MASTER DE CHIMIE DE PARIS CENTRE - M2S2
Proposition de stage 2023-2024
Internship Proposal 2023-2024

Parcours type(s) / *Specialty(ies) :*

☒ Chimie Analytique, Physique et Théorique / *Analytical, Physical and Theoretical Chemistry* :
☐ Chimie Moléculaire / *Molecular Chemistry* :
☐ Chimie et Sciences Du Vivant / *Chemistry and Life Sciences* :
☒ Chimie des Matériaux / *Materials Chemistry:*
☐ Ingénierie Chimique / *Chemical Engineering:*

Laboratoire d'accueil / *Host Institution*

Intitulés / *Name* : MONARIS
Adresse / *Address* : Faculté des Sciences et Ingénierie, Sorbonne Université, 4 Place Jussieu, 75005 Paris
Directeur / *Director (legal representative) :* C. Petit
Tél / *Tel* : 01 44 27 29 06
E-mail : christophe.petit@sorbonne-universite.fr

Equipe d'accueil / *Hosting Team :* NARCOS

Adresse / *Address :* MONARIS
Responsable équipe / *Team leader* : A. COURTY, L. BELLOT-GURLET
Site Web / *Web site :* http://www.monaris.cnrs.fr/
Responsable du stage (encadrant) / *Direct Supervisor :* Isabelle Lisiecki
Fonction / *Position :* Directrice de recherche
Tél / *Tel* : 01 44 27 20 21
E-mail : isabelle.lisiecki@sorbonne-universite.fr

Période de stage / *Internship period* * : 31 Janvier 2024 (5 mois)

Titre / *Title*

Synthesis of maghemite nanoparticles with tunable size, shape and surface chemistry. Temperature profile in nanomagnet based hyperthermia devices

Projet scientifique (1 page maximum) / *Scientific Project (maximum 1 page):*

1. Description du projet / *Description of the project*

Magnetic hyperthermia consists in converting electromagnetic power into heat by applying an external AC magnetic field to an assembly of magnetic nanoparticles (NPs). A very localized temperature rise is then observed, which can be useful in medicine or chemistry, especially catalysis. However, although very promising, this technique is not mature yet and, in order to be developed and extended, some fundamental aspects must be clarified. In particular, the role of NP concentration and thereby of the dipolar interaction has to be investigated in a systematic way. The NanoHype project (ANR) implements a global approach, from multiscale theory to innovative experiments, aiming at understanding how to control and optimize the temperature profile within magnetic nanoparticle assemblies of different concentrations.

* min. 5 mois à partir du 30 janv 2023 / *min. 5 months not earlier than January, 30st 2023.*
Fin de stage au plus tard le 13/07/2023 ou le 29/09/2023 (dates de validation de diplôme). / *End of internship at the latest July 13, 2023 or Sept. 29, 2023 (dates of graduation).*

The proposed Master study focusses on the synthesize of maghemite NP by using the thermal decomposition of organometallic precursor. The aim will be to control the shape from spherical to cubes and tetrahedra of the particles, which size will be around 10 and 15 nm. The ligands used to passivate the particles will be octanoic, dodecanoic and oleic acids. Although maghemite NPs with different shapes have been synthesized with the olecic acid as passivative ligands, the novelty of this study is the synthesis of different shapes maghemite NPs with otanoic and dodecanoic acids.
In order to study the dipolar interactions between NPs, assemblies with different concentrations in NPs (ferrofluids) will be prepared. In addition, colloidal crystals (isolated 3D ordered NP assemblies) will be performed, offering a system with strong dipolar interactions. These colloidal crystals will be prepared by a co-evaporation method with a mixture of ethanol/hexane (well mastered in MONARIS lab). This project is shared between the Sorbonne University and Paris-Saclay University. This project is funded by the ANR (Agence Nationale de Recherche) with industrial partners as well.

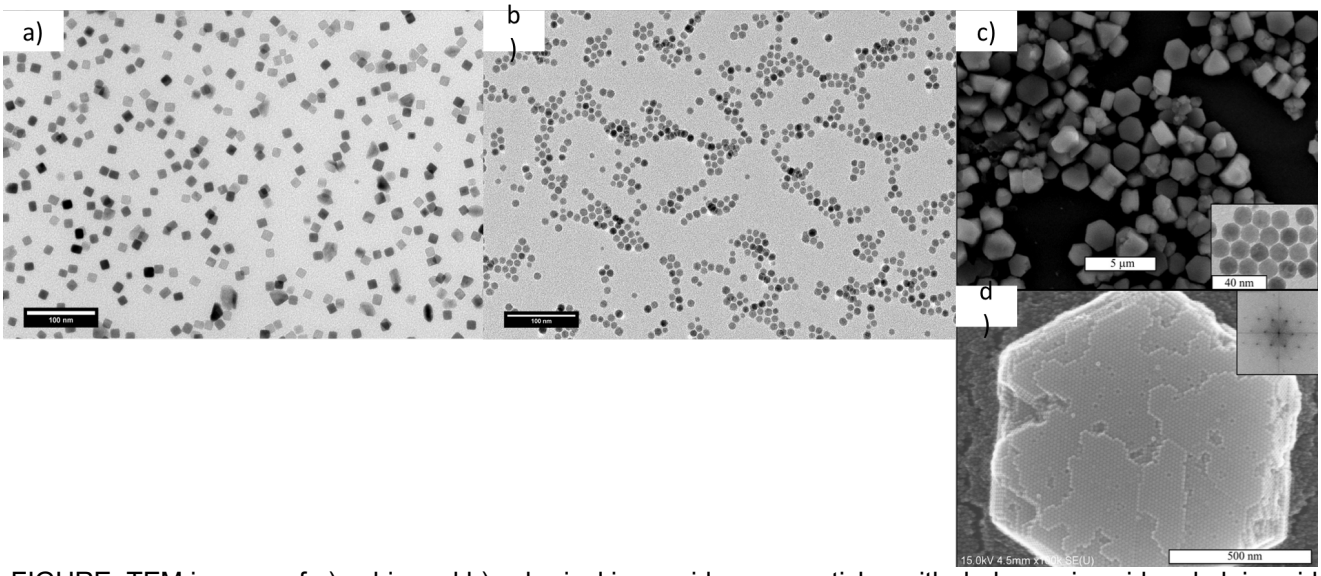

FIGURE: TEM images of a) cubic and b) spherical iron oxide nanoparticles with dodecanoic acid and oleic acid as the capping ligand, respectively. c) SEM and d) SEM-FEG images of colloidal crystals formed from spherical iron oxide nanoparticles.

2. Techniques ou méthodes utilisées / *Specific techniques or methods*

- The maghemite NPs will be synthesized by the thermal decomposition of organometallic precursors.
- They will be characterized by transmission electron microscopy (TEM) and X-ray diffraction.
- The colloidal crystals will be studied by small-angle X-ray scattering (SAXS).

3. Références / *References*

- I. Lisiecki et al."***Formation of colloidal crystals of maghemite nanoparticles: Experimental and theoretical investigations."*** *Colloids and Surfaces A 560 (2019) 270–277.*
- Zhou, Zijian, et al. "**Anisotropic shaped iron oxide nanostructures: controlled synthesis and proton relaxation shortening effects**." *Chemistry of Materials* 27.9 (2015): 3505-3515.
- Kovalenko, Maksym V., et al. "**Fatty acid salts as stabilizers in size-and shape-controlled nanocrystal synthesis: the case of inverse spinel iron oxide**." *Journal of the American Chemical Society* 129.20 (2007): 6352-6353.