Exploring Fe_2P Crystal Structures

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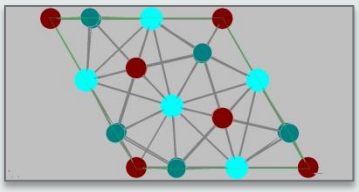
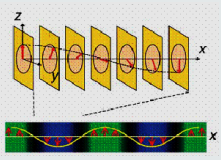
Project Context

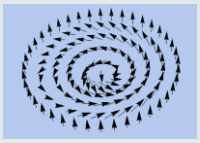


The Fe_2P crystal structure, a non-centrosymmetric lattice structure, may provide powerful insight into the properties of helimagnets. By synthesizing some of these ternary compounds we hope to produce helimagnetic ordering within materials capable of yielding skyrmions when subjected to a magnetic field

Helimagnets have an ordering that traces a helix



Skyrmions creates a magnetic vortex lacking hysteresis



Synthesis

Arc Melting By sealing a chamber with Argon, a large electrical potential creates a plasma arc capable of melting and combining the materials very quickly

Manganese proved to be a challenge because of it's low vaporization point and tendency to oxidize

RF Induction A 100 kHz alternating current driven through a work coil provides a controllable power supply to heat the sample

Eddy currents produced within conductors allow volatile powders to be combined while minimizing sample loss

Sample Annealing Once a sample is prepared, it must be allowed to anneal. A sample is sealed inside an evacuated quartz tube and then placed inside a box furnace. Enough heat is applied to allow the sample enough thermal energy to rearrange itself into the correct phase. Once this process is complete, the sample is then quenched to seal the sample into the achieved phase.

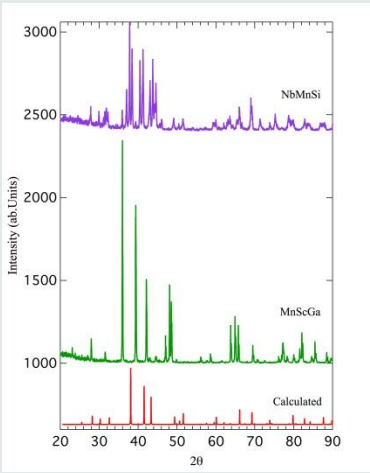
Measurement

X-Ray Diffraction

XRD is a reliable method to test for the Fe_2P lattice structure in our samples

By comparing the diffraction pattern of our powdered sample to a model generated from a software program, a visible comparison can be graphed

Both samples displayed to the left show many unrecognized peaks generated, relaying yet another confirmation to the difficulty in synthesizing these elusive compounds



SQUID The superconducting quantum interference device measures magnetic and electric properties of materials at various temperatures

Future Work

Once a repeatable process has been established for each compound and XRD is used to confirm their purity, samples will be tested for their magnetic susceptibility inside the SQUID.

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Acknowledgments

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