

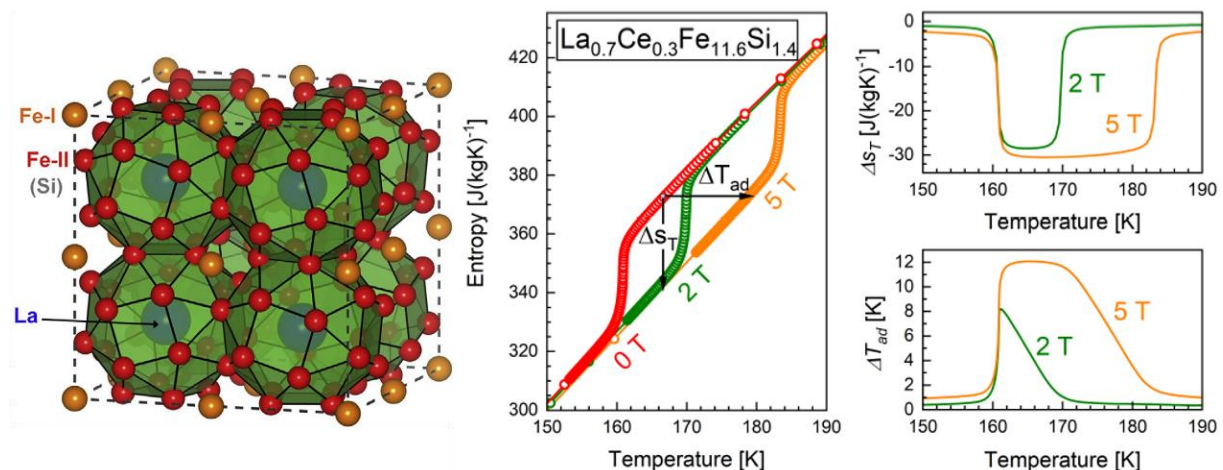
Offer for Bachelor / Advanced Research Lab / Master Topic

Title: $\text{La}(\text{Fe},\text{Si})_{13}$ -based compounds for magnetocaloric cooling at room and cryogenic temperatures

Magnetocaloric cooling is a promising technology for enabling a carbon-neutral, energy-efficient, and sustainable future [1]. Among the leading materials in this field are $\text{La}(\text{Fe},\text{Si})_{13}$ -based compounds, which are notable for their versatility, offering potential for applications at both room [2] and cryogenic temperatures [3]. This broad operating range is achieved through elemental substitutions at the La and Fe sites, as well as the introduction of interstitial atoms.

In this project, the student will synthesize $\text{La}(\text{Fe},\text{Si})_{13}$ -based compounds and optimize their chemical composition, synthesis routes, and magnetocaloric properties. The work will involve a variety of characterization methods to evaluate phase purity, (micro)structure, and magnetic and magnetocaloric behavior. Depending on the student's interests and experimental outcomes, the focus may shift toward either room-temperature or cryogenic applications.

- [1] K. Klinar, J. Y. Law, V. Franco, X. Moya, and A. Kitanovski, Adv. Energy Mater. 14, 2401739 (2024)
- [2] N. P. Weiß, U. Rocabert, C. Hoppe, J.-P. Zwick, K. Loewe, M. Fries, A. J. Karttunen, O. Gutfleisch, and F. Muench, ACS Appl. Eng. Mater. 3, 256 (2025)
- [3] B. Beckmann, L. Pfeuffer, J. Lill, B. Eggert, D. Koch, B. Lavina, J. Zhao, T. Toellner, E. E. Alp, K. Ollefs, K. P. Skokov, H. Wende, and O. Gutfleisch, ACS Appl. Mater. Interfaces 16, 38208 (2024)



Skills and expertise to be gained:

- **Synthesis Techniques:** Experience with induction, arc melting, and hydrogenation
- **Structural Characterization:** X-ray Powder Diffraction (XRD) at room temperature
- **Microstructural Characterization:** Scanning Electron Microscopy (SEM)
- **Magnetic Characterization:** Use of a Vibrating Sample Magnetometer (VSM)
- **Magnetocaloric Performance:** Entropy change calculations and heat capacity measurements

Supervisor: Dr. Benedikt Beckmann

Contact: Dr. Sagar Ghorai, sagar.ghorai@tu-darmstadt.de

Documents required for application:

1. Current CV
2. Up-to-date transcripts of Bachelor and (if available) Master semesters