

# SYNTHESIS AND INVESTIGATION OF MAGNETIC AND TRANSPORT PROPERTIES OF $\text{La}_{0.5}\text{Sr}_{0.5}\text{MnO}_3$ NANOSTRUCTURED MATERIAL

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July 29, 2011

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# Today's Topics

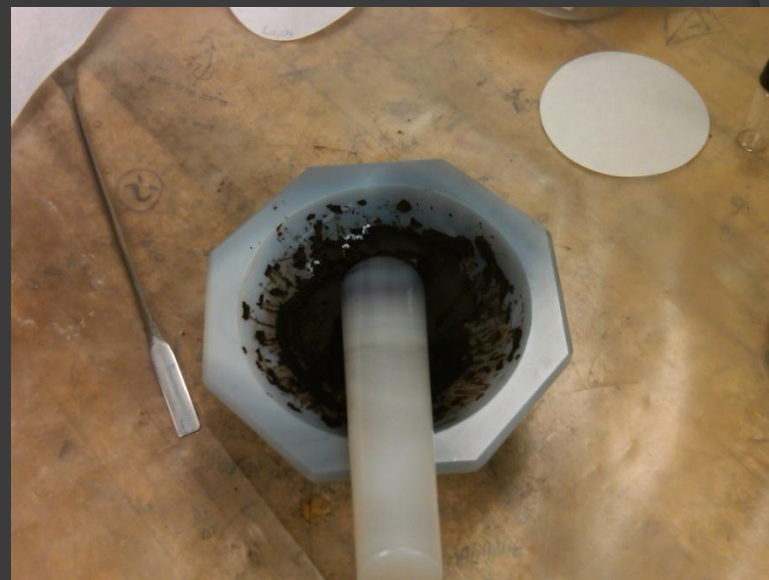
- ⦿ Project Objective
- ⦿ Background
  - Solid State Reactions
  - X-ray Diffraction (XRD)
  - Resistivity
- ⦿ Experimental Methods
- ⦿ Results
- ⦿ Conclusions
- ⦿ Acknowledgements
- ⦿ References
- ⦿ Q&A

# Project Objective

- This project's goal was to synthesize  $\text{La}_{0.5}\text{Sr}_{0.5}\text{MnO}_3$  with grain size in the nm range.

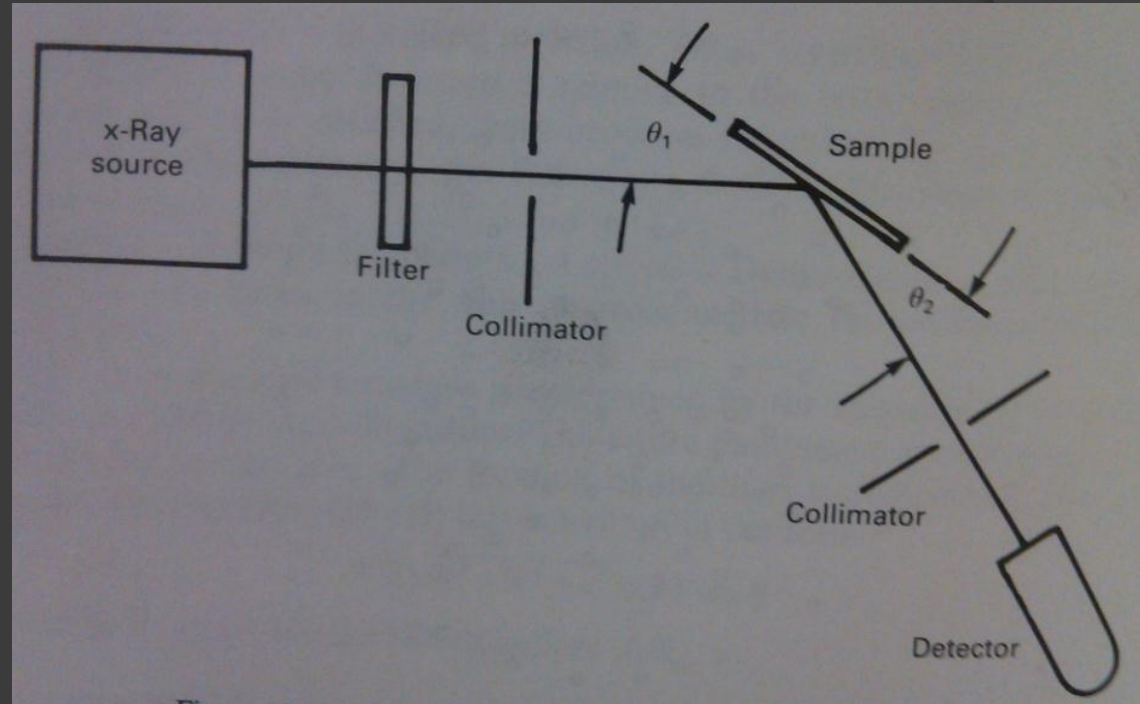
# Solid State Reactions

- ⦿ Solventless
- ⦿ Addition of Heat
- ⦿ Advantages



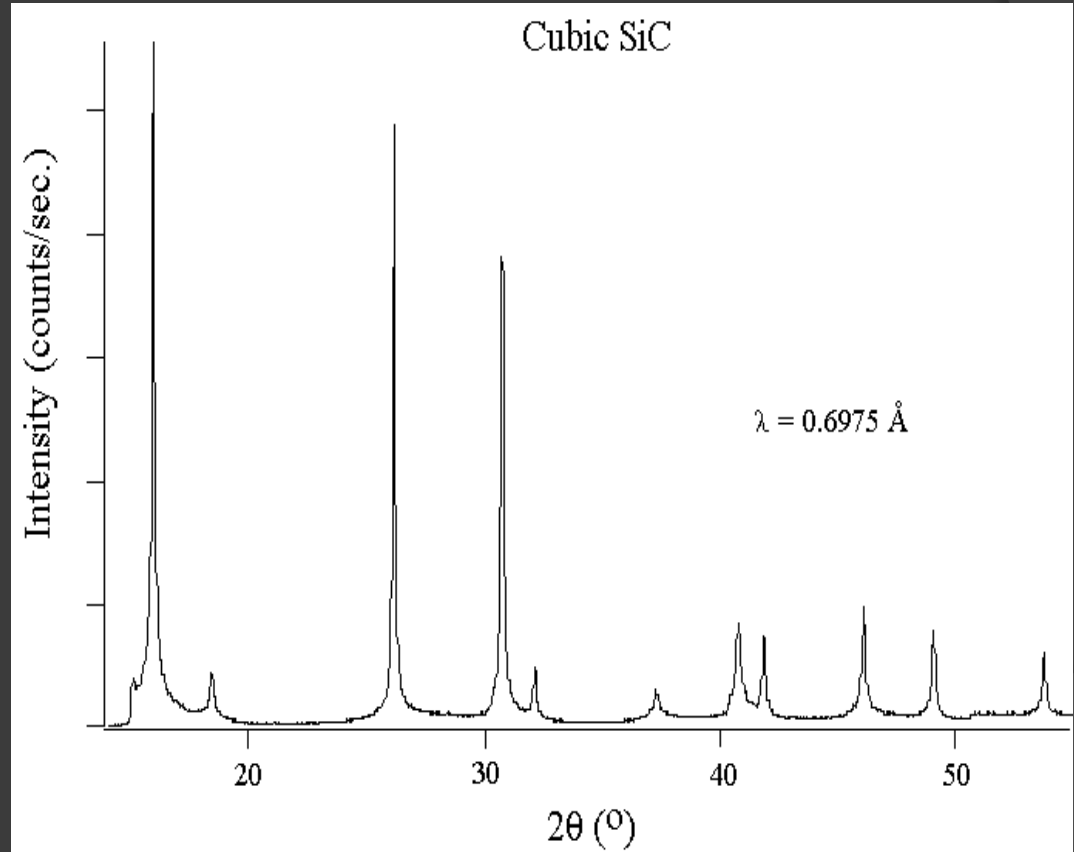
# X-Ray Diffraction (XRD)

- Structural and Composition information
- Emitting X-rays



# XRD Continued

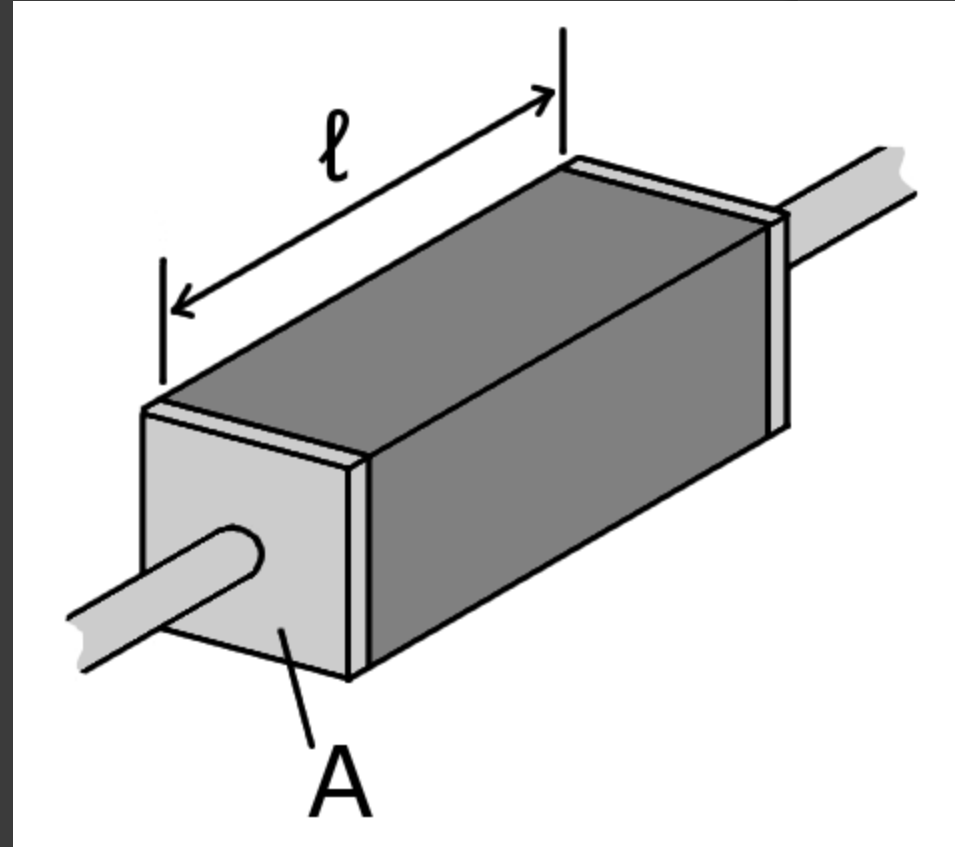
- Diffractogram



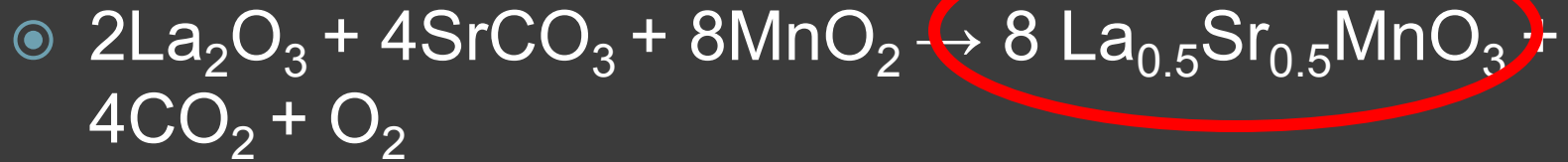
# Resistivity

$$\rho = \frac{RA}{l}$$

- where  $\rho$  = Resistivity,  $R$  = Resistance,  $A$  = cross sectional area and  $l$  = length



# Experimental Methods



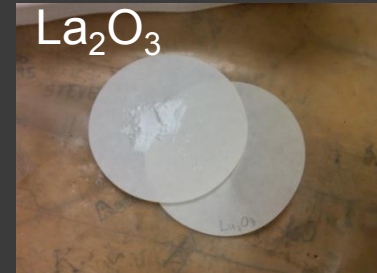
- ⊙ Sample #062011 and Sample #062911



0.6824 g  
1.706 g



0.8044 g  
2.011 g



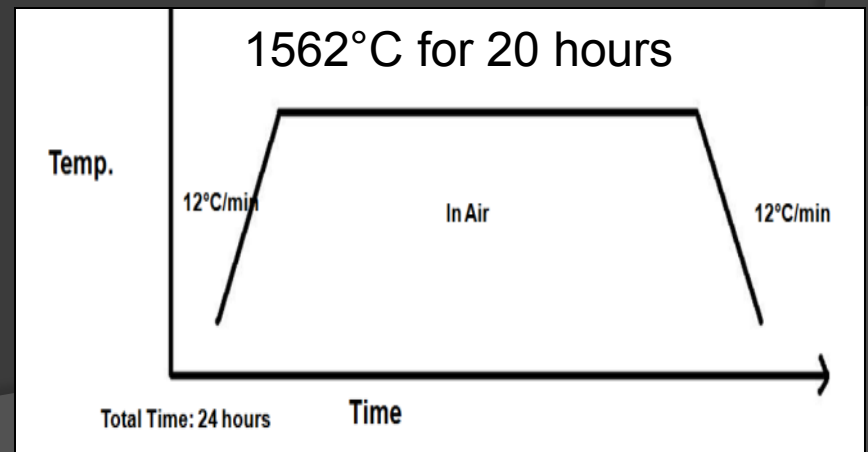
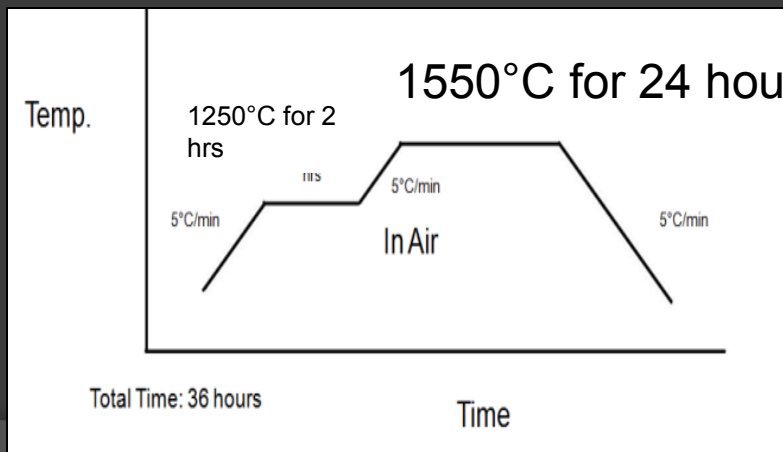
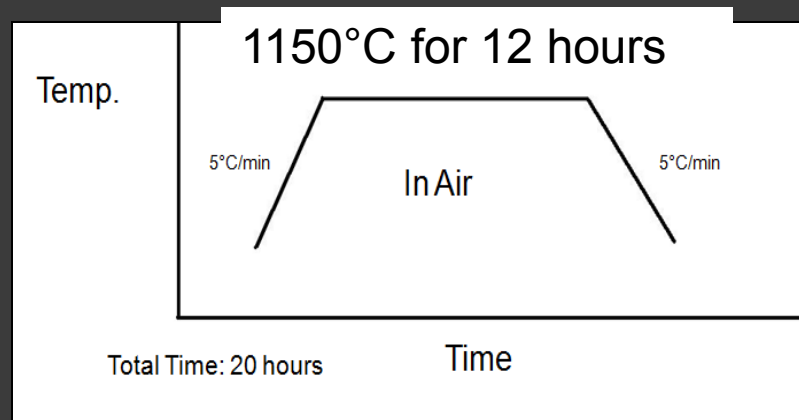
0.7536 g  
1.884 g



# Experimental Methods Cont.

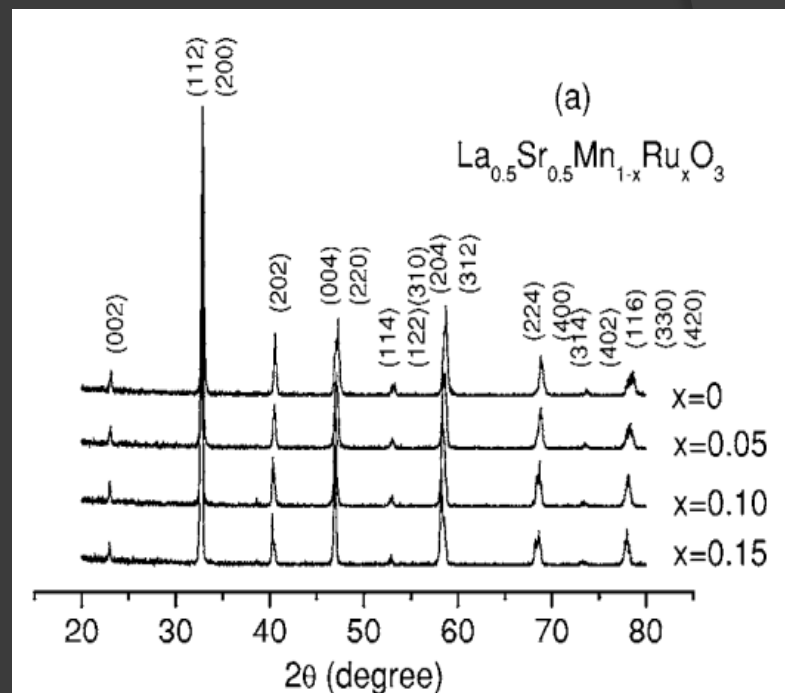
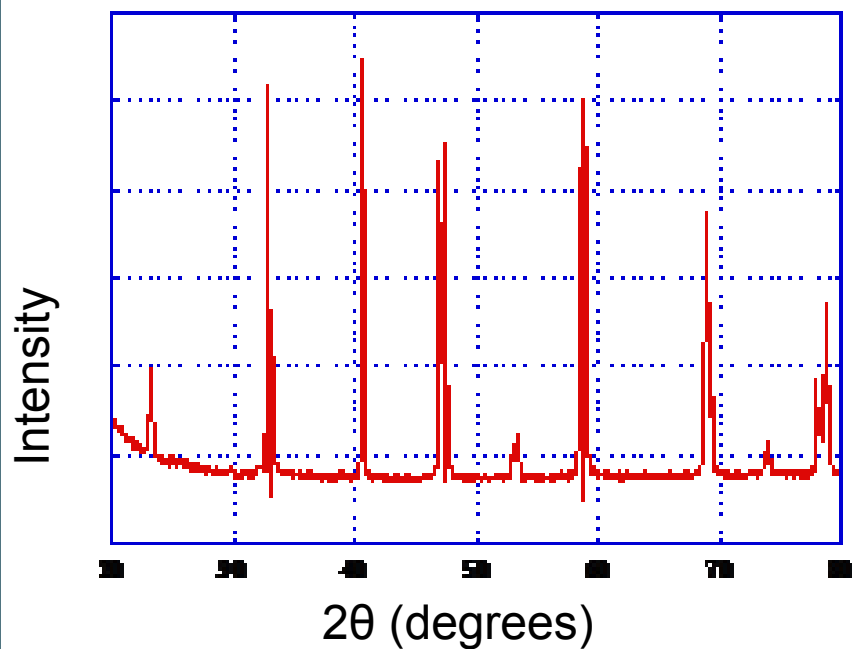
● Sample #062011

● Sample #062911



# Results: XRD

Slow Scan XRD sample #062911  
Sintered at 1478°C for 20 hours in air



# Results: XRD Cont.

Peak Position La <sub>0.5</sub> Sr <sub>0.5</sub> Mn <sub>1-x</sub> Ru xO <sub>3</sub> For x=0	Peak Position Sintered Sample #062911	% Difference	Crystal Size (Angstroms)
23	23.3	1.29	
32.5	32.9	1.22	119
40.6	40.8	0.49	103
46.9	47.4	1.06	97.54
52.6	53.3	1.32	
58.2	58.7	0.85	144.5
68.5	68.7	0.29	126.5
73.7	73.7	0	
78.7	78.7	0	

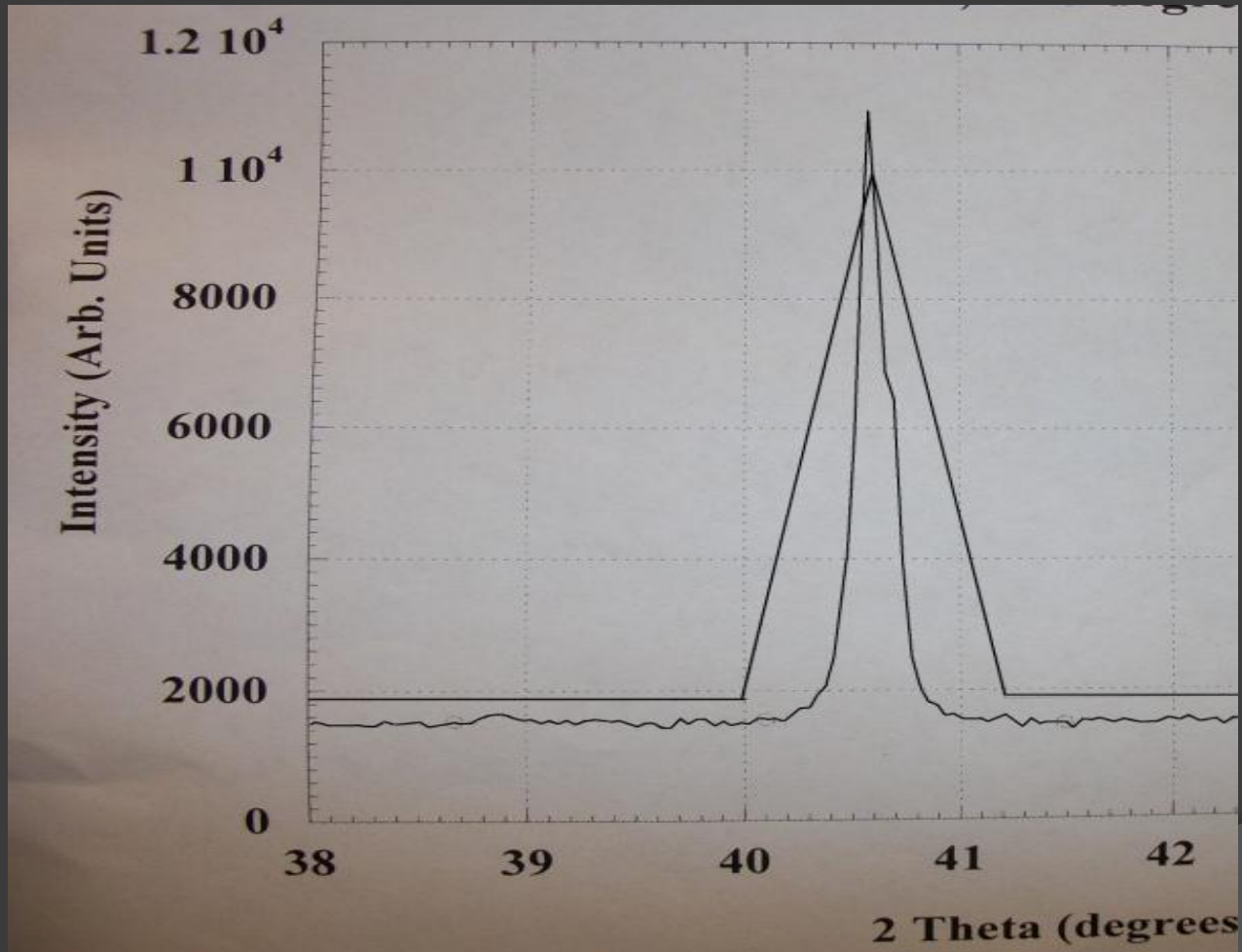
# Results: Crystallite Size

## ● Scherrer's equation

$$\tau = \frac{K\lambda}{\beta \cos \theta}$$

- $\tau$  is the mean size of the crystallites,  $K$  is the shape factor, usually 0.9,  $\lambda$ , which =1.54 Angstroms, is the x-ray wavelength of the k-alpha radiation of the copper x-ray target,  $\beta$  is the (FWHM) width of the peak at half the maximum intensity in radians and  $\theta$  is the angle in degrees where the peak is located.

# Results: Crystallite Size Cont.



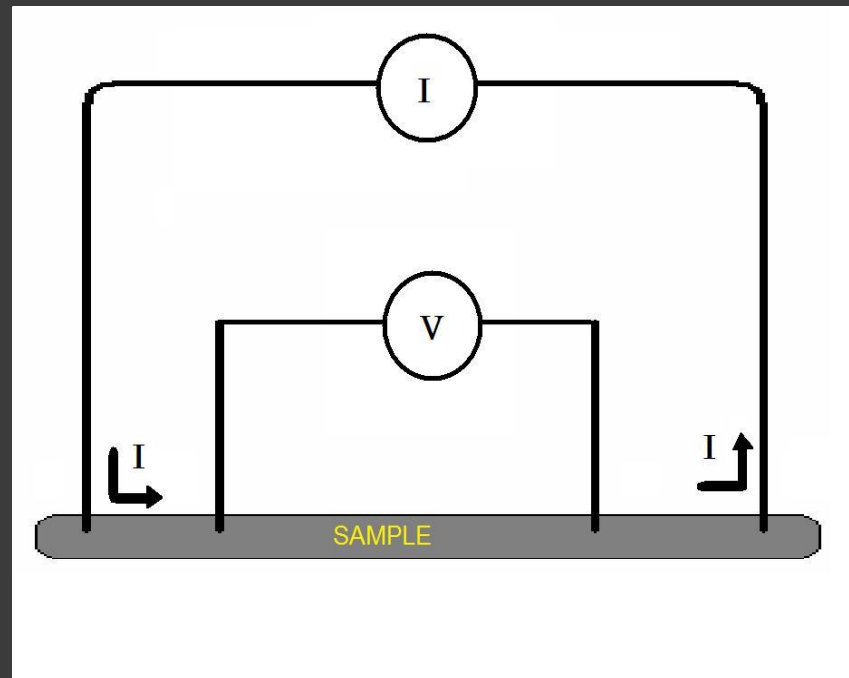
# Results: Crystallite Size Cont.

<b>Peak Position La<sub>0.5</sub>Sr<sub>0.5</sub>Mn<sub>1-x</sub>Ru O<sub>3</sub> For x=0</b>	<b>Peak Position Sintered Sample #062911</b>	<b>% Difference</b>	<b>Crystal Size (Angstroms)</b>
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# Results: Resistivity

- Four Probe method

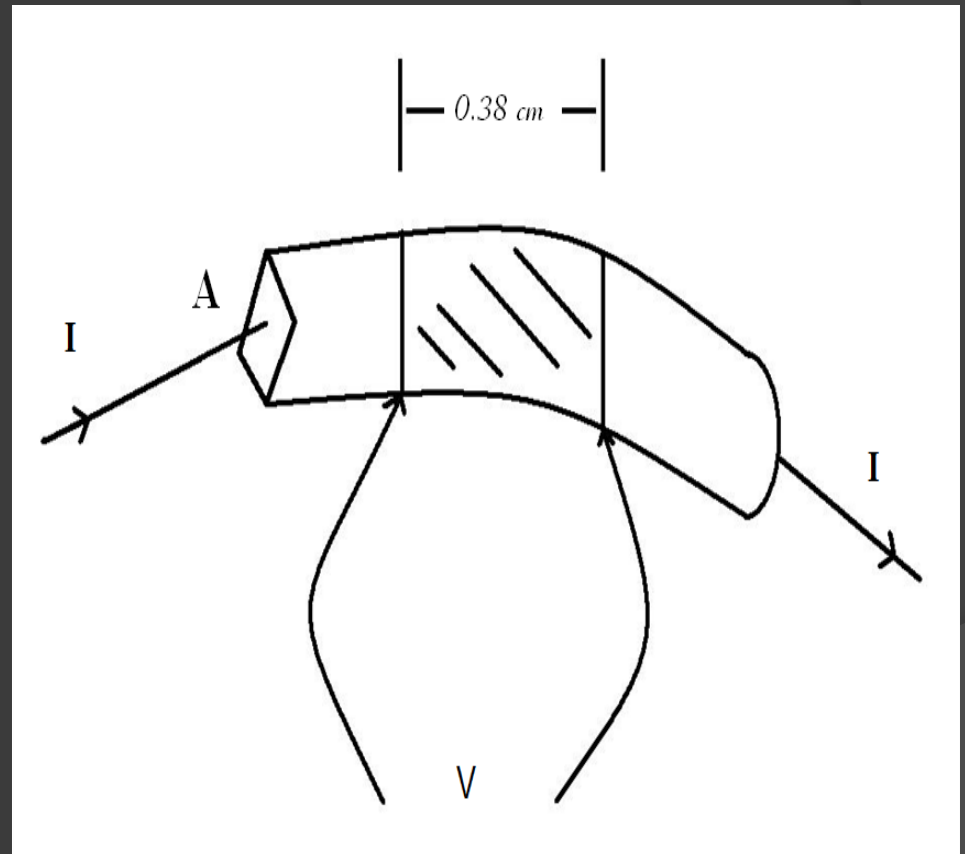
$$R = \frac{V}{I}$$



# Results: Resistivity

$\rho = \frac{RA}{l}$ , where  $\rho$  = Resistivity,  $A$  = cross sectional area and  $l$  = length

$$\begin{aligned}\rho &= \frac{RA}{l} = \frac{(0.11 \Omega)(0.011 \text{ cm}^2)}{(0.38 \text{ cm})} \\ &= \frac{0.0021 \Omega \cdot \text{m}}{0.38} = 3.18E^{-3} \Omega \cdot \text{m}\end{aligned}$$





# Results: Physical Characteristics

- Low Resistance
- Paramagnetism



# Conclusions and Future Work

- Synthesis was successful
- Future work for this project includes the development of a suitable method to produce nanoparticles. The PI plans to investigate and modify the magnetic and charge transport properties of the nanoparticles.

# Acknowledgements

- LA-SiGMA REU Program
- National Science Foundation
- Department of Physics at Southern University and A&M College
- Dr. E. Walker and Scott Wicker for help with the XRD component
- Dr. Laurence L. Henry who was my mentor for the project.

# References

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# Questions



# Thank You



Behold The Green and Gold