

The mighty power of photosynthesis. From solar light to semiartificial photosynthesis

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Planet Earth sustains all its life forms by exploiting photosynthesis, a paramount biological process performed by plants, algae, and some bacteria. Photosynthesis is the sole biological process able to fix energy on Earth by harvesting sunlight. The planetary relevance of such metabolic process was clear to Giacomo Ciamician, one of the founders of modern photochemistry who delivered a visionary in 1912 speech [1] on the urgency of substituting fossil fuels with “The enormous quantity of energy that the Earth receives from the sun”, anticipating by more than one century what is now an almost universally shared opinion.

The lecture will be divided in two parts; a general one in which the basic concepts of the photochemistry and photobiology of the photosynthetic process will be described and a more specialized part in which the recent developments in biohybrid photosynthesis in harnessing light and exploit it [2-6] are a useful little roadmap to employ photosynthetic in environmental applications.

[1] Ciamician, G. *The Photochemistry of the Future*, **Science**, 1912, 36, 385

[2] Grattieri, M., *et al.* *The periodic table of photosynthetic purple non-sulfur bacteria: intact cell-metal ions interactions*. **Photochem Photobiol Sci** (2021). Doi: 10.1007/s43630-021-00116-9.

[3] E. Altamura *et al.*, *Chromatophores efficiently promote light-driven ATP synthesis and DNA transcription inside hybrid multicompartiment artificial cells*. **Proceedings of the National Academy of Sciences** (2021), 118 (7) e2012170118; Doi: 10.1073/pnas.2012170118.

[4] Buscemi, G., *et al.* *Polydopamine/Ethylenediamine Nanoparticles Embedding a Photosynthetic Bacterial Reaction Center for Efficient Photocurrent Generation*. **Adv. Sustainable Syst.** (2021), 2000303. Doi: 10.1002/adsu.202000303

[5] E. Altamura *et al.* *Highly oriented photosynthetic reaction centers generate a proton gradient in synthetic protocells*. **Proceedings of the National Academy of Sciences** (2017) 114 (15), 3837-3842. Doi: /10.1073/pnas.1617593114.

[6] Buscemi, G., *et al.* *Enhancing photosynthesis in organic biological hybrid complexes*. **Photochemistry**, (2022) 385-410 Doi: 10.1039/9781839165269-00385