ITI HiFunMat Master Internship Proposal

☒ M 1 ☒ M 2

Title Understanding Biomineralization from Complex Coacervates (M1 or M2)

Internship supervisor

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Laboratory	CNRS, Institut Charles Sadron
Collaboration with a HiFunMat member (*please indicate their name*)	☒ No ☐ Yes :

Student profile looked for

Master program (*more than one box can be ticked*)	☒ Material science and engineering ☐ Chemistry ☒ Physics
Other indications if necessary	Physical chemists, polymer or materials scientists and engineers are encouraged to apply. Experience in polymer physical chemistry, crystallization, or microscopic characterization is a plus.

Internship description

Context

Polyelectrolyte complex coacervates, obtained via liquid-liquid phase separation of oppositely charged polyelectrolytes, are ubiquitous in nature, from membraneless organelles in biological cells to the underwater glue of sandcastle worms [1,2]. Membraneless organelles, also known as biomolecular condensates, are immiscible droplets rich in biomacromolecules (e.g. proteins) and play key roles in many cell functions. Among other functions, complex coacervates were recently reported to play a role in biomineralization, that is, the formation of inorganic minerals regulated by living cells [3]. Little is known about the relationships between the formation, structure, and properties of biominerals as a function of the different parameters of the cellular microenvironment.

Our group recently found the formation of highly regular dendritic patterns of salt crystals upon drying thin films of model complex coacervates rich in both salt and polyelectrolytes. Although these patterns were prepared from a model system and under conditions different from those in the physiological environment, studying the parameters controlling their formation and structure is relevant for understanding biomineralization.

Objectives

The goal of the internship is to study the crystallization of salt from different complex coacervate precursors upon drying or in solution. A library of complex coacervates based on various types of organic and inorganic salts will be prepared. The formation and structure of the crystals will be characterized via advanced imaging technics, optical microscopy, and image analysis. The effect of the type and concentration of salt and the concentration of the polyelectrolytes will be investigated. During the course of the internship, the intern may be trained on other characterization technics such as thermogravimetric analysis and rheology.

References [1] Martin, ChemBioChem, *2019*, 20, 2553; [2] Vahdati, et. al, Prog Polym Sci, *2023*, 139, 101649; [3] Krounbi, et.al, Chem Mat, *2021*, 33, 3534.