Title	**Smart sustainable biosensors for biomarker detection**
PI	**Marco Frasconi**
Research Group	**Analytical Chemistry**
Curriculum	**Chemical Sciences**
Location	Department of Chemical Sciences
Contact	**web: Marco Frasconi-UNIPD**
	email: marco.frasconi@unipd.it

Project description:

The design and development of smart biomaterials, which display adaptive functions and reconfigure dynamically in their environment, is a grand challenge toward the construction of artificial systems for numerous biomedical applications, including protein sensing. The precise control of noncovalent bonding interactions on large assemblies has paved the way for the development of a variety of artificial recognition systems and to explore the possibility of wholly synthetic systems able to perform advanced tasks, such as store and process molecular information based on specific recognition between the components as well as response to different external stimuli.

By embracing the concepts learned in the study of artificial molecular machines[1] with the properties of cellulose based hydrogels,[2,3] this project aims at developing sustainable smart biosensors for the early diagnosis and rapid monitoring of Alzheimer's. The research activity will be focused on the development of 1) methods for the preparation of smart materials based on the functionalization of cellulose derivatives with rotaxanes[4] and receptors (aptamers and antibodies), 2) fabrication and characterization of the biosensor, and 3) application of the biosensor for the detection of Alzheimer's biomarker proteins (tau proteins), in collaboration with national biomedical research groups. Owing to the importance of protein detection in clinical diagnostic, these sensing platforms will be applied in a variety of assays to identify disease-specific proteins, including the development of point-of-care devices for personalized medicine applications.

References:

1) Y. Wang, M. Frasconi, J. F. Stoddart “Introducing stable radicals into molecular machines” *ACS Central Science* 2017, 3, 927–935.
2) V. Gabrielli, R. Baretta, R. Pilot, A. Ferrarini, M. Frasconi “Insights into the gelation mechanism of metal-coordinated hydrogels by paramagnetic NMR spectroscopy and molecular dynamics” *Macromolecules* 2022, 55, 450−46.
3) R. Baretta, V. Gabrielli, M. Frasconi “Nanozyme−cellulose hydrogel composites enabling cascade catalysis for the colorimetric detection of glucose” *ACS Appl. Nanomat.* 2022, 10, 13845–13853.
4) Y. Wu, M. Frasconi, W.-G. Liu, R. M. Young, W. A. Goddard III, M. R. Wasielewski, J. F. Stoddart “Electro-chemical switching of a fluorescent molecular rotor embedded within a bistable rotaxane” *J. Am. Chem. Soc.* 2020, 142, 11835–11846.

Hosting group for the period abroad (tentative list, may change): Prof. Itamar Willner (The Hebrew University of Jerusalem, Israel).