Enhancing Photocatalytic Activity of Hematite by Surface Modification with Molecular Oxide Clusters

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Artificial photosynthesis enables us to produce fuels such as hydrogen and valuable chemicals in an environmentally friendly manner by decomposing water into hydrogen and oxygen with unlimited solar energy. With increasing concerns over energy and environmental problems, it has attracted great attention as an eco-friendly energy source. However, there remains numerous challenges for its realization. For example, most of materials found to be efficient are toxic, expensive, or unstable during redox reactions under light irradiation. In this regard, hematite (a-Fe2O3) is a very promising material for artificial photosynthesis due to its abundance, small bandgap, and high stability. However, its poor electrochemical properties (e.g., large overpotential for water oxidation) limits its potential use as a photoanode. In the present study, we report the surface modification of hematite photoanode by surface modification with catalytically molecular oxide clusters (commonly referred to as polyoxometalates) for enhancing its photocatalytic activity. We found that the modification of hematite photoanodes leads to significant decrease of overpotential for oxygen evolution reaction (OER) and significant increase of photocurrent at the same time.