Iron flow battery efficiency

Iron flow battery efficiency

The Iron Redox Flow Battery (IRFB), also known as Iron Salt Battery (ISB), stores and releases energy through the electrochemical reaction of iron salt. This type of battery belongs to the class of redox-flow batteries (RFB), which are alternative solutions to Lithium-Ion Batteries (LIB) for stationary applications.

The constructed all-liquid all-iron flow battery provided a 100-cycle life-span with a high coulombic efficiency of 99.5% at 80 mA cm -2. Although exciting improvements were achieved by the chelation of ligand with iron ions and many different ligands had been proposed to complex with ferric/ferrous ions, the mechanism of ligands stabilizing ...

Redox flow batteries (RFBs) are promising choices for stationary electric energy storage. Nevertheless, commercialization is impeded by high-cost electrolyte and membrane materials. Here, we report a low-cost all-iron RFB that features inexpensive FeSO 4 electrolytes, microporous membrane along with a glass fiber separator.

We have demonstrated a high-efficiency iron-chloride redox flow battery with promising characteristics for large-scale energy storage applications. The advances demonstrated in this study show a path for the deployment of large-scale systems based on the iron-chloride flow battery concept originally discussed by Savinell and others.

The Electrochemical Society (ECS) was founded in 1902 to advance the theory and practice at the forefront of electrochemical and solid state science and technology, and allied subjects.

A schematic of the principle of operation of this system is shown in Figure 1. The redox chemistry of the iron-chloride redox flow battery is based on the iron (II) chloride/iron (III) chloride couple at the positive electrode and the iron (II) chloride/metallic iron couple at the negative electrode. The reactions that take place during the charging and discharging of an iron-chloride redox flow battery are shown schematically in Figure 1 and in the following chemical equations.

Figure 1. Schematic of the principle of operation of an iron-chloride redox flow battery. In the chemical equations, "d" and "c" refer to discharge and charge, respectively.

During discharge of the battery, iron (III) chloride is reduced to iron (II) chloride at the positive electrode. At the negative electrode, metallic iron is dissolved into the electrolyte as iron (II) chloride; these processes are

reversed during battery charging (Eqs. 1 and 2). The open-circuit voltage of the iron-chloride redox flow battery is about 1.21 V.

While the early work by Savinell and Bartolozzi et al. outlined the various factors that affect the performance of the iron-chloride redox flow battery system, subsequent reports aiming at addressing these technical challenges are scarce in the literature. Recently, the results from the operation of a 1 kW "all-iron" system operating at 50 A and 20 V has been reported by Trunov and Yminskii. It was a 20-cell system with 1 m2 electrodes and was cycled for about 20 times yielding an energy density of 3.3 kWh/m3.23

During charging of the iron-chloride redox flow battery, the reaction at the negative electrode is the deposition of iron by the electro-reduction of ferrous ions (Eq. 2). The standard reduction potential of the Fe2+/Fe couple is -0.44 V and is about 440 mV more negative to that for the hydrogen evolution reaction (Eq. 4).