The

goal of this Master project is to create high-quality magnetic films, that exhibit a nanometer scale depth dependence of their composition and thus a depth dependence of their microscopic magnetic properties, such as exchange coupling constants or magneto-crystalline anisotropy. Such film structures exhibit non-uniform magnetization states by design, which leads to relevant modifications of their magnetic phase transitions and associated to that, their efficiency for magnetic refrigeration. Indeed, we recently demonstrated that nano-scale materials design enables the management of phase transitions in a far broader sense than otherwise feasible, implying broad-based device and general application relevance. The thesis will explore specific aspects of this materials design approach and accordingly, the main goals of this work are to:

i. study and identify suitable fabrication conditions for such thin films
ii. fabricate high-quality magnetic films with designed non-uniform depth profiles
iii. characterize their magnetic behavior, in particular their phase transitions
iv. analyze how non-uniform designs impact their magnetic refrigeration efficiency

These goals are not only of substantial scientific, but also of technological interest because already today, key technologies are based on magnetic films with non-trivial depth structures, and associated device operations typically include phase transitions. Modern fabrication techniques, such as the Ultra High Vacuum Sputter system at CIC nanoGUNE, allow for the precise fabrication of such films, in which different ferromagnetic layers can be deposited and manipulated with sub-nm precision while maintaining single-crystal structural control.

In the first part of the Master project, different ferromagnetic alloy films will be fabricated. Subsequently, their magnetic properties and states will be measured and classified by using a superconducting quantum interference device (SQUID). The project will involve the fabrication and characterization of samples as well as the analysis of experimental results. Some prior knowledge of solid-state physics and ferromagnetism will be beneficial but is not a prerequisite.

Description of the research group:

The **nano-magnetism Group** at CIC nanoGUNE is conducting world-class basic and applied research in the field of magnetism in nano-scale structures. The Group staff has a longstanding expertise and proven track record in fundamental and applied aspects of nano-magnetism.

Application:

If you are a (prospective) master student and you are interested in this project, please get in touch with the scientist in charge: **Andreas Berger (a.berger@nanogune.eu).**

To apply for a

master position fill in the form below and follow the instructions and recomendations of the general call (**open until 30 June 2023**).

NOTES:

(i) All applicants will receive an answer after the end of the selection process; but please note that due to the large number of submissions that are expected, we cannot provide individual feedback.

(ii) Additional information about nanoGUNE's commitment towards *HR excellence in Research and Gender Equality* *are available on our website.*

(iii) We encourage you to subscribe to our *HR mailing list* *to receive information related to nanoGUNE's open positions and open calls for different training and talent attraction programs.*