Interfacial Engineering of Hematite through Layer-by-Layer Assembly for Solar Water Oxidation

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Artificial photosynthesis has a great attention as a promising energy solution to environmental problems. In principle, valuable chemicals can be produced from wasted carbon dioxide and abundant water, instead of using fossil fuels, through a series of photoelectrochemical processes in a carbon-neutral manner. For the successful development of efficient and stable photosynthetic devices, it is significantly required to assemble various functional materials for efficient exciton generation, exciton dissociation, charge transport, and electrocatalytic charge transfer reactions. Here, we develop an efficient and stable photoanode for solar water oxidation through deposition of artificial nacre film on hematite by layer-by-layer assembly of cationic graphene oxide nanosheets and anionic molecular metal oxide catalysts. The deposition of the film greatly improved both the photocatalytic activity and stability of hematite photoanodes. It was found that deposition of alternating layers of cationic and anionic polymers prior to the artificial nacre film allowed fine-tuning of the work-function of the hematite electrode, enhancing the photoelectrochemical performance even further.