Photosynthesis at the nanoscale

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Understanding and controlling the mechanisms by which energy is transferred from one component of a system to another is a central topic in many different branches of science, from biology to optoelectronics. In photosynthetic systems the resonant energy transfer (RET) between chromophores plays a crucial role that enables an efficient and directional transport of solar energy between collection and reaction centres. This funnelling of energy relies on cascaded RET events, based primarily on dipole–dipole interactions, which occur between high energy-gap chromophores to lower energy-gap chromophores. The efficiency of the process is further improved by complementary effects, such as energy transfers at short distances mediated by exchange interaction, delocalization of the excitation over coherently coupled molecules... The influence of these parameters on the extraordinary ability of biological LHCs to transfer energy between distant centres remains to be clarified and their systematic control in artificial systems is both crucial and distant. As energy funneling relies primarily on the interaction between individual molecular elements, investigating its mechanisms requires methods that allow visualizing, addressing and manipulating each of the molecules separately.

The objective of this PhD project to use scanning probe microscopy approach in combination with optics to question quantum photosynthetic processes with ultimate spatial resolutions [1]. The internship fits into the larger framework of the European ERC project APOGEE within the STM team of the IPCMS.

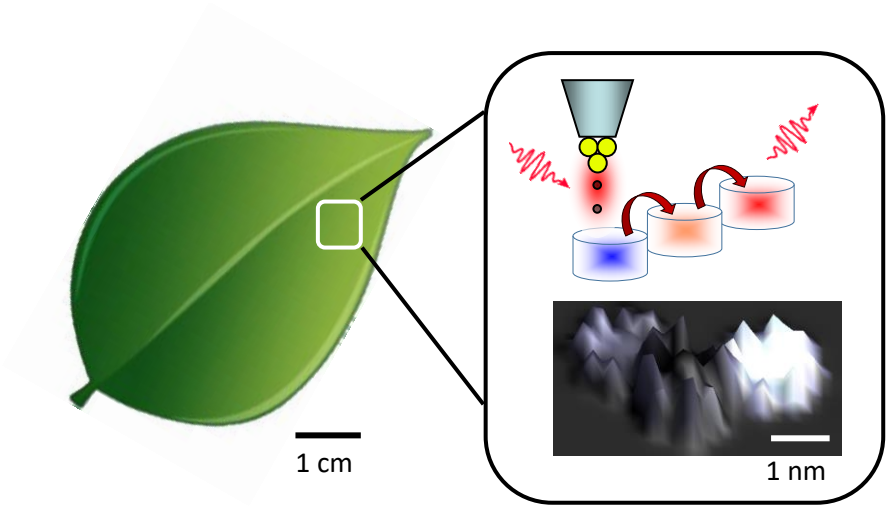

Figure : Tip-enhanced photoluminescence of a photosynthetic fundamental unit: three interacting molecules.

[1] Doppagne *et al.*, Nature Chem., **13,** 766 (2021)