FB 11 Materialwissenschaft
FG Funktionale Materialien
Prof. Dr. Oliver Gutfleisch
oliver.gutfleisch@tu-darmstadt.de
Peter-Grünberg-Str. 16
64287 Darmstadt
www.mawi.tu-darmstadt.de/fm

Bachelor/ Advanced Research Lab

Synthesis and characterization of $SmCo_4B$-based compounds

It is expected that $SmCo_4B$ exhibits the highest anisotropy field (H_a) with an estimated value of 90 T [1] at 300 K among intermetallic compounds. In this work, **(1) the first aim** is to synthesize $SmCo_4B$ samples in ball-milled powder form and in single crystal form (for ARL) to measure first time their anisotropy field with vertical single coil turns up to 100 T (Tokyo) and with non-destructive pulse coil up to 60 T (Dresden), respectively. The initial results will be obtained up to 14 T in our lab. As depicted in Figure 1, the preliminary results of ball-milled $SmCo_4B$ have already highlighted the significant magnitude of H_a. In this study, we will reduce the particle size through a systematic ball-milling experiment aimed at enhancing the signal-to-noise ratio for measuring vertical single coil turns. On the other hand, for non-destructive pulse coil measurement, a large single crystal is necessary (for ARL).

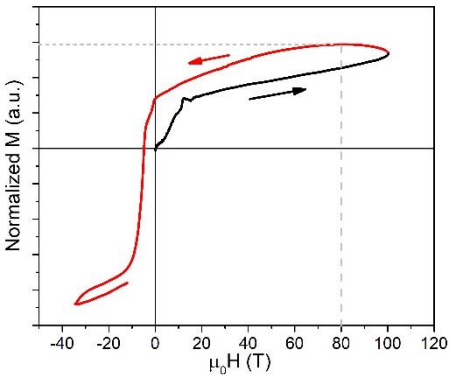

Fig. 1 *M-H* curve of SmCo4B powders which is obtained from vertical single coil turns.

Besides the extremely high anisotropy field, $SmCo_4B$ exhibits low saturation magnetization of 0.4 T. **(2) The second aim** is to tackle this problem by composition tunning. For this purpose, $SmCo_{3.8}Fe_{0.2}B$, and $Sm_{0.7}Nd_{0.3}Co_{3.8}Fe_{0.2}B$ will be synthesized and a similar procedure which is described above will be followed to determine their intrinsic magnetic properties such as saturation magnetization, anisotropy field and Curie temperature.

Ref: H. Ido, H. Ogata, and K. Maki, Magnetic characteristics of the $Sm_{1-x}PrxCo_{4-y}Fe_yB$ system, *J. Appl. Phys.* vol. 73, pp. 6269-6271, 1993.
H. Ido, O. Nashima, T. Takahashi, K. Oda, and K. Sugiyama, New magnetic material based on SmCo4B, *J. Appl. Phys*., vol. 76, pp. 6165-6167, 1994.

Expertise to be gained:

- Learning about **the magnetic materials for aerospace and satellite communication applications and scientific literature search**
- Powder sample preparation → **arc melting, induction melting and high-energy ball milling**
- Structural analysis → **X-ray powder diffraction**
- Microstructure analysis → **Scanning electron microscopy (SEM)**
- Magnetic characterization → **PPMS magnetometer**
- Gaining experience in reporting the result in manuscript format

Supervisors: Dr. Pelin Tozman, Co-supervisor: Dr. Alex Aubert

Contact: Dr. Fernando Maccari - fernando.maccari@tu-darmstadt.de