Design and nanoscale characterization of bio-inspired antimicrobial surfaces

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Contaminations with biofilms are an important issue in industries and human health. Biofilms are microbial communities embedded in protective exopolymeric substances (EPS) which are strongly adhered onto any substrates. Their formation always depends on initial adhesion of the pioneered cells onto the substrate (Fig. 1). Therefore, blocking this crucial step should result in an efficient surface protection. To this end, two main strategies can be used: i) anti-adhesive coating to prevent microorganisms anchorage onto the surface, and ii) antimicrobial coating which consists in functionalizing surfaces with agents that will degrade adhered microbial cells (Fig. 1).

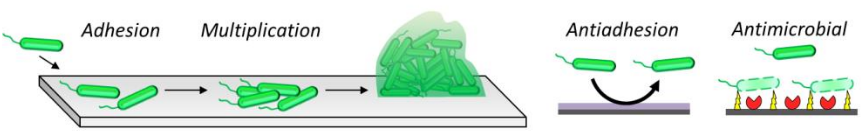

Figure 1 : Main steps involved in biofilm formation and strategies developed to impair these contaminations.

Despite numerous studies and emergence of new surface protection, there is still no reliable and totally efficient coating against biofilm formation. An effective surface protection rely on the detailed understanding on microbial adhesion and on the design of new strategies and methods that allow long-term, broad spectrum and renewable protection.

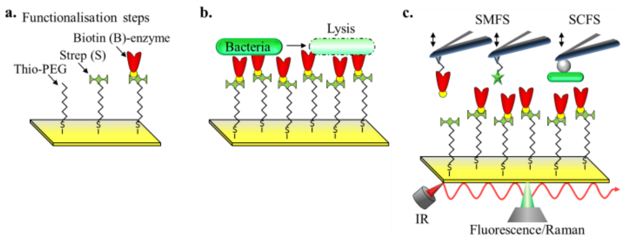

Figure 2 : Principle of surface protection with antimicrobial enzymes grafted through reversible ligand-receptor interaction (a,b). (c) Methodologies based on AFM, vibrational spectroscopy and microbiology for surface characterization.

This PhD project will aim to decipher the key parameters that govern microbial adhesion and to design a new coating for antimicrobial protection based on enzymatic activities. Surfaces will be functionalized or coated with antimicrobial enzymes through a reversible ligand-receptor interaction. This approach will protect enzyme conformation and activity and also will offer the possibility to renew the enzymatic activity grafted on the substrate (Fig. 2). A complete understanding of the interactions mechanism at such interfaces is required for the design of the new antimicrobial coating. Therefore, this project is based on a multidisciplinary approach and will combine nanotechnologies (*i.e.* atomic force microscopy for single-molecule and single-cell force spectroscopy) to vibrational spectroscopies (Raman and Infrared) and conventional microbiology techniques.

We are looking for a motivated applicant with Master degree in Chemistry or Physical Chemistry. Skills in microbiology will be appreciated but are not mandatory. The candidate will have a strong interest in material sciences and fit in an multidisciplinary lab.