Energy Materials by Molecular Design: Knitting the Catalytic Pattern of Artificial Photosynthesis

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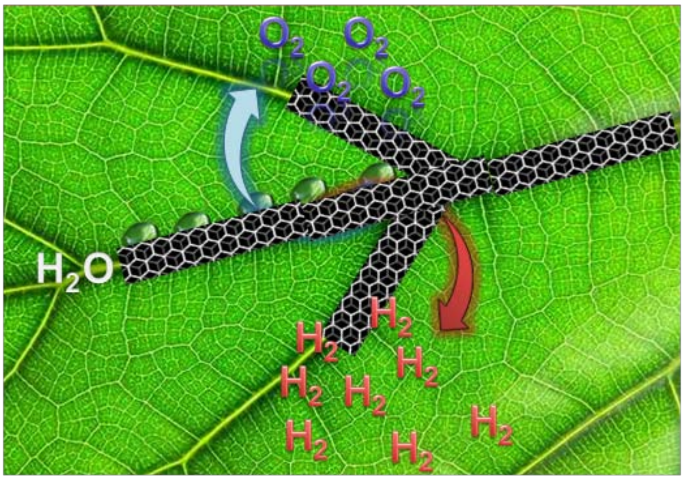
Bio-energy is renewed daily by catalytic water splitting, at the heart of the photosynthetic machinery, embedded in leaves. In contrast, the artificial process for the continuous extraction of O_2 and H_2, as alternative solar fuels, is an urgent concern of fundamental and applied energy research. The pitfall stems from the thermodynamic and kinetic barrier of the water oxidation stage, causing a major energy loss after the light collection events. Lowering the activation barrier of such “dark” phase translates into new catalyst-mediated pathways, with an overall energy cost close to the thermodynamic requirement (E^0= 1.23 V). This task, together with the long-term stability issue, is pivotal for the “artificial leaf” project, and calls for a tailored merging of molecular water oxidation catalysis (WOC) and nano-materials research. The synergy expected from these two disciplines targets the “all-around” shaping of the WOC functional environment at the nanoscale and supported on a functional surface. [1, 2]

The molecular engineering of a WOC texture, based on functionalized graphene nano-sheets will be discussed herein which integrates the tetra-ruthenate polyoxometalate $\{Ru_4(\mu\text{-}O)_4(\mu\text{-}OH)_2(H_2O)_4[\mu\text{-}SiW_{10}O_{36}]_2\}^{10-}$ (**Ru_4POM**), as the inorganic mimic of the natural photosynthetic Mn_4 cluster.[1, 2]



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