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Electrocatalytic Hydrogen Evolution Reaction with a Supramolecular Cobalt(II)phthalocyanine Carrying Four Cobaloxime Moieties

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Abstract

A supramolecular cobalt phthalocyanine (**CoPc**) bearing four redox active cobaloxime (**CoDMG**) substituents ((**CoDMG**)₄-**CoPc**) was synthesized and electrochemically characterized in order to determine its functionalities for practical usages as effective electrocatalysts. Voltammetric analyses of **CoDMG**, **CoPc**, and (**CoDMG**)₄-**CoPc** indicated redox activity of each compounds and supported substitution of **CoPc** with **CoDMG**. (**CoDMG**)₄-**CoPc** showed three **CoPc** based reduction processes and two **CoDMG** based reduction processes. While **CoDMG** showed two reduction and one oxidation processes, **CoPc** illustrated three reduction and two oxidation processes. Binding of **CoDMG** to **CoPc** increased the reduction processes to five. Multi-electron and metal and/or ring based redox processes showed worthy of the (**CoDMG**)₄-**CoPc** for using as an electrocatalyst. Shifting of the proton reduction reaction toward the positive potentials indicated electrocatalytic activities of the complexes for the hydrogen evolution reaction (**HER**). Among **CoDMG**, **CoPc**, and (**CoDMG**)₄-**CoPc**, modified glassy carbon electrode with (**CoDMG**)₄-**CoPc** illustrated the highest electrocatalytic activity and it decreased the over-potential of the bare electrode about 360 mV and increased the current density of the electrode about 10 fold.

Keywords: Supramolecule, Electrocatalyst, Hydrogen evolution reaction, Phthalocyanine

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