

Coordination Chemistry focused on Photochemical Water Splitting Molecular Devices

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Coordination Chemistry focused on Photochemical Water Splitting Molecular Devices

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Interests have been focused on the photochemically, chemically, and electrochemically driven water oxidation and reduction based on transition-metal-based catalysis and photocatalysis. Important targets have been to develop molecular catalysts exhibiting relatively low overpotentials for both processes [1-10]. Platinum(II) complexes had been the rare examples of catalysts for water reduction (WR) when driven by methylviologen radical (MV⁺) (150 meV of driving force for WR at pH 5.0) [1-4]. Co-NHC water reduction catalysts were realized to be unusual examples of base metal water reduction catalysts (WRCs) active for MV⁺-driven WR [5]. More importantly, unique ligand-based multi-step reductions, considered as PCET processes, have been realized to give a hydridonickel(II) intermediate required for WR [6]. By modification of EDTA/Ru(bpy)₃²⁺/MV²⁺/Pt(II)-WRC systems, various types of sensitizer-catalyst dyads, regarded as photo-H₂-evolving molecular devices, have been developed and characterized in details [3-4]. On the other hand, interests have also concentrated in invention and characterization of highly active molecular water oxidation catalysts (WOCs) and the detailed kinetic studies have been carried out to understand the mechanism of WO catalysis [7-9]. These involve our recent studies on single-cobalt-centered WOCs, including cobalt polymolybdate and porphyrin WOCs [7,8]. Our recent advancement in this field involves development of photoelectrochemical cells consisting of Ru(bpy)₃²⁺-anchored-TiO₂ for WO and Pt(porphyrin)-anchored-TiO₂ cathode for WR [10]. We also demonstrated for the first time in promoting NIR-driven water reduction using triruthenium polypyridyl photosensitizer [10].

1. H. Ozawa, M. Haga, K. Sakai, *J. Am. Chem. Soc.* **2006**, *128*, 4926.
2. K. Yamauchi, S. Masaoka, K. Sakai, *J. Am. Chem. Soc.* **2009**, *131*, 8404.
3. K. Kitamoto, K. Sakai, *Angew. Chem. Int. Ed.* **2014**, *53*, 4618.
4. K. Kitamoto, K. Sakai, *Chem. Commun.* **2016**, *52*, 1385.
5. K. Kawano, K. Yamauchi, K. Sakai, *Chem. Commun.* **2014**, *50*, 9872.
6. K. Koshiba, K. Yamauchi, K. Sakai, *Angew. Chem. Int. Ed.* **2017**, *56*, 4247.
7. S. Tanaka, M. Annaka, K. Sakai, *Chem. Commun.* **2012**, *48*, 1653.
8. T. Nakazono, Ken Sakai, *Dalton Trans.* **2016**, *45*, 12649.
9. Y. Tsubonouchi, S. Lin, A.R. Parent, G. Brudvig, K. Sakai, *Chem. Commun.* **2016**, *52*, 8018.
10. K. Morita, K. Takijiri, K. Sakai, H. Ozawa, *Dalton Trans.* **2017**, *46*, 15181.
11. Y. Tsuji, K. Yamamoto, K. Yamauchi, K. Sakai, *Angew. Chem. Int. Ed.* **2018**, *57*, 208.