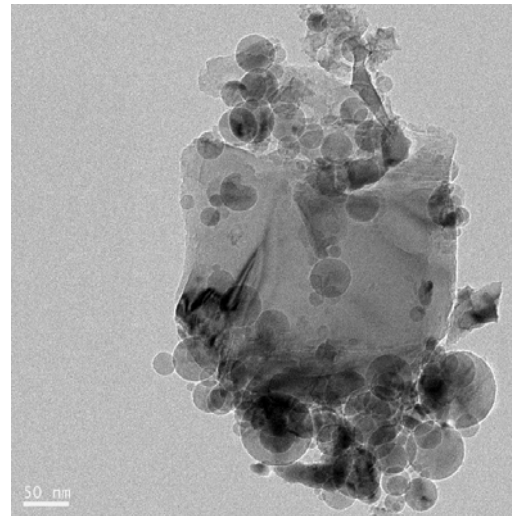
# Significant Findings

## Results

- ▶ Kinetic Barrier
- ▶ Trends with Temperature & Time
- ▶ Improved Processed

## Future Questions

- ▶ Which Variable Worked?
- ▶ Why are there Micro-Structures?





# Acknowledgements

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