

## Improvement of Faradaic Efficiency of Iron Electrode for Iron-Chloride Redox Flow Battery

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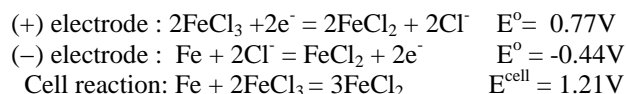
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Renewable electricity generation has become important for energy security and protection of the environment. However, this type of energy generation requires large-scale energy storage systems to deal with the intermittency of generation. Specifically an eco-friendly, scalable and inexpensive energy storage system is needed [1].

Among the several types of redox flow batteries under consideration, the iron-chloride redox flow battery can be a promising candidate for addressing the challenge of future energy storage systems. Iron as a low-cost, non-toxic, and abundant material is attractive for an eco-friendly large-scale energy storage system. The first report of the iron-chloride redox flow battery was by Hruska and Savinell in 1981[2].

The reactions in the iron chloride redox flow battery are shown below:



Since the reversible potential for hydrogen evolution is more positive to that of the iron deposition reaction, hydrogen evolution reaction occurs unavoidably at the negative electrode during charging. Hydrogen evolution decreases the charging efficiency to as low as 50% depending on the electrolyte composition [2]. The low charge efficiency causes reduction of round trip energy efficiency and loss of electrolyte.

This study focuses on finding the optimal electrolyte composition and experimental conditions for achieving high faradaic efficiency at the negative electrode in an iron-chloride redox flow battery.

A 3 molar solution of ferrous chloride solution was prepared at room temperature under argon flow. The argon flow prevents the oxidation of the ferrous ion. Electro-deposition and electro-dissolution of iron was studied using a glassy carbon rotating disc working electrode (RDE). A Ag/AgCl electrode was used as the reference electrode, while a platinum electrode served as the counter electrode. The experiments were conducted at various current densities and rotation rates. The faradaic efficiency of deposition was measured under various experimental conditions.

In highly acidic media, iron electro-deposition competes

with hydrogen evolution. Faradaic efficiency values as high as 95% was achieved at pH 2 (Figure 1). Therefore, pH is a critical factor in achieving high faradaic efficiency.

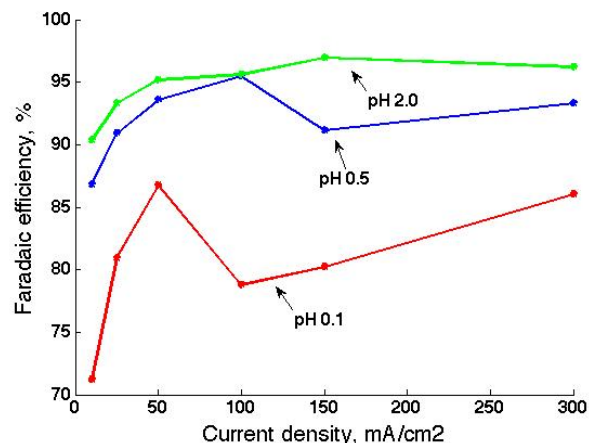


Figure 1. Effect of electrolyte pH and current density on the faradaic efficiency of iron deposition.

### Acknowledgement

The authors acknowledge the financial support for this research from US Army RDECOM CERDEC C2D.

### References

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