PhD project "**Artificial Cuticle": Cuticular biomimetic polymer assemblage for modeling the surface interactions with micro-organisms.**

(ANR Articute, ANR-21-CE20-0001)

Insects of the order*Hemiptera* are major crop pests, notably because of their ability to transmit pathogens (viruses, phytoplasma, bacteria) which cause considerable losses on many crops throughout the world.

Retention sites for many viral species and phytopathogenic bacteria are located on the surface of the cuticle of the mouthparts of insect vectors. The cuticle of insects is in fact a complex material with hierarchical microstructure consisting in the association of chitin (polysaccharide, in the form of nanofibrils) and specific structural proteins (cuticular proteins, CuPs).

The detailed understanding of pathogen-receptor interactions that could lead to the identification of blocking agents and the development of innovative approaches to limit vectorial transmission would be a major step for an evolution to a more sustainable agriculture.

It would require tools to recreate in vitro the µterritories of the cuticular environments, including protein structuration ant the material interface, that would allow a more systematic deciphering of vector-pathogen interactions and the screening of agents blocking these interactions. We are thus focused on the development of an in vitro biomimetic interaction platform consisting of chitin/ chitosan films incorporating CuP receptor candidates. We will thus study the cuticle as a model of biomimetic material to obtain bioinspired chitin based polymer/cuticular protein alloys.

A first approach is the preparation of films of chitin /chitosans with CuP by solution casting. We will characterize and control the molecular structure of chitin/chitosan polymers by the production of homogeneous series of chitosan polymers of known degree of polymerization (DP) and degree of acetylation (DA, i.e. the fraction of N-acetyl Glucosamine in chitin or chitosan). A second subtlety is related to the formulation of the chitosan solution (ex: choice of the acid, added salts) and neutralization during/after film formation. So doing, a second level of microstructure can be addressed at the level of the crystallites (typically 5~10 nm). A third complexity level will be addressed by protein deposition onto the films, by controlling rehydration and protein diffusion. Finally, in the structure of natural cuticles, chitin is systematically organized lamella of oriented fibrils, and CuP thus interact with the nanofibrils surface.

Such higher scale ordering will not be fully addressed, but we will also process CuPchitin/chitosan films when the polysaccharide is structured in the form nanofibrils. In this task, fibers of chitin will be produced by acid hydrolysis. The coatings will be studied by a variety of structural techniques (GiWAXS, SEM, AFM, Ellipsometry). The interactions with phytopathogenic bacteria and viruses will also be studied.

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Expected candidate: Polymer material scientist, preferably physico-chemist, if possible with knowledge of natural polymer properties and their extraction from biomass. Fluent English required.

Send CV and motivation letter to the mail addresses above.