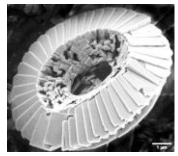

PhD Position

Metal partitioning in coccolith-based calcite and biotechnological applications of metal-functionalized coccolith materials

Project: Coccolithophore microalgae produce a calcite-based biomineral called the coccolith (see above image). These biominerals are biomineralized within a dedicated vesicle, which are then extruded to the surface of the microalgal cell to create a shell [Taylor *et al.*, *Annu. Rev. Mar. Sci.* 2017]. Coccolith materials have diverse morphologies (shape, size, structural features) that are species dependent. Some general features and properties include nanostructured surfaces and high surface area-to-volume (e.g., nanoporosity). Despite the fact that several coccolithophore species can now be cultured regularly and that gram-scale production of coccoliths is feasible [Jakob *et al.*, *Algal Res.* 2018], coccolith materials have made little progress as advanced functional materials in bionanotechnologies. This project aims to identify such possibilities by understanding how technologically-relevant metal ions can be incorporated into or onto coccolith materials that can modify or add an optical or physical property apt for application (e.g., photoluminescence, catalytic activity). First, metal partitioning into coccolith-based calcite with be quantitatively described for several transition metals, main group elements and lanthanides, elucidating the potential of coccolithophore to incorporate certain metal ions into calcite materials via biomineralization. Enhanced metal-doped coccolith materials will then be pursued (for metals that incorporate at higher concentration into calcite) and characterized with materials science approaches to examine optical, crystalline and physical properties. For the second approach, the surface of coccolith materials will functionalized by metal ions via ion-exchange reaction or deposition of metal nanoparticles. Following characterization of surface-functionalized coccolith materials, catalytic CO2 reduction reactions will be tested.

Environment: The project will be conducted in the Molecular and Environmental Microbiology (MEM) team at the Bioscience and Biotechnology Institute of Aix-Marseille (BIAM), located in Cadarache, France. The student will take part in interdisciplinary laboratory tasks including microalgae cultivation, biomaterial purification, mass spectrometry and X-ray/electron/laser-scanning microscopy techniques. The project will involve measurements at synchrotron radiation facilities within France and in Europe with visits to collaborating laboratories within France.

Profile: The candidate must have a Master 2 (or equivalent) in physical chemistry, biological sciences, materials science or analytical sciences with an interest in working with biological systems and biomaterials. Previous training in one or several of the following will be an asset to the project: optical/electron microscopy, optical/atomic spectroscopy, mass spectrometry, (bio-)materials characterization, catalytic chemistry.

Apply: Please send your CV, a letter of motivation and two references to Daniel Chevrier (daniel.chevrier@cea.fr).

MEM group website : https://www.cite-des-energies.fr/biam/recherche/mem/
MEM social media : (Twitter/X @MicroBioMin)
Personal profile : https://www.cite-des-energies.fr/chercheur/daniel-chevrier/

Application deadline May 15, 2024
Start date October 1, 2024