MODERNIZATION SOLAR

Quinone-based flow battery

Overview

Quinones are electroactive species that have shown great promise for redox flow batteries due to the ability to tune their properties and to act as both negative and positive electrolytes. The following review outlines highlights of work in the l. Quinones are electroactive species that have shown great promise for redox flow batteries due to the ability to tune their properties and to act as both negative and positive electrolytes. The following review outlines highlights of work in the last couple of years working to provide materials with higher stability, solubility, and performance. Developments toward stable negolytes have provided opportunities for potential commercial opportunities when paired with alternate chemistries. However, the stability of quinones in high potential electrolytes is still not sufficient and the number of potential quinones limited.••.

Quinones are redox-active molecules with good electrochemical reversibility and reaction rates. They are a class of metal-free organic compounds that consist of earth-abundant elements providing potentially low-cost redox flow batteries (RFBs) with synthetic tunability. Although these compounds show promise and may be found to be applicable for certain applications, they can suffer from stability issues, low solubility and/or low operating voltages which limits broad acceptance. For example, the solubility of the quinone is often pH dependent with limited solubility at neutral pH. Adding acid or base increases their solubility but greatly decreases their stability as the quinone can undergo various chemical reactions including Michael addition, epoxidation, nucleophilic attack, dimerization, and tautomerization.

Ideally, the redox flow battery utilizes quinones on both sides of the battery as shown in Figure 1. The RFB utilizes an oxidized version of one quinone and the reduced version of a different quinone (hydroquinone) for the two electrolytes and charging/discharging ideally involves converting between these two forms. The difference in redox potential for the two quinones provides the overall cell voltage.Unfortunately, a stable system has yet to be demonstrated. Until recently, the best quinones incorporated in the negolyte have shown stabilities of around 0.1%/day, whereas those on the positive side tend to only last tens of cycles. The stability of high potential quinones is the greatest technical difficulty for implementation of this ideal system.

SolubilityThe solubility of active species is the predominant parameter that determines the volumetric capacity of electrolyte in an RFB. As such, work has been performed to determine ways to increase the solubility and understand how it is impacted by other solution parameters [21]. These studies have led to models which semi-quantitatively [22] predict the solubility of different quinone systems as a function of substituent group and coordinating cation. The incorporated cation has been found to be very important [23] in neutral solution; the solubility of the salts 9,10-anthraquinone- 2,7-disulfonic acid increased from 0.58 M for sodium to 1.9 M for ammonium.

To increase the capacity of the quinone in the system, capacity boost.

Although there has been a large amount of work to develop quinone-based RFBs, the technology is not yet at a stage to be commercially viable for an all-quinone system; the stability of quinones in high potential electrolytes is not sufficient and these attempts have led to very low overall cell voltages. Electrolyte lifetime for various organic systems have been compared with vanadium systems [36] and stabilities less than 0.1%/day are required when considering replacement costs and project lifetime. Dramatic improvements are required, which (based on various computational models) may not be possible, even if the materials can be easily obtained from cheap raw materials.However, recent improvements in the achieved capacity and stability for quinon.

Do quinones have redox properties for organic flow batteries?

Here, we report a systematic study on the electrochemical characteristics of quinones for organic flow batteries with a combined experimental and computational method. The redox properties of quinones were found to be strongly dependent on the molecular aromaticity and their electronic structures.

Can quinone-based flow batteries be adapted to alkaline solutions?

We demonstrate that quinone-based flow batteries can be adapted to alkaline solutions, where hydroxylated anthraquinones are highly soluble and bromine can be replaced with the nontoxic ferricyanide ion (8, 9)—a food additive (10).

How does a redox flow battery work?

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Can redox-active organic molecules be used in alkaline flow batteries?

The battery operates efficiently with high power density near room temperature. These results demonstrate the stability and performance of redox-active organic molecules in alkaline flow batteries, potentially enabling cost-effective stationary storage of renewable energy.

Quinone-based flow battery

[An Aqueous All-Quinone-Based Redox Flow Battery ...]

Apr 26, 2024 · Considering the sustainability of energy storage devices, an aqueous all-quinone redox flow battery employing biomass-derived quinones and neutral electrolytes is reported ...

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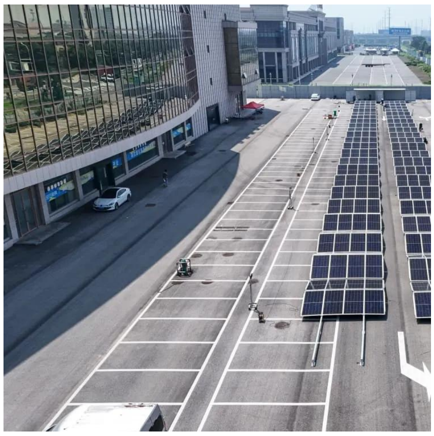


Computational design of quinone electrolytes for redox flow batteries

Jan 6, 2023 · These quinone molecules can attain low solvation-free energy and high HOMO-LUMO gap simultaneously, and thus can be used as candidate materials for quinone-based ...

[Quinones for Aqueous Organic Redox Flow ...]

Jul 17, 2023 · The emergence of quinone-based aqueous organic redox flow batteries (AQRFBs) represents an exciting advancement in ...

Quino Energy

Oct 29, 2025 · Our Mission Practical, Affordable Grid Storage We create water-based flow batteries that store electrical energy in organic quinone molecules for commercial and grid ...

High-Performance Aqueous Organic Flow ...

May 10, 2016 · We have demonstrated the repeated cycling of a redox flow cell based on water-soluble organic redox couples (ORBAT) at high ...

Exploring Bio-inspired Quinone-Based Organic Redox Flow Batteries...

Nov 10, 2016 · In contrast to recently reported quinone-based energy-storage systems, the Li-based non-aqueous flow battery combines the advantages of Li-ion batteries and flow ...

Alkaline quinone flow battery , Science

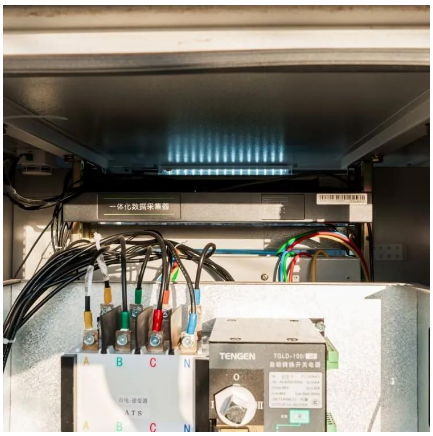
Sep 25, 2015 · Storage of photovoltaic and wind electricity in batteries could solve the mismatch problem between the intermittent supply of these renewable resources and variable demand. ...

Novel Quinone-Based Couples for Flow Batteries

Dec 30, 2024 · ABSTRACT Flow batteries are of interest for low-cost grid-scale electrical energy storage in the face of rising electricity production from intermittent renewables like wind and ...

A Water-Miscible Quinone Flow Battery with High ...

May 22, 2019 · A water-miscible anthraquinone with polyethylene glycol (PEG)-based solubilizing groups is introduced as the redox-active molecule in a negative electrolyte (negolyte) for ...



High-Performance Aqueous Organic Flow Battery with Quinone-Based ...

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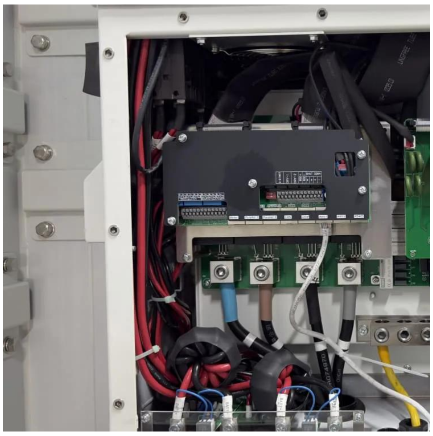

Computational design of quinone electrolytes ...

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Quinones for redox flow batteries

Oct 1, 2021 · Quinone chemistries Ideally, the redox flow battery utilizes quinones on both sides of the battery as shown in Figure 1. The RFB utilizes an oxidized version of one quinone and the ...

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