



2023 Master internship at UBO



LAB & PEOPLE

- **Name of the hosting lab:** CEMCA, UMR CNRS 6521
General activities of the lab: Organic chemistry, Electrochemistry, Analytical chemistry, Coordination chemistry
Website: <https://www.umn6521.cnrs.fr/en/>
Number of staff / PhD: 27 professors, assistant professors, CNRS researchers, 8 engineers and technicians, 20-30 non-permanent members (phD and postgraduate students, postdoctoral researchers, Emeritus and invited researchers).
- **Supervisor name and contact:** Dr Mathieu BERCHEL (PhD, HDR), (mathieu.berchel@univ-brest.fr)

TOPIC OF THE INTERSHIP

- Scientific context of the internship (max 20 lines)

Natural or artificial surfaces (ship hulls, sonar devices) submerged in seawater are rapidly colonized by a wide range of organisms from bacteria (microfouling) to invertebrates (macrofouling) resulting in significant economic (energy consumption, corrosion) and environmental impacts (alien species spreading) for marine industries.^{1,2} Till nowadays, numerous strategies have been developed to combat biofouling, mainly chemical methods such as the use of biocide like organotin compounds (TBT). Although being efficient, these antifoulants were banned by the International Maritime organization (IMO) in 2001 because of their high toxicity toward non-target species and their persistence in the aquatic environment.^{3,4} Thus, there is a continuing need for new antifouling compounds.

Recently, the development of amphiphilic zwitterionic materials with antifouling properties have attracted increasing interest due to their potent antifouling activity and low environmental impacts.⁵ Our interest in the synthesis and study of the properties of amphiphilic compounds led us to highlight the promising anti-adhesion properties of some zwitterionic lipids. Indeed, we designed two novel zwitterionic lipids and have demonstrated their antibiofilm activity against various marine bacteria.

This project aims to synthesize a library of amphiphilic compounds in view of a structure-activity study in order to further investigate their potential as antifouling agents against pioneer bacteria responsible for the formation biofilms.

Keywords : antifouling, biofilm, metal complexes, amphiphilic compounds

Bibliography

1. Fitridge I, Dempster T, Guenther J, de Nys R. **2012**. The impact and control of biofouling in marine aquaculture: a review. *Biofouling*. 28, 649–669.

- Schultz MP, Bendick JA, Holm ER, Hertel WM. **2011**. Economic impact of biofouling on a naval surface ship. *Biofouling*. 27, 87–98.
- Cardwell RD, Brancato MS, Toll J, DeForest D, Tear L. **1999**. Aquatic ecological risks posed by Tributyltin in United States surface waters : Pre-1989 to 1996 data. *Environmental Toxicology and Chemistry*. 18, 567–577, 1999.
- Sarti, F., Mezzani, M., Ceccarelli, J., Caligiore, A., **2011**. The management of the effects of navigation on the marine environment: the case of tributyltin (TBT). *Chemistry and Ecology*. 27, 15-23.
- Dai G, Xie Q, Ai X, Ma C, Zhang G. **2019**. Self-generating and Self-renewing Zwitterionic Polymer Surfaces for Marine Anti-biofouling. *ACS Appl. Mater. Interfaces*. 11, 41750-41757.

- **Tasks and duties entrusted to the student:**

Based on our previous results obtained in the field, the student will be responsible for synthesizing new zwitterionic amphiphiles in order to complete a library of compounds to carry out a study of structure-activity relationship study. All new compounds will be purified by chromatography and characterized by Nuclear Magnetic Resonance (NMR) and Infra-Red (IR) spectroscopies. Moreover, amphiphilic compounds will be formulated as liposomes and characterized by Dynamic Light Scattering (DLS) to determine their size, zeta potential and polydispersity. All the skills and technical equipment are available in the laboratory.

- Skills to be acquired or developed

The student will strengthen his skills in organic chemistry and laboratory practice, as well as the techniques for characterizing compounds. The student will be initiated to the formulation of amphiphilic compounds and in the methods used to characterize their supramolecular aggregates formed in aqueous media by Dynamic Light Scattering (DLS).

PROFILE OF THE DESIRED STUDENT

- Minimum level of study required: Master degree
- Field(s) of study: Organic chemistry
- Scientific skills : organic syntheses, analytical method (NMR and IR spectroscopy)
- Language skills required : English

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): 5 months



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Desired Starting date of the mission: February 2023

Indicative weekly schedule: 35h / week

Remuneration: 600€/month, paid on French SEA-EU funds for a maximum of 5 months; additional Erasmus grant could be asked to your own university.

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:

If you're interested please send your CV and letter of motivation to the scientist in charge, mathieu.berchel@univ-brest.fr before the 1st February 2023.