Synthesis and Characterization of $GdMn_6Ge_6$

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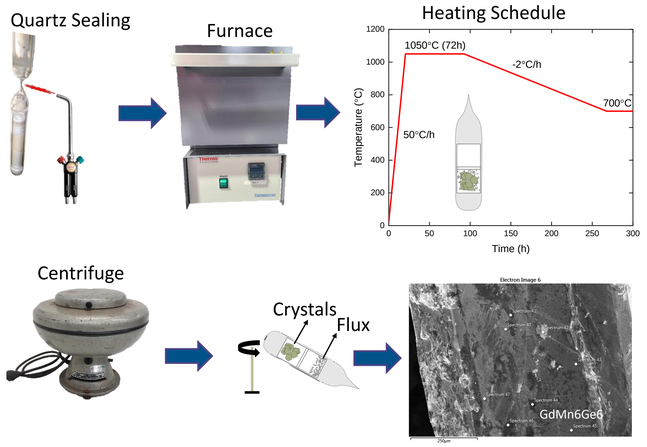
Introduction

Previous reports on $GdMn_6Ge_6$ have demonstrated its magnetic complexities with respect to the unique Kagome lattice structure [1]. To fully understand its magnetic ground state, we synthesized high-quality single crystals of $GdMn_6Ge_6$ using the molten metal flux growth technique and investigated the properties of these crystals.

Molten Metal Flux Growth



(1)

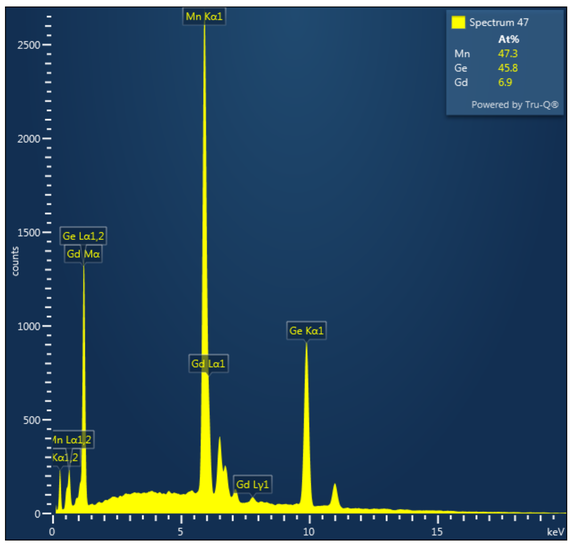
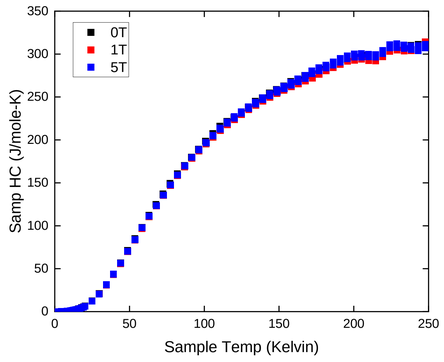


Figure (1) Characterization and identity of $GdMn_6Ge_6$

Heat Capacity

(2A)



(2B)

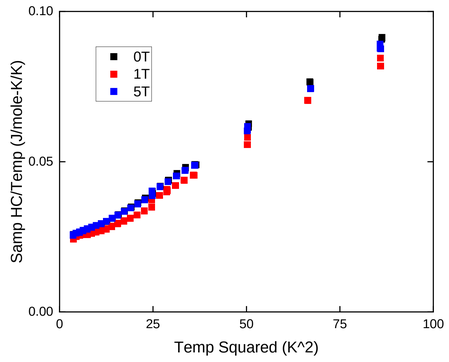
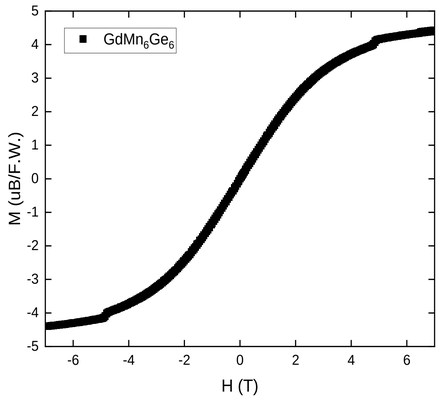


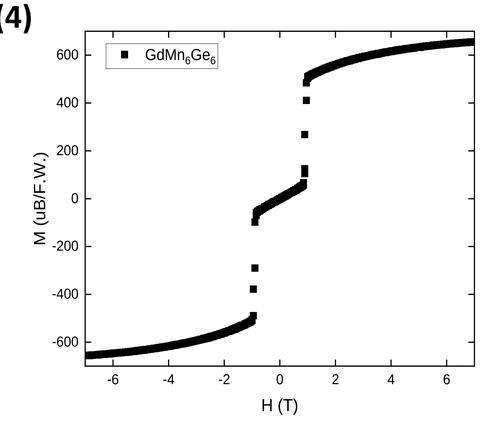
Figure (2A) Heat capacity measurement of $GdMn_6Ge_6$. (2B) Heat capacity of $GdMn_6Ge_6$ over temperature in Kelvin squared. The black, red, and blue squares represent 0 Tesla, 1 Tesla, and 5 Tesla respectively.

Magnetization

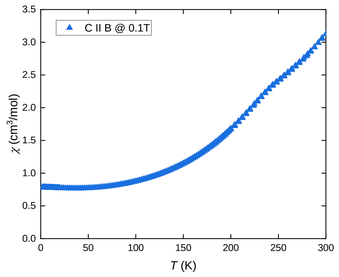
(3)



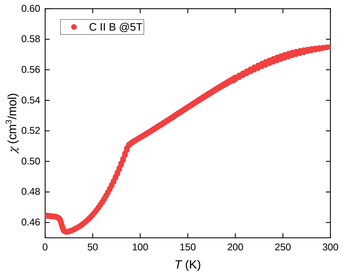
(4)



(5)



(6)



(7)

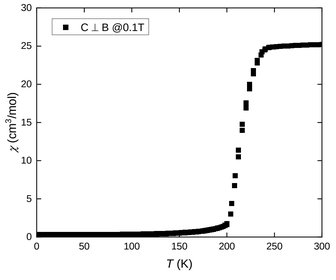


Figure (3) Magnetization measurement of $GdMn_6Ge_6$, (4) Magnetization measurement in a more intense magnetic field, showcasing the "Devil's Staircase" phenomena [2]. Figure (5) Temperature-dependent magnetization *c*-axis parallel to *b*-axis at 0.1 Tesla, (6) temperature-dependent magnetization *c*-axis parallel to *b*-axis at 5 Tesla, (7) temperature-dependent magnetization *c*-axis perpendicular to *b*-axis at 0.1 Tesla for compound $GdMn_6Ge_6$.

Powder X-Ray Diffraction

(8)

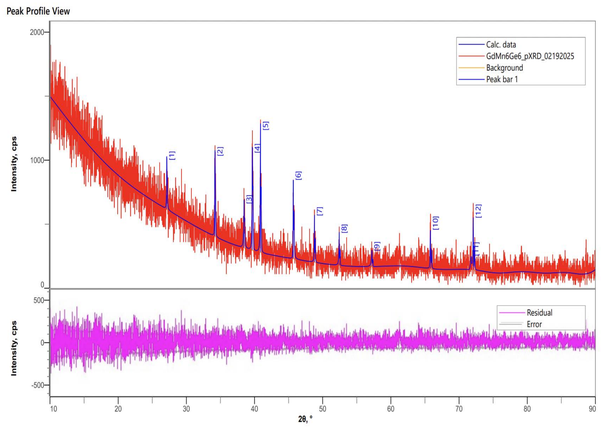


Figure (8) Powder X-Ray Diffraction revealing Kagome lattice structure and further proof of the identity of $GdMn_6Ge_6$.

Discussion and Conclusions

- Structural characterizations were done using Energy-Dispersive Spectroscopy and X-ray diffraction techniques.
- Magnetic properties measurements as well as heat capacity properties measurements were performed along different crystallographic directions of the single crystals.
- No significant phenomena such as the "Devil's Staircase" occurred in heat capacity measurements.

Acknowledgements

I would like to acknowledge and express my gratitude to the Student Council for Undergraduate Research and Creativity (SCURC), the Honors Program, and Scholarship Committee at Florida State University for funding travel expenses.

References

[1] Rösch, et al. J. Magn. Magn. Mater. 164, 175-182 (1996).

[2] Chen, et al. Phys. Rev. B 96, 014421 (2017).

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-2128556 and the State of Florida.