


**Internship proposal 2009-2010**

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**Elaboration of composite materials based on magnetic nanowires for the fabrication of permanent magnets.**

The chemical synthesis techniques have made such progress nowadays that it is now possible to produce nano-objects with complex shapes, in particular nanowires with very well defined shapes. The high aspect ratios of these objects give them remarkable magnetic properties: the coercivity of Co wires can be larger than 1T. This motivates their incorporation in composite materials for the fabrication of permanent magnets based on 3d metals rather than rare-earths. The difficulty is to be able to achieve a controlled dispersion of the wires in a matrix polymer.

We propose to use the technique of Small Angle Neutron Scattering (SANS) to study these composites materials. We propose in particular to study the alignment and the possible aggregation of the magnetic wires as a function of the alignment procedure (amplitude and modulation of the applied magnetic field). SANS is well suited for the study of these anisotropic systems because it is easy to perform in-situ measurements. This has already been successfully performed for silicon oxide particles composites (for applications in mechanical reinforcement).

The obtained composite materials will then be magnetically characterized both by conventional magnetometry measurements (VSM –SQUID) and SANS.

A more detailed study using contrast variation could give information on the interactions between the surfactants grafted on the wires and the polymer chains in the matrix in order to better understand the exact dispersion mechanism.

The work will be supervised both by an expert in magnetism and a polymer physicist of the Laboratoire Léon Brillouin.

This work will be supported by the ANR MAGAFIL whose objective is the study and elaboration of composite magnetic materials. This network gathers ITODYS (Univ. Paris Diderot) which is specialized in the synthesis of magnetic nanowires, the LPMTM (Univ. Paris XIII) which provides an expertise in metallurgy and the LPCNO (INSA Toulouse) which provided both an expertise in chemical synthesis and high resolution TEM imaging.

**Techniques in use :**

**Small Angle Neutron Scattering**

**Magnetic measurements (SQUID – VSM) – Micromagnetic calculations**

**Applicant skills : ready to invest in a multi-disciplinary approach to tackle the problem**

<b>Granted internship :</b>	<b>yes</b>
<b>C'nano IdF laboratory (France only) :</b>	<b>yes</b>
<b>Possibility for a thesis :</b>	<b>yes (type of grant : BDI, if accepted)</b>