Photocatalytic CO_2 Reduction by an Iron Porphyrin-Based Framework Catalyst Constructed by Hydrogen Bonding

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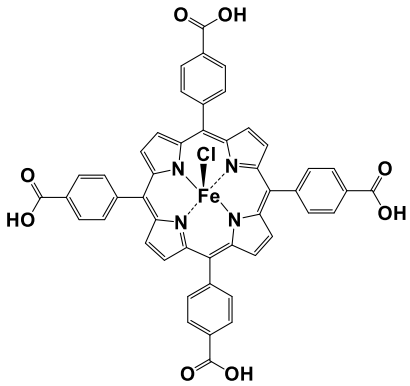
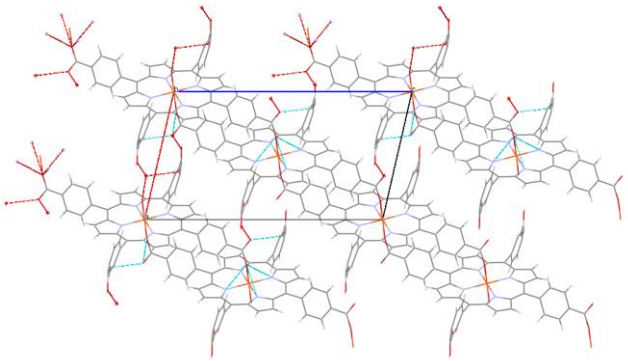
As one of the approaches to solving both energy and environmental problems, artificial photosynthesis has attracted considerable attentions in these days. In this work, we focus on a development of efficient catalyst for CO_2 reduction half-reaction by introducing the concept of framework catalyst. This class of materials can exhibit the high porosity and large specific surface area, and simultaneously possess advantages of both traditional homogeneous and heterogeneous systems, such as high efficiency, long lifetime, and easy recycling.

A framework catalyst composed of iron(III) tetra(4-carboxyphenyl)porphyrin (**Fe-TCPP**) was synthesized using our original self-assembly method: after dissolving **Fe-TCPP-Cl** (Figure, left) into methanol, excess KOH was added for basification. Then the pH of the solution was adjusted to around 3-5 by acetic acid, and heating up overnight in a 50 ºC oven. As a result, the framework of **Fe-TCPP** (**Fe-TCPP-para framework**, Figure, right) bearing a hydrogen-bonding network between each layer was generated in a 62% yield. This method indicated a new sight view to get a framework catalyst at a low temperature in a short time.

Fe-TCPP-para framework promotes CO_2 photoproduction reaction with up to almost 100% selectivity of CO as the product. Moreover, we achieved an extremely high efficiency reaching 1864 mmol/(g·h) using our framework. In near future, we plan to further investigate the mechanism of the CO_2 photoreduction process, such as CO_2 adsorption and CV test.



Fe-TCPP-Cl



Fe-TCPP-para framework