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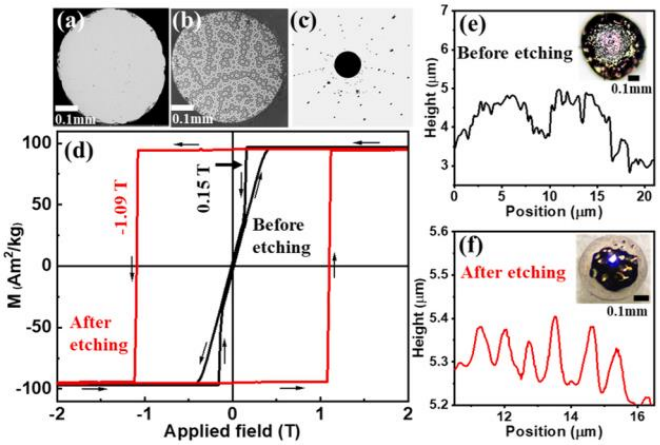
Advanced Research Lab / Hiwi / Master thesis

Title: Investigations of single crystal hard magnets

For the successful implementation of permanent magnets (PMs) in the growing green energy sector and in high-temperature applications, high coercivity is a crucial property that must be achieved. However, the current values of coercivity obtained for various PMs are still significantly lower than the theoretical upper limit, generally reaching only 25 % of its intrinsic potential. This discrepancy is known as Brown's paradox, which is still a crucial topic in current PM studies. To overcome this threshold and meet the increasing demand for higher coercivity magnets in various applications, it is imperative to understand the cause of this large difference.

To address this constraint, an effective approach is to employ simple model single crystal objects [1]. Single crystals are regarded as the simplest entities and ideally lack grain boundaries, exhibiting a single phase, and eliminating the grain size effect entirely. Thus, they serve as excellent model objects for studying surface defects and their impact on coercivity. This study will be focused on the synthesis and characterization of various single crystal hard magnets (Nd-Fe-B, Sm-Co-Cu etc.).



[1] Zhang *et al*, JALCOM. **993**, 174570 (2024)

Expertise to be gained:

- Learning about processing technology to make single crystals
- Experience on relevant powder metallurgy processes, including alloy/powder preparation → induction melting, heat treatment, electro chemical polishing
- Room temperature structural characterization → X-ray diffraction (Laue) (XRD)
- Microstructural analysis → Scanning Electron Microscopy (SEM)
- Magnetic characterization → Vibrating Sample Magnetometer (VSM)

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Bachelor-, ARL and Master-works are always possible in the field of functional magnetic materials:

- *Permanent magnets*
- *Magnetocaloric materials*
- *Magnetic sensors, dampers, actuators*
- *Biomedical application of magnetic particles*