Photochemical Hydrogen Production from Water Catalyzed by a Robust Platinum(II) Molecular Catalyst

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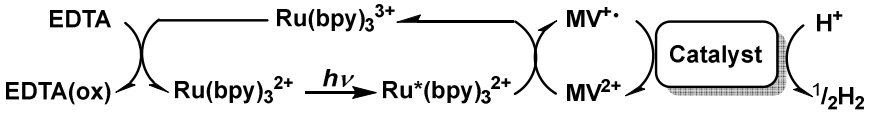
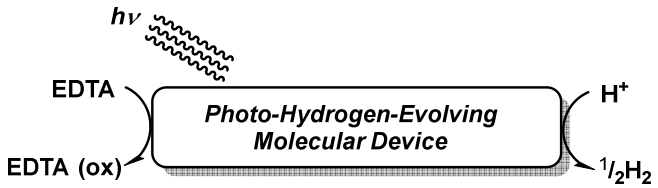
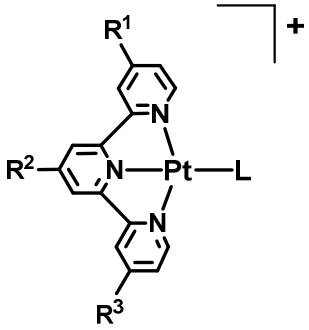
Molecular hydrogen is a promising candidate as an alternative to fossil fuels. Although hydrogen is now commercially produced by the steam reforming of natural gas ($CH_4 + H_2O \rightarrow CO + 3H_2$), one of the more environmentally benign methods is to split water into H_2 and O_2 based on solar energy conversion. In this context, we have focused on Pt(II)-based molecular catalysis for H_2 generation from water by employing a photochemical system comprising of EDTA, $[Ru(bpy)_3]^{2+}$, MV^{2+} (methylviologen) and the catalyst at pH 5.0 (a three-component system; see Scheme 1) [1]. In addition, we succeeded in demonstrating that thermal reduction of water by electrochemically generated MV^{+}• indeed proceeds in the presence of Pt(II) catalysts even without light irradiation [2]. On the other hand, we previously focused on the stability of platinum(II) compounds under 1 atm of H_2, to reveal that the Pt(II) complexes having π-acceptor ligands are expected to be highly stable during the catalysis of H_2 evolution [3]. In the present study, some water-soluble Pt(terpyridine) derivatives (see below) were newly synthesized and evaluated as H_2-evolving catalysts in order to develop highly robust molecular catalysts. Among them, a Pt(II) complex was found to serve as an efficient and stable homogeneous catalyst for H_2 production from water, employing the three-component system shown in Scheme 1. In addition, it was also ascertained that it exhibits a single-component photocatalysis [4,5], which is depicted in Scheme 2, driving both photosensitization and reduction of water into H_2.



Scheme 1. A three-component system





Scheme 2. A single-component system

References

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