INSTITUT NEEL Grenoble

Proposition de stage Master 2 - Année universitaire 2022-2023

Combinatorial studies of hard magnetic materials

General Scope:
The demand for high performance magnets is continuously growing, in particular for the green energy transition (windmills, (hybrid)-electric-vehicles, electric bicycles) but also for robotics. The present reliance on critical rare earth (RE) elements in such magnets is not sustainable. The high throughput thin film combinatorial approach (Fig. 1) holds much potential to explore the use of substitutional elements, so as to reduce dependence on critical RE elements [1]. The experimental data sets generated in such studies can serve as input in the emerging field of machine-learning-led magnet development.

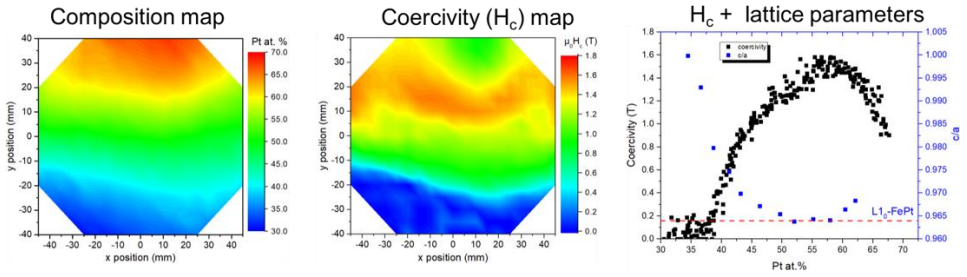

Figure 1: Composition and coercivity maps of compositionally graded Fe-Pt films, dependence of coercivity and lattice parameters on composition

[1] Y. Hong et al., J. Mater. Res. Technol. 18 (2022) 1245 doi.org/10.1016/j.jmrt.2022.03.055.

Research topic and facilities available:
This internship concerns the high throughput fabrication and characterization of thin film libraries of hard magnetic materials. Compositionally graded RE-TM based films will be fabricated by sputtering. The influence of composition and post-deposition annealing conditions (temperature and time) on both structural and magnetic properties will be explored using high throughput scanning characterization techniques. Composition will be characterized by Energy Dispersive X-Ray analysis in a scanning electron microscope, crystal structure by X-Ray Diffraction and magnetic properties will be probed using an in-house developed scanning polar Magneto-Optic Kerr effect system. More detailed structural (SEM imaging of microstructure) and magnetic (M(H,T)) characterization will be carried out on select samples. Experimental data sets will be analyzed to search for trends in the evolution of both intrinsic and extrinsic properties.

Possible collaboration and networking: This internship will be carried out in the framework of a collaboration with the group of Prof. Thomas Schrefl at the Christian Doppler Laboratory for magnet design by machine learning (Danube Unviersity Krems, Austria).

Possible extension as a PhD: Yes

Required skills: Materials science / condensed matter physics, experience with coding (python) for data analysis would be very useful

Expected start of internship: February 2023

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