Molecular Photosynthesis: Such Stuff as Dreams are Made On

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The use of solar-activated H_2O/CO_2 routines as a feed-stock for photosynthetic processes is nowadays a breakthrough concept for sustainable energy, solar fuels, green chemistry and food security. The enormous potential of this vital cycle is far from being adequately exploited.[1] The game-changer relies on a man-made re-design of photosynthesis to overcome the natural bottlenecks, efficiency losses. An extraordinary research effort has been dedicated to elucidate the structural and mechanistic prerogatives of the natural oxygen evolving complex embedded within the photosystem II enzyme (PSII-OEC). A recent breakthrough in the field of artificial photosynthesis is the discovery of synthetic multi-redox catalysts, as analogs of the PSII-OEC (Scheme 1), with a common functional-motif, i.e. a redox-active, tetranuclear, metal-oxo core boosting H_2O oxidation to O_2 with unprecedented efficiency.[2] Our vision points to a careful choice/design of the catalytic core, of its ligand set and of the surrounding nano-environment. We report herein a synthetic, spectroscopic and mechanistic study on the use multi-metal catalysts for water oxidation and their combined use with visible light sensitizers and carbon nanostructures (CNS).[3-4] The outcome is a hybrid nanomaterial with unperturbed CNS electrical properties, enabling water splitting with high efficiency at overpotentials as low as the natural protein.[5-7]

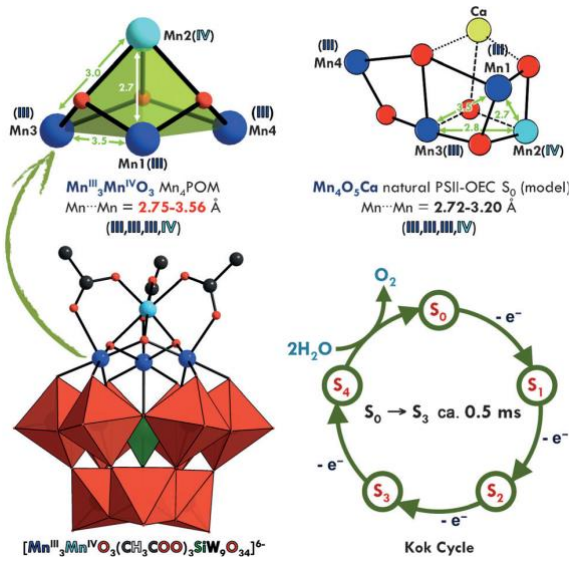

Figure 1. Artificial Oxygen Evolving Catalysts mimicking the Natural PSII-OEC

References

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