Growth of $AMnT_2$ (A= Sr, Ba; T= Sr, Bi) Single Crystals

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Introduction

- My research is about growing single crystals. The goal of my research is to learn the process of making single crystals. We have attempted to grow $BaMnBi_2$, $BaMnSb_2$, $SrMnBi_2$, and $SrMnSb_2$. With the resultant product, we further identified their phases using the X-ray diffraction technique. Their physical properties were measured as well.

Background

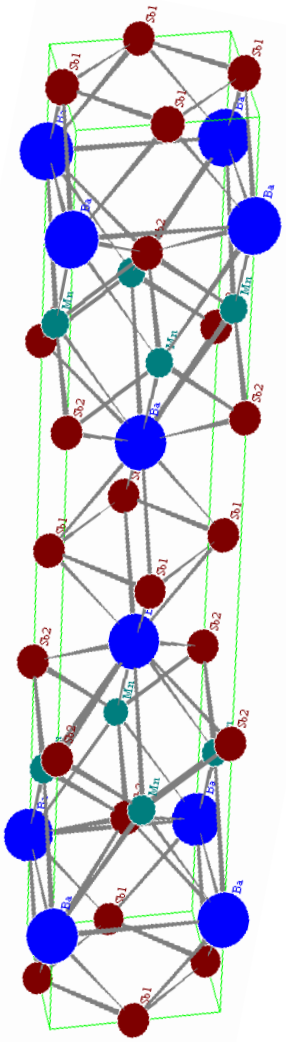
- Topological insulators are a new type of material that have an insulating bulk and conducting on the surface.
- Topological insulating properties were first discovered in the compound Bi_2Se_3.
- Although topological insulators may help make quantum computers, there is not enough information about their properties.
- We aim at studying a new set of materials to help learn how topological insulators work.

Crystal Structures

- Structure: tetragonal

$BaMnSb_2$

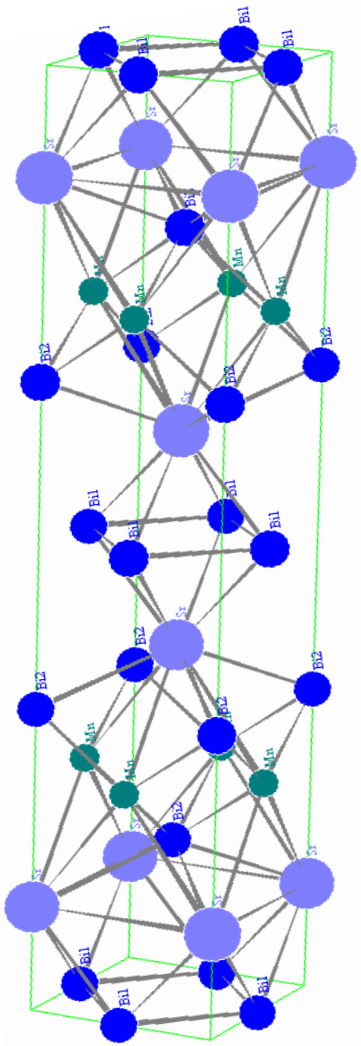
- Ba
- Mn
- Sb



- Structure: tetragonal

$SrMnBi_2$

- Sr
- Mn
- Bi

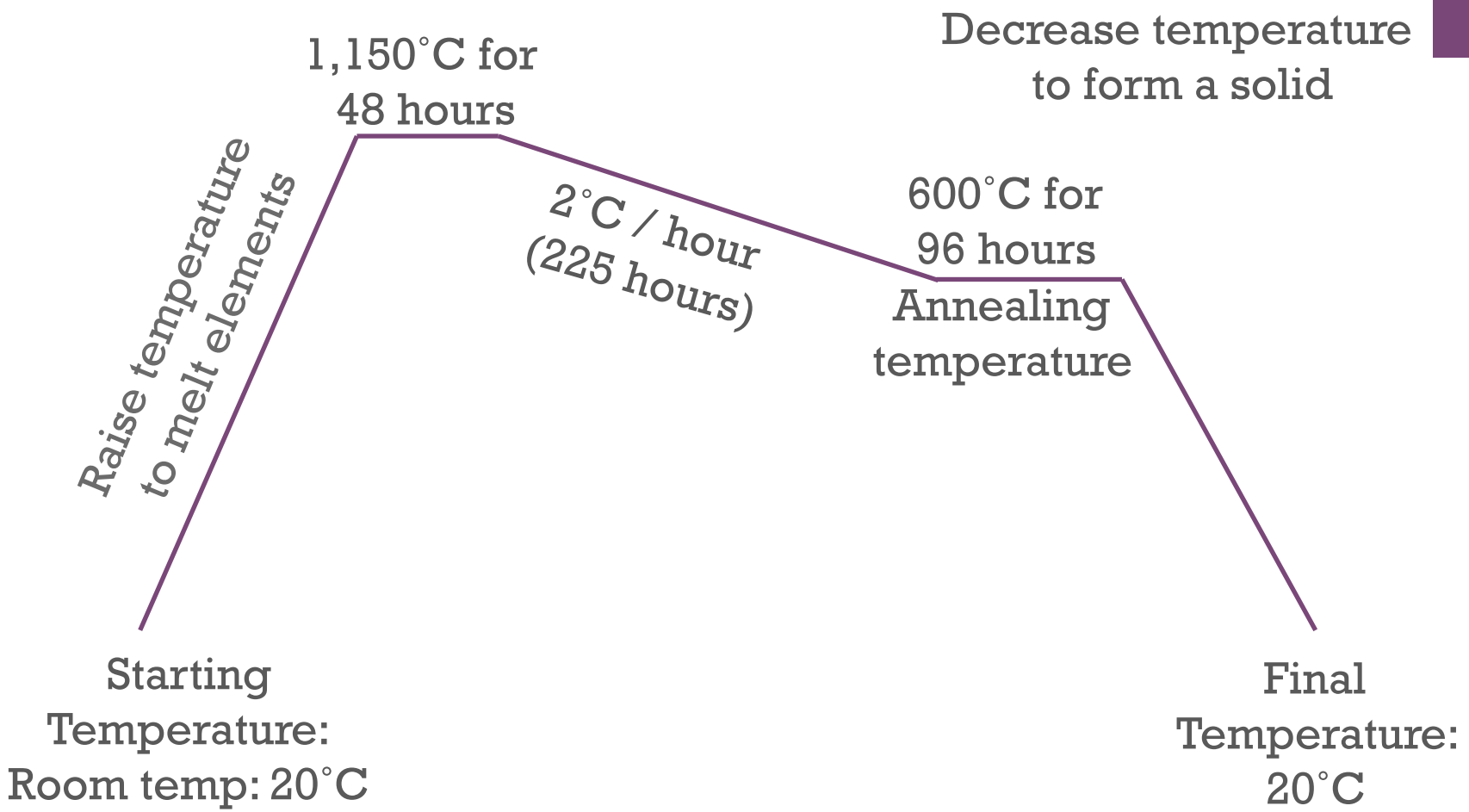


Procedure to Make Crystals

- We use the self-flux method to make samples. The following is the detailed information:
  - Measure out starting material
  - Mix starting materials with an appropriate ratio
  - Put mixture in a crucible
  - Create the seal on the bottom of the quartz tube
  - Put crucible in a tube, and make a neck
  - *Create a vacuum in the tube (15 mTorr)
  - Seal tube at the neck
  - Put in tube furnace and compute the program

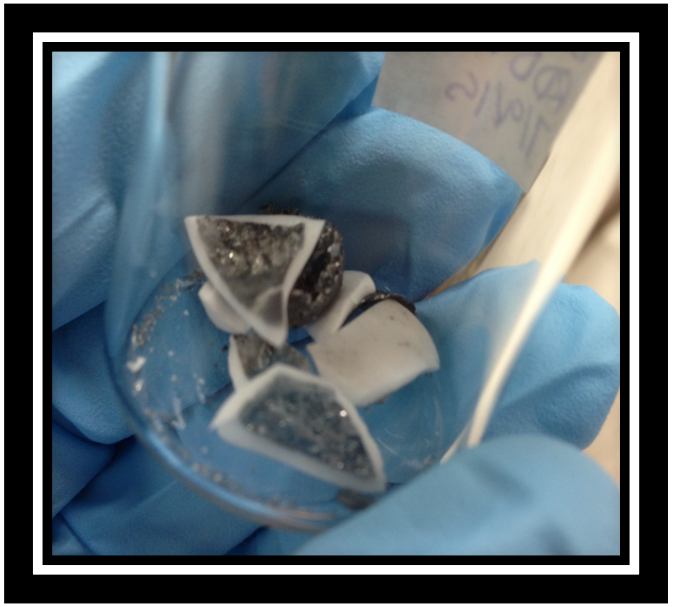
Neck

Furnace Program



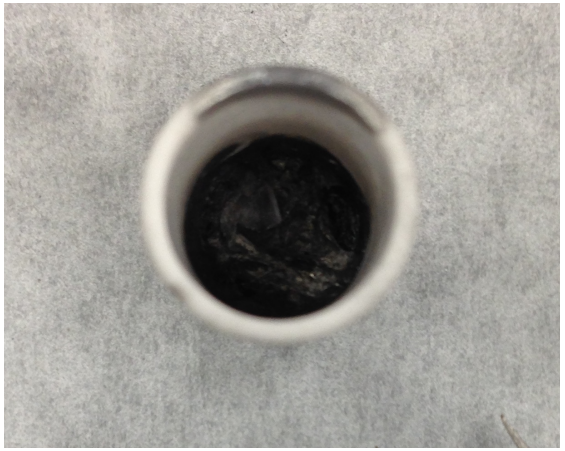
Results of Crystal Growth

- Negative: $BaMnBi_2$ and $SrMnBi_2$ evaporated in the tube while in the tube furnace
- Positive: $SrMnSb_2$ did not evaporate
- Positive: $BaMnSb_2$ came out as the right phase



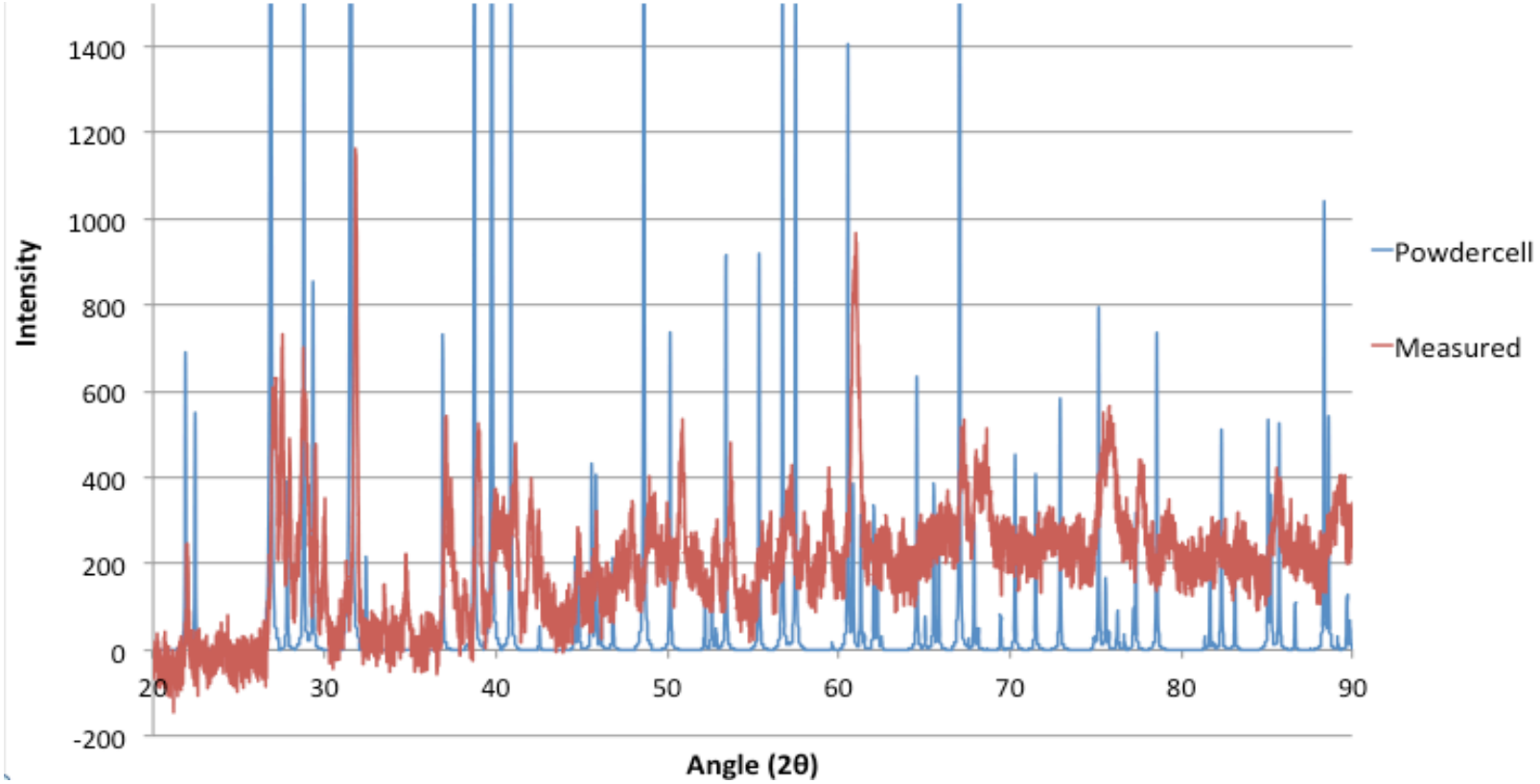
$BaMnSb_2$

$SrMnBi_2$



$SrMnSb_2$

X-ray Diffraction $BaMnSb_2$

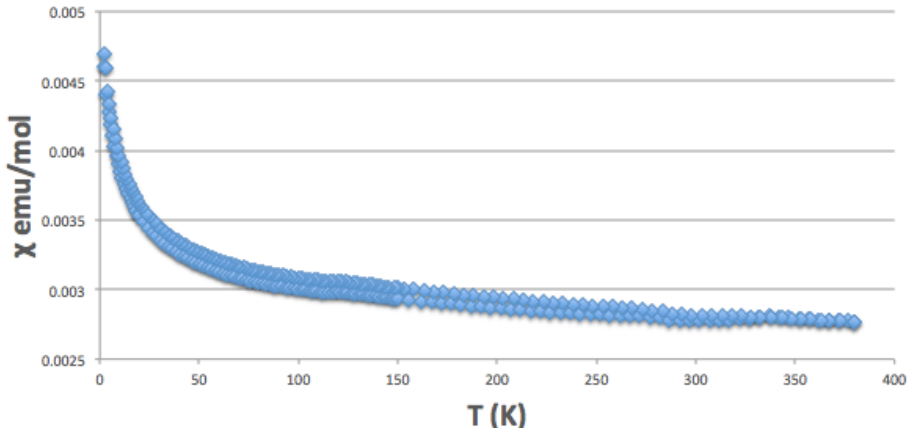


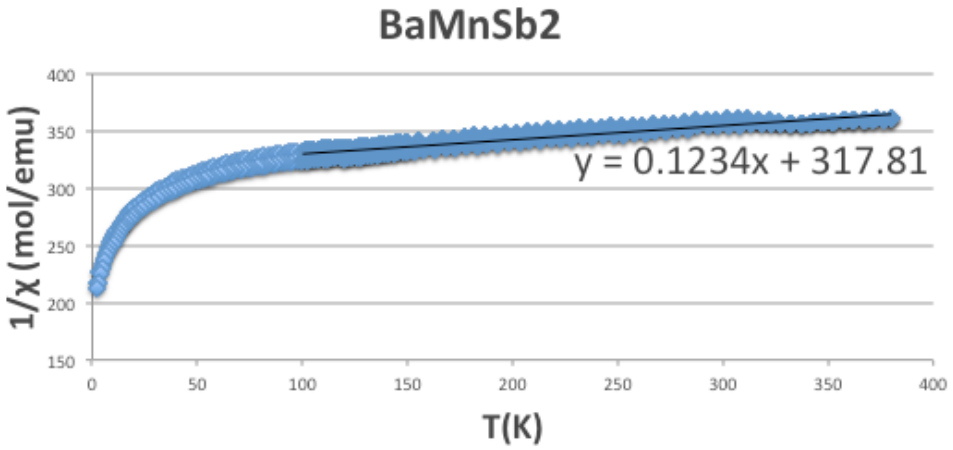
$BaMnSb_2$ came out as a single crystal with some impurities

Magnetic Properties

- Paramagnetic behavior
- No Magnetic Ordering

- Curie-Weiss Law
- $\chi = \frac{C}{T - T_c}$
- C= 8.18
- T_c= - 2599





Summary

- We have tried to make four new materials
- How it came out:
  - $BaMnSb_2$ came out as a single crystal
  - $BaMnBi_2$, $SrMnBi_2$, and $SrMnSb_2$ did not come out as the right phase
- For the future: come out with all single crystals

Acknowledgments

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References

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