Growth of Topological $Bi_{2-x}Sb_xSe_3$ Single Crystals

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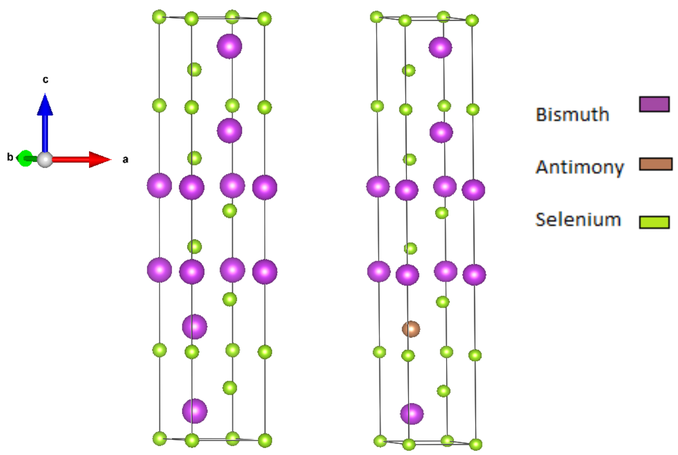
Abstract

In order to study the topological properties of $Bi_{2-x}Sb_xSe_3$, we need to grow high quality single crystals. These high quality single crystals allow us to measure the crystal's conducting outer layer and insulating inner bulk. This type of structure is characteristic of a topological insulator.

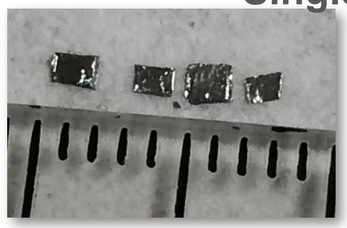
Introduction

Topological insulators have been the attention of many condensed matter studies recently. One such crystal is Bi_2Se_3. My research is to grow and analyze such crystals with different doping of antimony, $Bi_{2-x}Sb_xSe_3$, to see how its physical properties change with doping using the self flux method.



Bi_2Se_3 $Bi_{1.64}Sb_{0.36}Se_3$

Single Crystals

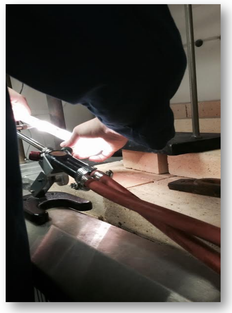


Bi_2Se_3

$Bi_{1.64}Sb_{0.36}Se_3$

Procedure

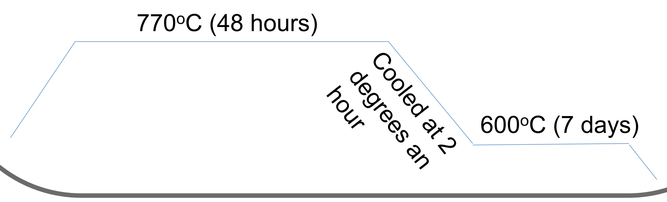
- Weigh starting materials with appropriate ratio
- Mix the starting materials
- Put the mixture in crucible and seal in silica tube (15mTorr)



Sealing

Sealed

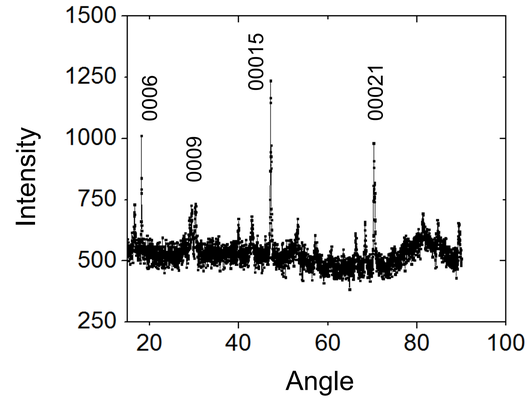
- Use a box furnace to cook and anneal



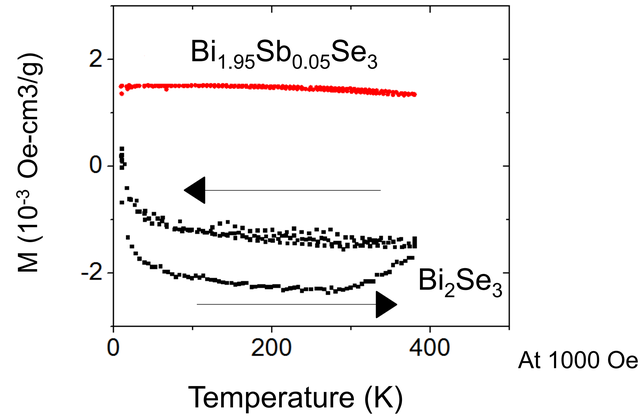
Summary

- We have successfully grown $Bi_{2-x}Sb_xBi_3$ single crystals with different doping levels
- The temperature dependence of magnetization shows that $Bi_{2-x}Sb_xSe_3$ is paramagnetic
- The field dependence of magnetization at 2 K indicates that there is some ferromagnetic interaction at low temperatures

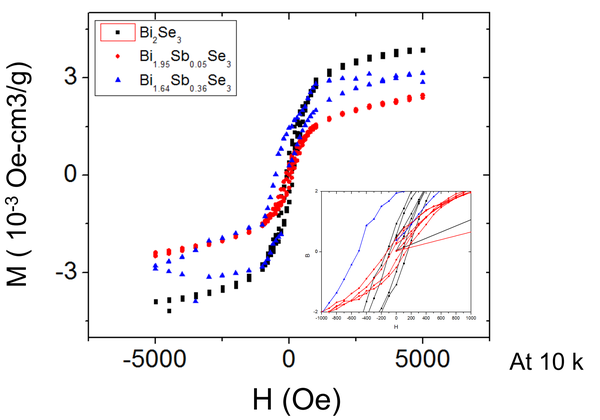
Properties



- X-ray Diffraction



- Bi_2Se_3: diamagnetic, hysteretic
- $Bi_{1.95}Sb_{0.05}Se_3$: paramagnetic



- Bi_2Se_3: no hysteresis
- $Bi_{1.95}Sb_{0.05}Se_3$ and $Bi_{1.64}Sb_{0.36}Se_3$: hysteretic

Acknowledgements

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