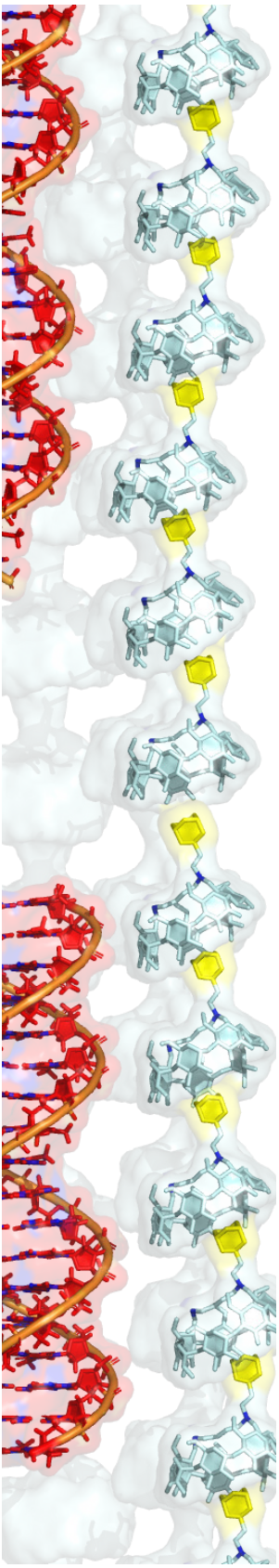


Ph.D position in organic synthesis and supramolecular chemistry

Title: Biomimetic supramolecular co-assemblies.

Research group: Team *Organic Biological & Supramolecular Glycochemistry* (GOBS, Parisian Institute of Molecular Chemistry), Sorbonne Université, campus P. et M. Curie, Paris 5ème, France.

Supervisors & contacts: Pr. Matthieu Sollogoub (matthieu.sollogoub@sorbonne-universite.fr), Dr. Mickaël Ménand (mickael.menand@sorbonne-universite.fr).

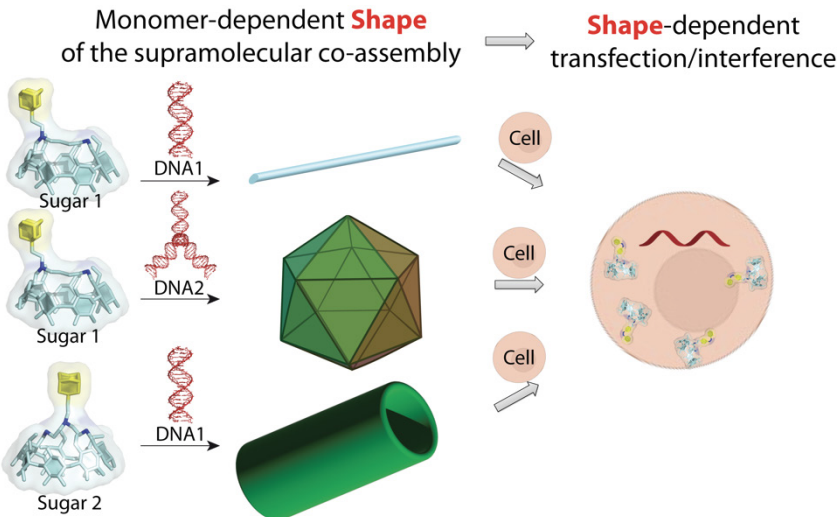
Duration : 36 months, starting 1srt october 2025

3.7 Billion years of evolution have led Nature to select four different families of molecular building blocks - proteins, lipids, nucleic acids and saccharides - to generate the wealth of molecules that combine and interact within a living organism.[1] Each family fulfills specific roles and they barely, if at all, exchange the roles for which evolution has selected them. We recently serendipitously discovered that a saccharide could act as a capsid protein encapsulating DNA in a viro-like architecture! [2]

This functional carbohydrate, namely a cyclodextrin,[3] self-assembles into seven fibrils surrounding tightly packed DNA molecules to form a fibre-like co-assembly. Structural resolution with near-atomic resolution by cryo-electron microscopy (cryo-EM) gives us the structural basis of the molecular architecture (image on the left). With this knowledge in mind, we now wish to explore the possibilities offered by such a discovery. The proposed PhD will explore both the control of the **shape** of the architecture to generate 2D or 3D structures… and the ability of these structure to interact with other molecules.

Why? Nature makes beautiful architectures such as microtubules, fibrils, helical or icosahedral viruses… These shapes precisely engineered by Nature are directly linked to their function. In line with this statement, we endeavour the variation of different parameters of the assembly to modulate the shape and the polymerization behaviour of the assembly. The link between **shape** and function and the **dynamic behaviour** are the ultimate goal of the PhD project, the transfection ability being our focus (shape influence over cell-penetration ability, and dynamic DNA delivery).

Profile and skills of the candidate: A Master in organic chemistry is required with a strong theorical background in organic chemistry. Knowledge of supramolecular chemistry is welcome. Candidates must master classical synthetic chemistry techniques and spectroscopic analyses. Candidates must be able to work independently in the laboratory. Previous experience in an organic synthesis and/or supramolecular chemistry research laboratory would be welcome. Very good oral and written communication skills in English (French is not compulsory) are required.



Application: The application must include a detailed CV and a motivation letter. At least two reference contacts must be given. Recommendation letters are also welcome. Master's grades will be requested.

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[1] **A unified vision of the building blocks of life**. J. D. Marth, *Nat. Cell Biol.* **2008**, *10*, 1015–1015.

[2] **Sugars as capsid proteins, formation and cryo-EM structure of a viro-inspired architecture**. L. Lavnevitch, P. Evenou, R. Churamani, V. Libérioux, D. Colesnic, R. Ferreira-Veloso, C. Henrique-Fernandes, C. Fagnen, G. Pembouong, P.-A. Driguez, et al., *ChemRxiv* **2024**, DOI 10.26434/chemrxiv-2024-v90l8.

[3] **Bridging β-Cyclodextrin Prevents Self-Inclusion, Promotes Supra- molecular Polymerization, and Promotes Cooperative Interaction with Nucleic Acids**, P. Evenou, J. Rossignol, G. Pembouong, A. Gothland, D. Colesnic, R. Barbeyron, S. Rudiuk, A.-G. Marcelin, M. Ménand, D. Baigl, V. Calvez, L. Bouteiller, M. Sollogoub, *Angew. Chem. Int. Ed.* **2018**, *57*, 7753–7758.