

Photo-driven water oxidation with visible light using catalysts containing cobalt, iron and manganese

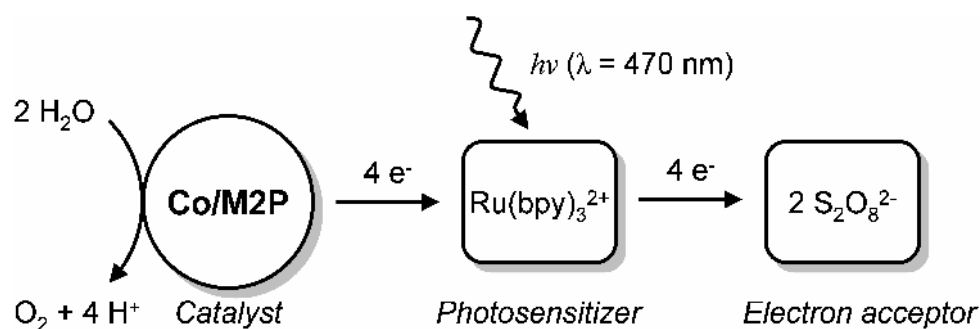
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The aim of artificial photosynthesis is to capture solar energy and store it in chemical bonds. For this purpose the natural photosynthesis serves as model and an inspiration. Natural photosynthesis uses the energy in sunlight to oxidatively split water to oxygen, protons and electrons. The reducing power of these electrons can be stored in various products to be used by the organism as a fuel when needed. Artificial photosynthesis aims at mimicking these reactions and store the energy in a chemical fuel. A longstanding goal of artificial photosynthesis has been to develop a water oxidation catalyst, based on first row transition metals, that operates at low over potential.

Our focus has been to use manganese, cobalt or mixed-metal complexes as potential water splitting catalysts together with either chemical oxidants or light driven oxidation in the form of ruthenium complexes as photosensitizers and electron acceptors. Through detailed studies of oxidation events and electron transfer we hope to understand what factors are necessary to attain complexes that are able to bind and deprotonate water, store four oxidizing equivalents and finally to allow for oxygen-oxygen bond formation.

The potential for a number of systems containing either a single metal (cobalt or manganese) or two metals (manganese/calcium or cobalt/iron) to work as water oxidation catalysts will be reported. In particular we present an oxygen evolving water oxidation catalyst based on cobalt that can be driven by visible light in aqueous solutions at pH 7. The cobalt based catalyst uses methylenediphosphonate (M2P) as a ligand. The ruthenium complex $\text{Ru}(\text{bpy})_3^{2+}$ is used as the photosensitizer and peroxosulfate ($\text{S}_2\text{O}_8^{2-}$) as the sacrificial electron acceptor.



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