Cerium-zinc flow battery

What are zinc-cerium redox flow batteries (ZCBs)?
Zinc-cerium redox flow batteries (ZCBs) are emerging as a very promising new technology with the potential to store a large amount of energy economically and efficiently, thanking to its highest thermodynamic open-circuit cell voltage among all the currently studied aqueous redox flow batteries.

Why is zinc-cerium flow battery a good choice?
While the zinc-cerium flow battery has the merits of low cost,fast reaction kinetics,and high cell voltage,its potential has been restricted due to unacceptable charge loss and unstable cycling performance,which stem from the incompatibility of the Ce and Zn electrolytes.

What are the coulombic and voltage efficiencies of zinc-cerium redox flow batteries?
During charge/discharge cycles at 50 mA cm -2,the coulombic and voltage efficiencies of the zinc-cerium redox flow battery are reported to be 92 and 68%,respectively .

What is the life-cycle of a zinc-cerium redox flow battery (RFB)?
The life-cycle of a zinc-cerium redox flow battery (RFB) is investigated in detail by in situ monitoring of the half-cell electrode potentials and measurement of the Ce (IV) and H + concentrations on the positive and negative side, respectively, by titrimetric analysis over its entire life.

Which electrolyte is used in a zinc cerium & NRS redox flow cell?
In a zinc cerium &NRS redox flow cell,Ce 3+/Ce 4+&NRS mixed electrolyteis used as positive electrolyte. In alkaline solution,the electrode reaction of NRS exhibits sluggish electrode kinetics. On the contrary,with rising acid concentration,it exhibits faster electrode kinetics and a diffusion-controlled process.

Are anion exchange membranes important for zinc-cerium redox flow batteries?
This analysis revealed that the use of anion exchange membranes with extremely low proton leakage and high stability in the presence of Ce (IV) is keyfor the ultimate success of zinc-cerium redox flow batteries. Kiana Amini: Investigation,Methodology,Data curation,Writing - original draft.

A neutral zinc-iron redox flow battery (Zn/Fe RFB) using K 3 Fe(CN) 6 /K 4 Fe(CN) 6 and Zn/Zn 2+ as redox species is proposed and investigated. Both experimental and theoretical results verify that bromide ions could stabilize zinc ions via complexation interactions in the cost-effective and eco-friendly neutral electrolyte and improve the redox reversibility of Zn/Zn 2+.

While the zinc-cerium flow battery has the merits of low cost, fast reaction kinetics, and high cell voltage, its potential has been restricted due to unacceptable charge loss and unstable cycling performance, which stem from ...

The ebb and flow: The hybrid redox flow battery (RFB) Zn-Ce has the highest open-circuit cell potential at 2.4 V, amongst other aqueous RFBs.This review considers the thermodynamics and kinetics aspects of the Ce IV /Ce III ...

Scientists in Hong Kong have designed a redox flow battery with electrolytes made of zinc and cerium. They claim to have solved the incompatibility issue posed by these two elements. The device ...

Abstract: Cerium-Zinc redox flow battery has a significant high voltage compared with other redox flow batteries. The potential utilization of cerium-zinc redox flow battery is most likely to occur in energy storage system due to the abundant resources of raw materials and cost-efficient products. This review summarized the recent research and ...

Zinc-cerium flow battery, featuring a high open circuit voltage (2.4 V) and energy density, commonly employs methanesulfonic acid as an electrolyte to augment cerium ion solubility [41, 42]. In addition, zinc-manganese flow battery and zinc-lead dioxide flow battery have also been studied due to their high voltage [43].

One such device that has been successfully scaled up and commercialized is the Zinc-Cerium (Zn-Ce) redox flow battery. The Zn-Ce flow battery has been investigated widely in the lab and on the market since its inception in 2005. Its open-circuit cell potential may exceed 2.4 V when completely charged, making it the highest of all aquatic RFBs.

Zinc-cerium redox flow batteries. The Zn-Ce RFB benefits from the high positive standard potential of the Ce(III)/Ce(IV) redox couple and is made possible by the ample solubility of cerium ions in methanesulfonic acid solutions [120]. This battery was introduced in 2004 in a US Patent application [55], as a logical spin-off to the routine ...

The zinc-cerium flow battery has been considered by research groups at the universities of Southampton [11-14] and Strathclyde [15, 16]. It realizes a relatively high open-circuit cell potential by combining the zinc half-cell with a Ce(IV)/Ce(III) redox half-cell, both electrolytes often being methanesulfonic acid based, and the cell is ...

The life-cycle of a zinc-cerium redox flow battery (RFB) is investigated in detail by in situ monitoring of the half-cell electrode potentials and measurement of the Ce(IV) and H + concentrations on the positive and negative side, respectively, by titrimetric analysis over its entire life. At a current density of 25 mA cm - 2, the charge efficiency of the battery is initially limited ...

At 50% state of the charge, the exchange current density for zinc oxidation was estimated to be 7.4 mA cm-2, while the corresponding value for cerium reduction was found to be 24.2 mA cm ...

Characterization of a zinc-cerium flow battery. J. Power Sources, 196 (2011), pp. 5174-5185. View PDF View

article View in Scopus Google Scholar [14] G. Nikiforidis, L. Berlouisa, D. Hallb, D. Hodgsonb. Evaluation of carbon composite materials for the negative electrode in the zinc-cerium redox flow cell.

Redox flow cells batteries: zinc - cerium is a research project within Engineering and the Environment at the University of Southampton. ... Redox flow batteries often use an ion-exchange membrane similar to that of fuel cells; hence they ...

Redox flow battery: A Zn-Ce redox flow battery based on choline chloride ethylene glycol deep eutectic solvent was studied. The open-circuit voltage of the battery reaches 2.2 V, and the coulombic efficiency of the ...

Taking the zinc-iron flow battery as an example, a capital cost of $95 per kWh can be achieved based on a 0.1 MW/0.8 MWh system that works at the current density of 100 mA cm-2 [3]. Considering the maturity of zinc-based flow batteries, current cost analysis methods or models remain to be improved since the costs of control systems as well as ...

The zinc-bromine flow battery (ZBFB) has a theoretical voltage of 1.85 V and a high energy density, but the problem of zinc dendrites and the toxicity of Br 2 at the positive electrode are still unavoidable [19]. Therefore, it is urgent to develop a new type of aqueous flow battery with high voltage, high energy density and non-toxicity.

The early development of zinc-cerium flow battery has been reviewed by Walsh et al. [176]. Future work on this system should focus on low-cost, chemically stable electrodes and electrolytes to dissolve more cerium species at low acid concentrations. Electrolyte additives for improving morphologies and inhibiting corrosion of the zinc ...

Consequently, the validated model can be used for further predictions of the performance of this bench-scale zinc-cerium redox flow battery. 6.2. Applied current density. An important operating parameter that affects charge/discharge cycling of the RFBs and can influence the output charge and voltage efficiencies is the applied current density.

The benefits and limitations of zinc negative electrodes are outlined with examples to discuss their thermodynamic and kinetic characteristics along with their practical aspects. Four main types of redox flow batteries employing zinc electrodes are considered: zinc-bromine, zinc-cerium, zinc-air and zinc-nickel.

Leung P, Ponce-de-León C, Low C, Shah AA, Walsh F (2011) Characterization of a zinc-cerium flow battery. J Power Sour 196(11):5174-5185. Article CAS Google Scholar Huang SL, Yu HF, Lin YS (2017) Modification of Nafion® membrane via a sol-gel route for vanadium redox flow energy storage battery applications.

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