Master 2 Internship (Stage de M2) in Physics or Chemistry 2019

Laboratoire : Institut de Biologie Structurale
Directeur : Winfried WEISSENHORN

Intitulé de l'équipe : Microscopie Électronique et Méthodes **Responsable :** Guy SCHOEHN
Nom et Qualité du Responsable du Stage : Dr. Wai Li LING, **i**n collaboration with Dr. Peter REISS in CEA, Grenoble
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Parcours de Master 2 en Physique:

Complex matter living matter
Nanophysics
Photonics and semiconductors
Materials for energy
Medical physics

Or

Parcours de Master 2 en Chimie:

Chemistry for Life Sciences (CLS)
Organic Synthesis (SOIPA)

Subject title : *Cryo-Electron diffraction and microscopy of novel nanoparticles*

Objectives:
We aim to characterize beam-sensitive nanoparticles (NPs) with cryo-electron microscopy (cryo-EM). We will obtain high resolution images and diffraction patterns of quantum dots (QDs) and nanocrystals of halogenated perovskites. We will also adapt programs for analyzing X-ray diffraction patterns for the analysis of electron diffraction patterns.

Pedagogical interests and skills:
In this project, the student will learn the technique of cryo-EM, including sample preparation, high resolution imaging and powder electron diffraction. The student will interact with Dr. Reiss group, which produces the NPs to understand the role of structural characterization in the syntheses and functions of the nanoparticles.

Summary:
This project uses cryo-EM, a technique generally applied in biology, to study the structure of nanoparticles (NPs) sensitive to radiation damage. These studies aim to understand the internal structure of the NPs and to better guide their synthesis process.
Nanoparticles such as QDs and perovskite nanocrystals are developed in the laboratory of our collaborator Dr. Peter Reiss at CEA, Grenoble. The applications of QDs as biosensors are based on functionalization of QDs by organic compounds, such as, for example, antibodies. Conventional X-ray techniques, commonly applied to study NPs, do not allow access to the organization in individual NPs, which governs their functional properties.
In addition to imaging, we will use electron diffraction to probe the crystalline structure of NPs. The multi-scale structural information will provide us with important information for optimizing the synthesis and functionalization of NPs.

Approach and Methods:
We will adapt cryo-EM to obtain high resolution structural information from NPs. We will focus on QDs without Cd based on functionalized InP and CuInS2, as well as on the emerging class of nanocrystals of halogenated perovskites without Pb ABX3 (A: Cs +, B: M2 +, X: Cl, Br, I). Computer tools will be developed to analyze the powder diffraction obtained with the electrons and the results will be compared to X-ray diffractograms to ensure consistency of structural characteristics observed globally and locally.

Domain of competence of candidate:
Image treatment and analysis, interests in electron microscopy, diffraction, nanoparticle synthesis and applications, knowledge in Python will be a big plus.