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seminar

Tuesday, 15th November, 12.00pm

Seminar Room

Host: Prof. Luis M. Liz-Marzán

Supramolecular Architectures for Artificial Photosynthesis: The Quantasome Vision

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In the early studies, on Oxygenic Photosynthesis, the "quantasome hypothesis" led to seminal discoveries correlating the structure of natural photosystems with their complementary photo-redox functions.[1,2] Indeed, and despite the vast bio-diversity footprint, just one protein complex is used by Nature as the H2O-photolyzer: photosystem II (PSII). Man-made systems are still far from replicating the complexity of PSII, showing the ideal co-localization of Light Harvesting antennas with the functional Reaction Center (LH-RC). Here we report the design of multi-perylenebisimide (PBI) networks shaped to function by interaction with a polyoxometalate water oxidation catalyst (Ru4POM).[3-5] Our results point to overcome the classical "photo-dyad" model, based on a donor-acceptor binary combination, with integrated artificial "quantasomes" formed both in solution and on photoelectrodes, showing a: (i) red-shifted, light harvesting efficiency (LHE>40%), (ii) favorable exciton accumulation and negligible excimeric loss; (iii) a robust amphiphilic structure; (iv) dynamic aggregation into large 2D-paracrystalline domains.[5] Photoexcitation of the PBI-quantasome triggers one of the highest driving force for photo-induced electron transfer applied so far.[5-7]

References

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[3] Piccinin, S.; Sartorel, A.; Aquilanti, G.; Goldoni, A.; Bonchio, M.; Fabris, S. Water oxidation surface mechanisms replicated by a totally inorganic tetraruthenium-oxo molecular complex. Proc. Natl. Acad. Sci. 110, 4917–4922 (2013)
[4] Toma, F. M.; Prato, M.; Bonchio, M. et al. Efficient water oxidation at carbon nanotube–polyoxometalate electrocatalytic interfaces. Nature Chemistry 2, 826-831 (2010).
[5] Bonchio, M.; Sartorel, A.; Prato, M. et al. Hierarchical organization of perylene bisimides and polyoxometalates for photo-assisted water oxidation. Nature Chemistry 11, 146-153 (2019).
[6] Gobbo, P.; Bonchio, M.; Mann, S. et al. Catalytic processing in ruthenium-based polyoxometalate coacervate protocells Nature Commun 11, 41 (2020).
[7] GobbatoT.; Rigodanza F.; Benazzi, E.; Prato, M.; Bonchio M. et al. J. Am. Chem. Soc.144,14021-14025 (2022).