



Master Internship Project

Engineering lectins for functionalizing artificial plant cell walls

1. Presentation and description of the project

The plant cell walls consist of an assembly of semi-crystalline and amorphous complex polysaccharides. The group of Laurent Heux in CERMAV successfully reproduced their composition and architecture as two-dimensional films [1], or on the surface of vesicles and liposomes [2]. Lectins and carbohydrate-binding- modules (CBM) specifically recognize carbohydrates, and the group of Anne Imberty in CERMAV as well tailored the engineering of such protein modules to produce Janus-lectins with double specificity [3]. The project will include the selection of appropriate CBMs for binding to cellulose, hemicellulose and pectin, the design of their association with a multivalent lectin able to bind to fucose or galactose and the production of the resulting Janus-lectin. The monovalent and multivalent proteins will be tested for their ability to bind to plant polysaccharides. In a second step, they will be fluorescently labelled and incorporated in artificial cell wall models. The property of the new biomaterial at the frontier of synthetic biology and biotechnology will be tested for their efficiency to promote the assembly of plant cell polysaccharides.

2. Techniques / methods used

Molecular biology and biochemistry: Production of protein in bacteria, purification, characterization by DLS and SAXS

Characterization of protein carbohydrate interactions: Iso Thermal Calorimetry, Surface Plasmon Resonance, Quartz Crystal Microbalance

Preparation of biomimetic membranes, decoration of liposome with cellulose nanocrystals and plant cell wall polysaccharides

Imaging methods: Confocal Microscopy, Total Internal Reflection Fluorescence, Cryo-TEM Atomic Force Microscopy on synthetic membranes

Mechanical test: deformation of vesicles under osmotic shocks,

3. References and contact

Laurent Heux : Laurent.heux@cermav.cnrs.fr

Anne Imberty : Anne.imberty@cermav.cnrs.fr

[1] Navon, Y., Radavidson, H., Putaux, J. L., Jean, B., & Heux, L (2017) pH-sensitive Interactions between Cellulose Nanocrystals and DOPC Liposomes. *Biomacromolecules*, **18**, 2918–2927

[2] Navon, Y., Jean, B., Coche-Guerente, L., Dahlem, F., Bernheim-Groswasser, A., & Heux, L. (2020) Deposition of cellulose nanocrystals onto biomimetic lipid membranes. *Langmuir*, **6**, 1474-1483

[3] J. P. Ribeiro, S. Villringer, D. Goyard, L. Coche-Guerente, M. Höferlin, O. Renaudet, W. Römer & A. Imberty (2018) Tailor-made Janus lectin with dual avidity assembles glycoconjugate multilayers and crosslinks protocells. *Chem. Sci.* **9**, 7634-7641