Artificial Nacre Film for Solar Water Oxidation

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Artificial photosynthesis has been considered a promising solution to energy and environmental problems. In principle, we can produce valuable chemicals (e.g., formate, synthesis gas, and methanol) from abundant carbon dioxide and water through a series of photoelectrochemical processes in a carbon-neutral manner. For the successful development of efficient and stable photosynthetic devices, it is critically required to precisely assemble various functional materials for efficient exciton generation, exciton dissociation, charge transport, and electrocatalytic charge transfer reactions. Here, we report the development of an efficient and stable hematite-based photoanode for solar water oxidation using artificial nacre film, which was fabricated by layer-by-layer assembly of cationic graphene oxide (GO) nanosheets and anionic molecular metal oxide catalysts. Unexpectedly, it was also 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, which resulted in even further performance improvement.