



2019-2020



Master thesis proposal

NIMBE-LIONS CEA Saclay
Director: Antoine THILL

Title: Magnetotactic bacteria in a micro-container

Keywords: microfluidics - bacteria - biomineralization

Scientific description: Some single cell micro-organisms such as magnetotactic bacteria synthesize and organize nanocrystalline structures, the magnetosome chain, in physiological environment with a degree of control far superior to that obtained by chemists using harsh conditions (high temperature/pressure and organic solvents). This so-called biomineralization typically involves transport of minute amounts of chemicals (femtograms) from the labile pool to intracellular compartments in which they are crystallized and organized.

The development of encapsulation methods using microfluidics allows single cell trapping and dynamic monitoring of physiologically relevant amount of chemicals (fg) to be contained at concentrations (μM) typically far exceeding the detection limit of conventional analytical techniques. In addition, environments with a similar size to that of the bacteria can be produced such that the morphology of the cell and its intracellular organization can be altered. Such processes can be analyzed with high throughput and in parallelized studies.

The successful candidate will contribute to the design, the microfabrication, and the optimization of the microsystem, to the measurement campaigns and to the data analysis. Especially he/she will determine the influence of the chemical and the physical environment on the nucleation and organization of the magnetosomes at the single cell level. Microfluidics and correlative quantitative microscopy techniques will be used to this effect. A special emphasis is laid on interdisciplinary research so that close collaboration with scientists working on chemical, biological and physical aspects of biomineralization and biomimetics of magnetic assemblies will be expected.

The candidate will work at LIONS (CEA Saclay) but he/she will be in close collaboration with the biologists from the BIAM (CEA Cadarache). A stay in Cadarache to learn about cell culture is possible.

Techniques/methods in use: Microfabrication, microfluidics, cell culture, optical/fluorescence microscopy

Applicant skills: We are seeking a student with a background in chemistry, biophysics, biotechnology, or physics. Skills in microfluidics, analytical chemistry, and fluorescence microscopy are appreciated. Programming skills and CAD design would be a plus. Good knowledge in English, reliability and self-motivation are required.

Paper to read before the interview

D. Faivre, T. Ukmar Godec, From Bacteria to Mollusks: The Principles Underlying the Biomineralization of Iron Oxide Materials, *Angew. Chem. Int. Ed.*, 54 (2015) 4728-4747.

Duration: 5-6 months

Starting date: February 2020

Localization: LIONS at CEA Saclay Gif sur Yvette France.

Industrial partnership: N

Internship supervisor(s):

Dr. Florent Malloggi : florent.malloggi@cea.fr

Dr. Damien Faivre : damien.faivre@cea.fr

Internship location: LIONS CEA Saclay, Gif sur Yvette

Possibility for a Doctoral thesis: N

