M2 internship

Superferrimagnetism as a new magnetization pinning mechanism in nanomagnets

Context of the study:

Hard nanomagnets are promising building blocks for new spintronic devices and high capacity data storage systems. However, their synthesis is hindered by the low thermal stability of their magnetization. In order to overcome this technological bolt, one needs to find efficient magnetization-pinning mechanisms. Superferrimagnetism occurs when a magnetic grain is antiferromagnetically exchange-coupled with a surrounding shell. The reversal of the inner grain magnetization costs an additional energy contribution owing to the formation of a magnetic domain wall in the shell. This principle has been recently proposed to increase the hardness of bulk NdFeB-based permanent magnets. Applied to nanomagnets, it could be a promising way to overcome thermal stability related issues.

Description of work:

This internship is mainly focused on the experimental investigation of the superferrimagnetism on nanomagnets. It will first consist in the synthesis of MnBi nanoclusters in the chemically-ordered LTP-MnBi phase, by Low Energy Cluster Beam Deposition (LECBD). The structure and magnetism of the nanoparticles will be explored using electron microscopy and SQUID magnetometry. Once the intrinsic properties studied, MnBi nanoparticles will be deposited on a thin Fe layer, supposedly coupled antiferromagnetically. The influence of the interfacial coupling will be investigated using advanced magnetization measurements and simultations.

This work is intended to lead to a thesis with the support of SHAMAN ANR, a collaboration between iLM, Néel Institute and ESRF at Grenoble.
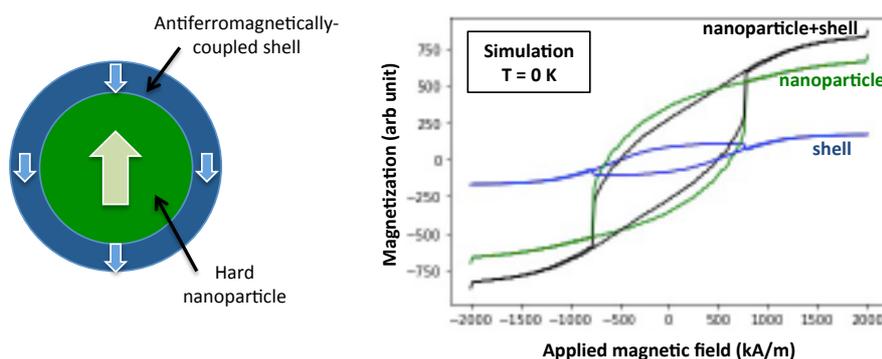

Figure : (left) schematics of a superferrimanetic nanoparticle, (right) simulated magnetization curves based on extended Stoner-Wolhfarth model.

Research group : 'Magnetic Nanostructures' group
Supervisors: Damien Le Roy damien.le-roy@univ-lyon1.fr
                     Véronique Dupuis veronique.dupuis@univ-lyon1.fr