

Copper(II) Catalysis of Water Oxidation

Meyer

Scientific Achievement

We report here that simple Cu(II) salts are highly reactive as water oxidation electrocatalysts in neutral to weakly basic aqueous solutions concentrated in $\text{CO}_2/\text{HCO}_3^-/\text{CO}_3^{2-}$.

Significance and Impact

Our observations are remarkable for the simple nature of the catalyst and solution conditions and the robust character of the catalysis.

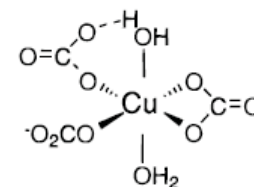
Research Details

- The coordination environment offered by these buffer anions prevents precipitation of $\text{Cu}(\text{OH})_2$ and CuCO_3 , and appear to stabilize higher oxidation states of copper.
- The results of voltammetric measurements are consistent with water oxidation by Cu(II) by a second order pathway in 1 M Na_2CO_3 (pH ~10.8).
- The rate of water oxidation is especially notable with current densities of $> 20 \text{ mA/cm}^2$ at 1.46 V vs. NHE at 3 mM Cu(II).
- The electrocatalysis was sustained for a long period of time with O_2 detected with a Faradaic efficiency of 97%.

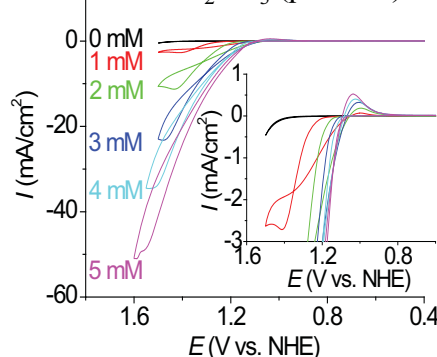
Chen, Z. F.; Meyer, T. J. "Copper(II) catalysis of water oxidation." *Angewandte Chemie International Edition* **2012**, submitted.

$$K_{\text{sp}}(\text{Cu}(\text{OH})_2) = 4.8 \times 10^{-20}$$

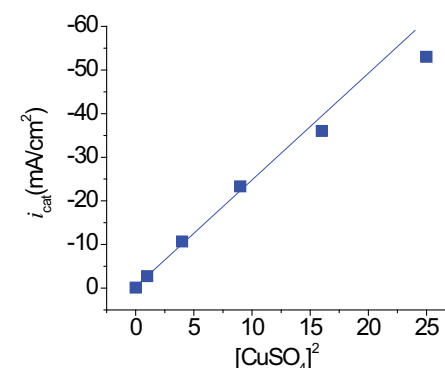
$$K_{\text{sp}}(\text{CuCO}_3) = 1.4 \times 10^{-10}$$



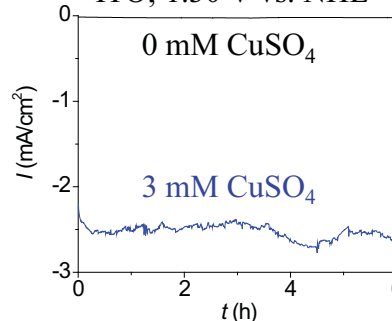
CV: BDD, 100 mV/s;
1 M Na_2CO_3 (pH 10.8)



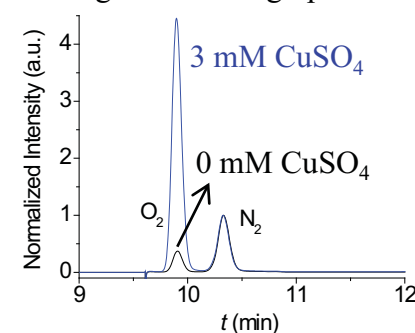
second order



Electrolysis:
ITO; 1.30 V vs. NHE



gas chromatographs



Work was performed at the University of North Carolina at Chapel Hill



U.S. DEPARTMENT OF
ENERGY

Office of
Science

