2020-21 M2 Internship proposal at LMGP

Surface adsorption and auto-organisation of naturally "sticky" proteins

Abstract: Adhesive proteins, which are produced naturally by several animals, exhibit exciting properties, as they can stick to hard materials, in air or under-water conditions. Species of the barnacle family (see image) produce a mixture of several proteins that, upon secretion, form a sticky cement, allowing the anchoring of these organisms in suitable habitats. In this way, they are colonizing rocks but also man-made structures such pisciculture cages or ship hulls, where they are a major biofouling burden. Understanding the molecular mechanisms that allow these protein-based, underwater glue properties could be harnessed to develop biological surgical glue alternatives and to control marine biofouling.

Project description: It is known that the cement proteins (cp's) can adsorb and self-organize on surfaces by aggregation into amyloid fibres[1]. On the molecular level, particular amino acid sequences, found repetitively within the cement proteins, are likely to be involved in the surface-dependent aggregation process. It was demonstrated that peptides, representing such repetitive sequences, aggregate *in vitro* into thioflavinT-positive amyloid fibers. Furthermore, sequence alignments of the *Megabalanus rosa* cement protein 19 (Mrcp-19) with its homologs in other barnacles have shown that the N-terminus of this protein presents a 50 aa sequence that is conserved and potentially involved in the establishment of the sticky cement.

Objectives: We propose to further investigate the self-aggregating properties of peptides derived from the sequence of the cement proteins and of Mrcp-19 N-terminal sequence.

Methodology: The peptides will be tested *in vitro* for their surface-dependent aggregation properties using a multiwell plate aggregation assay. A fluorescently labelled version of the peptides has been synthesized and can be used for direct imaging or quantification of surface adsorption. ThioflavinT, a fluorescent conformational protein marker, indicative of amyloid fibs, will be used to monitor the formation of fibers. The influence of material properties on the adsorption of the peptides can be investigated by using surface functionalisations in combination with surface-sensitive techniques, such as surface plasmon resonance.

Scientific environment: The internship will take place at the Laboratoire des Matériaux et du Génie Physique, LMGP (UMR5628) in Grenoble. The project is a collaboration between LMGP, team Interaction Materials Biological Matter (IMBM) and the ERRMECE laboratory of the University Cergy-Pontoise. The project will be supervised by Denis Rousseau (LMGP) and Charlotte Vendrely (ERRMECE, visiting scientist at LMGP). Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work. LMGP Web Site: http://www.lmgp.grenoble-inp.fr/

Profile & requested skills: We look for a student with a strong knowledge in protein biochemistry and biophysical methods and some interest for material sciences. The student

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should be able to work in a team, have good writing skills (report, presentation…), and a good knowledge of spoken and written English.
The internship will be from February 2021 for a duration of 6 months.

Subject could be continued with a PhD thesis: possibly, dependent on funding

Allowance: Internship allowance will be provided

CONTACT: Send a *C.V*. and a motivation letter to Denis Rousseau (denis.rousseau@univ-grenoble-alpes.fr) and Charlotte Vendrely (charlotte.vendrely@cyu.fr)

References:
1. Barlow DE, Dickinson GH, Orihuela B, Kulp JL, Rittschof D & Wahl KJ (2010) Characterization of the adhesive plaque of the barnacle Balanus amphitrite: Amyloid-like nanofibrils are a major component. Langmuir 26, 6549–6556.