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

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Abstract

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 will further identify their phases using the X-ray diffraction technique. Their physical properties will be measured as well.

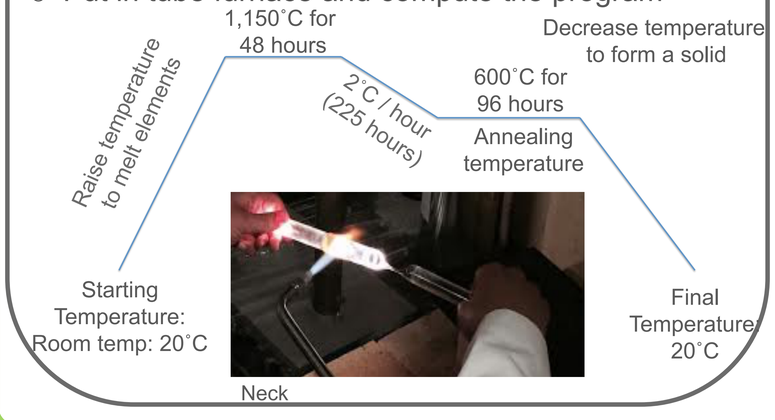
Background

- 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.

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 tubes
- 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

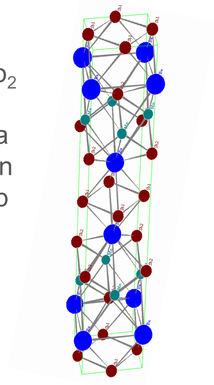


Crystal Structures

Structure: tetragonal

$BaMnSb_2$

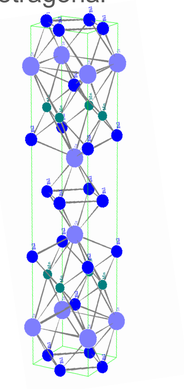
- Ba
- Mn
- Sb



Structure: tetragonal

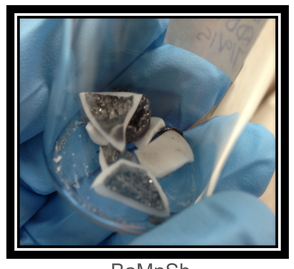
$SrMnBi_2$

- Sr
- Mn
- Bi



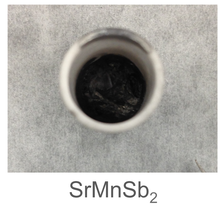
Results of Crystal Growth

- The pictures below show the outcome of the 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, but as $BaMn_2Sb_2$
- $BaMnSb_2$ came out as the right phase but there were impurities: $BaMn_2Sb_2$



$BaMnSb_2$

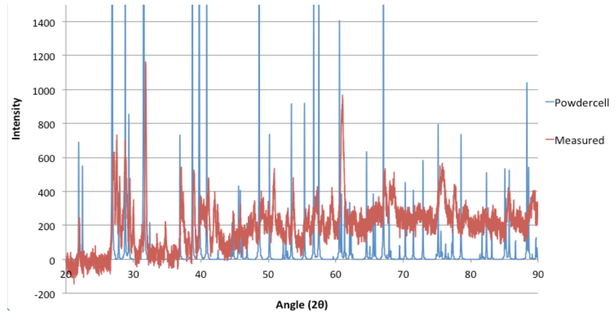
$SrMnBi_2$



$SrMnSb_2$

X-ray Diffraction

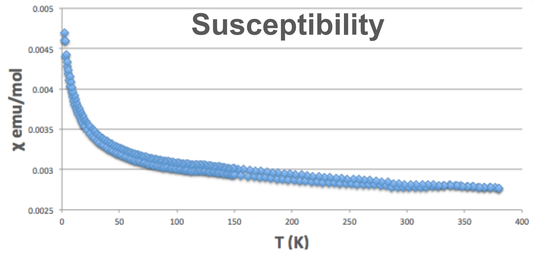
$BaMnSb_2$

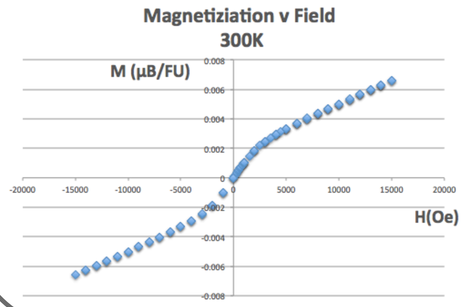


$BaMnSb_2$ came out as a single crystal with some impurities

Magnetic Properties

- Paramagnetic behavior
- No magnetic ordering





- Very small magnetic moments
- *S* shaped graph, due to Mn impurities

Summary

- We have tried to make four new materials
- How it came out:
  - $BaMnSb_2$ came out as a single crystal, but with impurities
  - $BaMnBi_2$, $SrMnBi_2$, 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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