Title	**Bio-inspired Frameworks for CO_2 FIXATION**
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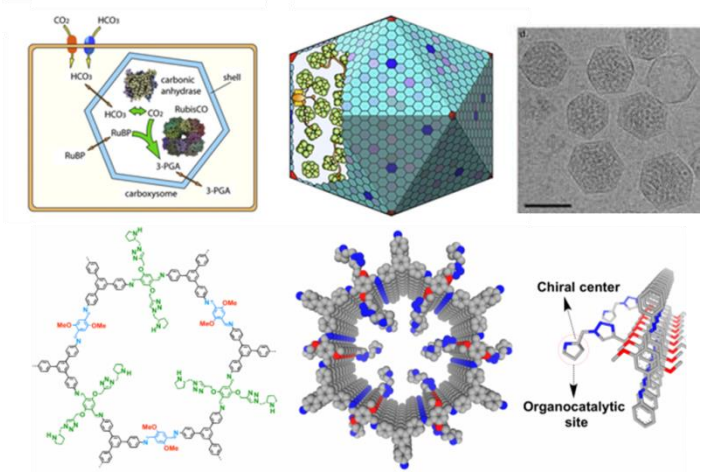
Project description:

Photosynthetic CO_2 fixation can win over the anthropogenic carbon emissions (ca. 120 Pg yr^{-1} vs. 7 Pg yr^{-1}; 1 Pg = 1 petagram = 1 billion tonnes = 10^{15} grams), however the key player for carbon-fixation i.e. the RuBisCO enzyme, is highly inefficient in terms of reaction kinetics (few Turnovers per hour) and selectivity (O_2 vs CO_2 processing). To overcome these limitations, most biological photosynthesizers adopt a combined strategy of spatial organization and separation of functions with cascade catalysis principles. One prominent example is found in the structure and multiple functions of the natural carboxysomes, i.e. microcompartments made by a self-assembling porous shell that encapsulates the RuBisCO catalyst in a confined, space. In this asset, the carboxysome allows for an efficient capture and activation of CO_2 while facilitating its fixation by feeding the catalyst with an increased local concentration of CO_2, boosting rates and controlling selectivity. The artificial replica of carboxysomes is still waiting for a groundbreaking molecular approach. The project will focus on the design of multi-functional molecular systems for CO_2 fixation, based on bio-inspired guidelines, including: (i) porous covalent organic frameworks (COF) using well established reversible condensation reactions and linkers; (ii) molecular organocatalysis; (iii) photo-redox cascade mechanisms. The PhD student will be trained on state-of-the art synthetic methods, solution and solid state characterization analysis (FT-IR, X-Ray techniques, NMR spectroscopy, mass spectrometry, chromatography and HPLC, circular dichroism) and advanced technology as micro-wave assisted protocols and photo-fluidic apparatus.



Publications:

M. Bonchio, et al. “Efficient water oxidation at carbon nanotube–polyoxometalate electrocatalytic interfaces” *Nature Chemistry 2*, 826–831 (2010); M. Bonchio, et al. “Hierarchical organization of perylene bisimides and polyoxometalates for photo-assisted water oxidation”. *Nature Chemistry 11*, 146–153 (2019); Cherubini-Celli, A.; Mateos, J.; Bonchio, M.; Dell'amico, L.; Companyò, X. "Transition-metal-free CO_2 fixation into new carbon-carbon bonds" *ChemSusChem* (2018), DOI: 10.1002/cssc.201801063.

Collaborations/Network:

See national and international collaborations in recent publications.

Research funding:

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