CIC nanoGUNE
nanoscience cooperative research center

SUMMER INTERNSHIPS 2017

TITLE: "Seeing" ferromagnetism

DESCRIPTION (Objectives, tasks, materials, equipment…):

Magnetism and more precisely ferromagnetism is an important physical property that some materials (such as iron, for instance) exhibit. The importance of ferromagnetism is hereby given by its relevance in applications (such as digital data storage, wind converters and position sensors, to name a few) as well as its role in fundamental science, because ferromagnetic states and properties are an excellent testing ground for studies of quantum mechanics and thermodynamics. They are furthermore an important field of material science and experimentation, and very sophisticated measurement techniques have been developed to study ferromagnetism.

One such instrument is the experimental MOKE (Magneto Optical Kerr Effect) system at nanoGUNE that measures light polarization changes, which are caused by the magnetic properties of materials. This technique allows one "to see" ferromagnetism with light, and more specifically, it enables one to measure the rotation of the light polarization vector that is caused by ferromagnetism. Instruments such as the MOKE system at nanoGUNE are capable of measuring polarization vector rotations as small as 10-8 radians, which approximately corresponds to "seeing" a one-cent coin lying flat on the ground in Donostia by looking at it from Bilbao. The goal of the present internship project is to utilize one of our MOKE set-ups, a so-called Generalized Magneto-optical Ellipsometer (GME), for the purpose of performing ferromagnetic characterizations of novel electronic materials.

The project will consist of two parts. In the first part, the GME set-up will be used to perform measurements on magnetic thin film, multilayer, and nano-structure samples (also produced in our labs). This work may also include modifications of the experimental set-up and control software to run these novel experiments (LabView programming platform). In the second part, the experimental results will be analyzed so that quantitative data for different materials can be extracted. This part will include data analysis programming, the use of commercial analysis software and will furthermore benefit from a good understanding of electromagnetism and optics. Knowledge of solid-state physics or advanced quantum mechanics is not required.

References and reading list:

- G. R. Fowles, Introduction to Modern Optics (Dover Publications, INC., New York)
- Z. Q. Qiu, and S.D. Bader, J. Magn. Magn. Mater. 200, 664 (1999)
- A. Berger, and M. R. Pufall, Appl. Phys. Lett. 71, 965 (1997)

SUPERVISOR: Dr. Andreas Berger

SHORT DESCRIPTION OF THE GROUP:

The Nanomagnetism 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, and specifically in the use of magneto-optical methods. The main scientific topics pursued by the Nanomagnetism Group are:

- understanding magnetism and magnetic phenomena on very small length and very fast time scales in systems with competing interactions by means of experiments and theory

- development of advanced methodologies and tooling for magnetic materials characterization at the nanometer-length scale and the picosecond-timescale (especially magneto-optics)

- design, fabrication and characterization of novel nanometer-scale magnetic structures, meta-magnetic materials, thin films and multilayers

- novel concepts for applied magnetic nano-scale materials

More info: http://www.nanogune.eu/nanomagnetism

TIMETABLE: to be determined

COMMENTS: Internship duration from 1.5 to 2 months (to be discussed).
Applicants should send an email to jm.pitarke@nanogune.eu including their academic record.
More info: http://www.nanogune.eu/summer-internship
Deadline for applications: 5 February 2017

SUITABLE FOR: physicists, materials scientists, engineers, chemists