Applications of Quinone Redox Chemistry for Flow Batteries

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In order to make flow batteries cost-competitive for large-scale stationary storage, significant reductions must be made in the cost of the redox-active materials. Organic molecules such as quinones offer potentially dramatic cost reductions to the storage medium. Quinones also provide the ability to tune the redox and solubility properties of the molecules through the incorporation of various substituent groups onto the aromatic ring.

We will report the synthesis, chemical, and electrochemical properties of several substituted quinone molecules. These results indicate that quinones can be synthetically modified to span a range of reduction potentials, while showing rapid and reversible electrochemical kinetics. These molecules are strong candidates for large-scale energy storage in a flow battery.

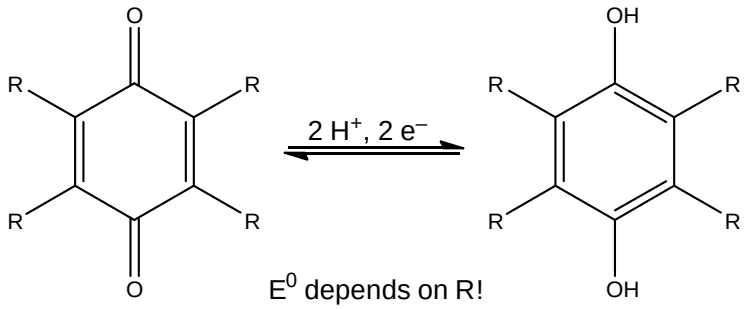

Figure 1. General two-electron redox scheme for a quinone molecule. Variation of the functional groups, R, can change the reduction potential by > 2 V.

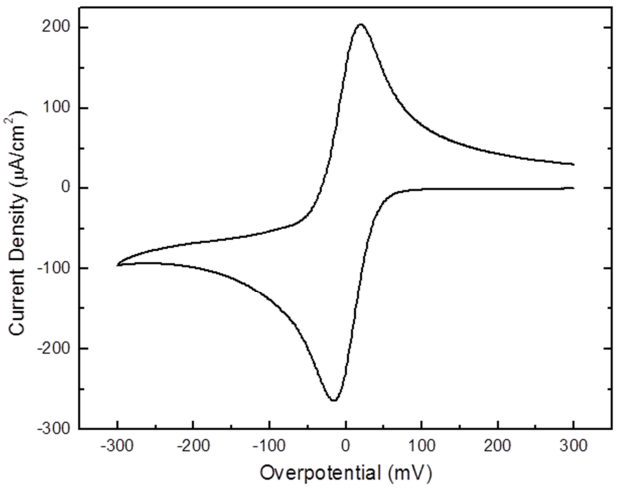

Figure 2. Cyclic voltammetry of a substituted quinone in 1 M sulfuric acid on a glassy carbon electrode at room temperature.