Poster Presentation
Inter-Disciplinary Explorations in Chemistry (I-DEC 2018)

Photobiocatalytic water oxidation: Let's break to make

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Abstract: Artificial photosynthesis has drawn significant attention of the scientific community since it opens up an opportunity for the effective use of solar energy by converting it into chemical energy. In natural photosynthesis, plants harness solar energy, oxidize water and reduce CO_2 to carbon based compounds. Artificial photosynthetic systems which can work in a similar manner by using water as a sacrificial electron donor is an active area of research. However, the water-oxidation reaction is both thermodynamically and kinetically demanding, resulting in slow kinetics without the use of a catalyst.[1] The development of active and robust water-oxidation catalysts is pivotal for the creation of artificial photosynthetic systems. Herein, our approach is to develop a photobiocatalyst for water oxidation. Photobiocatalysis is an emerging field, which couples a photocatalyst and a biocatalyst to promote energetically demanding reactions that are not easily accessible at room temperature. Recently, it has been shown that laccase from *Trametes hirsuta*, a protein in the multicopper oxidase family, can perform electro catalytic water oxidation.[2, 3] We envisage a photobiocatalyst for water oxidation can be designed by coupling laccase to a suitable photoredox system. This novel strategy will be utilized to decipher the electron-transfer and water oxidation mechanism by laccase.

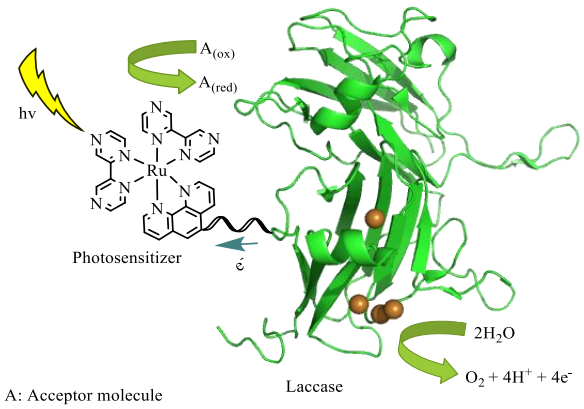

Figure 1: Schematic diagram of water oxidation photobiocatalyst based on laccase.

References and Notes:

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2. Pita, M.; Mate, D. M.; Gonzalez-Perez, D.; Shleev, S.; Fernandez, V. M.; Alcalde, M.; De Lacey, A. L. Bioelectrochemical Oxidation of Water. *Journal of the American Chemical Society* **2014**, *136* (16), 5892–5895.
3. Tapia, C.; Shleev, S.; Conesa, J. C.; De Lacey, A. L.; Pita, M. Laccase-Catalyzed Bioelectrochemical Oxidation of Water Assisted with Visible Light. *ACS Catalysis* **2017**, *7* (7), 4881–4889.