

Master 2 internship proposal

Nanoparticles of metal oxides for medical imaging and therapy: targeting of pathologies thanks to biological molecules

Laboratory

Laboratory ICB UMR 6303 CNRS-UBFC – Nanosciences Dpt./BH2N – Mirande, wing C, 4th floor
BH2N's team leader: nadine.millot@u-bourgogne.fr, +333 80 395 937, <https://icb.u-bourgogne.fr/en/bh2n-en/>

Internship supervisors

Julien BOUDON, PhD; Lionel MAURIZI, PhD; Nadine MILLOT, Prof.

Contact information

julien.boudon@u-bourgogne.fr, +333 80 395 942; lionel.maurizi@u-bourgogne.fr, +333 80 396 142

Scientific background

The subjects proposed range from the elaboration of nanoparticles to their surface modifications by organic molecules of interest, notably in collaboration with the regional center for cancer ([Center Leclerc CGFL](#)), the [Bio-PeroxIL](#) laboratory, the [Vivexia](#) firm and with the Institute of Molecular Chemistry ([ICMUB](#)). The objective of this internship is the improvement of both the diagnosis and the treatment of various pathologies (cancer in particular but also neurodegenerative diseases and infections) by new nanotechnologies. For several years, our team has been synthesizing nanoparticles of metal oxides. Its know-how has led to the development of nanohybrids as biological nanovectors and contrast agents. On the other hand, the team and the laboratory are very well equipped in characterization techniques and have access to a [medical imaging platform](#) thanks to the CGFL.

Description of the scientific project

The idea is to develop a common functionalization approach for different types of nanoparticles (oxides of Fe or Ti or Ta) by controlling the number of active molecules on the surface of nanoparticles. It will also control the grafting and stabilization provided by the intermediate functionalization layers on the surface of inorganic cores (linkers or polymers). In addition, the grafting of active molecules (synthesized at ICMUB) on these nanoparticles will also be treated. Based on advances and in collaboration with biologist colleagues, *in vitro* studies on cell lines (cytotoxicity tests) will be considered.

Required skills of the candidate

We are looking for a Master 2 student with a profile of chemist, especially in inorganic chemistry and with a knowledge and interest in organic chemistry, an experiment in nanoparticle synthesis being preferable. The candidate must have good communication skills to be able to work collaboratively on a subject between inorganic and organic chemistries. The internship will cover two parts: an inorganic aspect concerning the synthesis of nanoparticles and an organic aspect required for the surface modification of nanoparticles. The characterization of nanohybrids will be an important part of the internship. Therefore, the following characterization techniques should be known, at least theoretically: TGA (possibly coupled to MS), UV-visible spectroscopy, FTIR and Raman, XPS, TEM, XRD, DLS, Zetametry, electrophoresis, HPLC(-MS). Candidates will have to read the scientific literature of the subject (see below to get started).

Funding opportunities for a PhD thesis: European project (EuroNanoMed), ANR project, Graduate school EIPHI

Bibliographical references

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3. Influence of surface charge and polymer coating on internalization and biodistribution of PEG-modified iron oxide nanoparticles, L. Maurizi, A.L. Papa, L. Dumont, F. Bouyer, D. Vandroux, P. Walker, N. Millot, [J. Biomed. Nanotechnol.](#) **11**, 126–136 (2015)
4. Titanate nanotubes: towards a novel and safer nanovector for cardiomyocytes, A.-L. Papa, L. Dumont, D. Vandroux, N. Millot, [Nanotoxicology](#) **7** (6), 1131 (2013)
5. The radiosensitization effect of titanate nanotubes as a new tool in radiation therapy for glioblastoma: a proof-of-concept", C. Mirjolet, A.-L. Papa, G. Créhange, G. Truc, P. Maingon, N. Millot, [Radiother. Oncol.](#) **108**, 136 (2013)