



Title	Alkaline-based hydrogen bromine fuel cell
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The hydrogen bromine (H₂-Br₂) fuel cell system is an attractive system for electrical energy storage because of its high round-trip conversion efficiency, high power density capability, and anticipated low costs. The hydrogen-bromine fuel cell system can be operated in the acid or alkaline modes as shown by below.

Acid-based H₂-Br₂ System

Negative: H₂ → 2H⁺ + 2e⁻, Positive: Br₂ + 2e⁻ → 2Br⁻,



(E_{ored} = 0.0V) (E_{ored} = 1.09V)

Acid System

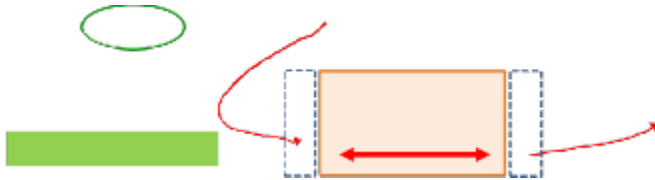
Membrane

H⁺

2Br⁻ + 2H⁺ → 2HBr

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Overall: H₂ + Br₂ → 2HBr + electricity, E_o = 1.09V

Alkaline-based H₂-Br₂ System



Negative: H₂ + 2K⁺OH⁻ → 2H₂O + 2K⁺ + 2e⁻, Positive: Br₂ + 2e⁻ → 2Br⁻,

(E_{ored} = -0.83V) (E_{ored} = 1.09V)

Alkaline System

Membrane

K⁺

2Br⁻ + 2K⁺ → 2KBr



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Overall: $H_2 + 2KOH + Br_2 \rightarrow 2KBr + 2H_2O + \text{electricity}$, $E_0 = 1.92V$

Figure 1 shows schematics of the cell configuration of these two systems. The main difference is the additional compartment for KOH solution between the negative electrode and the membrane for the hydrogen reactions.

The alkaline H_2 - Br_2 fuel cell was studied recently by us because of its advantages over the acid system such as higher cell potential, low cost catalyst for the hydrogen evolution and oxidation reactions and lower

corrosivity. The results from that study confirmed that this system can deliver a higher cell voltage and that

the reaction rates of the hydrogen and bromine reactions in alkaline solution (KOH) were as fast as in acid solution (HBr). The results also showed that high power density performance could be obtained and its current performance was limited by high cell internal resistance, due mainly to high ionic resistance of the potassium ion (K^+) conducting membrane. [1]

This presentation will discuss new development in the alkaline H_2 - Br_2 fuel cell.

Acidic System

Alkaline System

HBr/ Br_2

In

KOH In

KBr/ Br_2

In

H_2 In

H_2 In

H_2 Out

H_2

Electrode

(single phase)

Br₂

Electrode

HBr/Br₂ Out

H₂ Out

H₂

Electrode

(two phase)

KOH Out

Br₂

Electrode

KBr/Br₂ Out

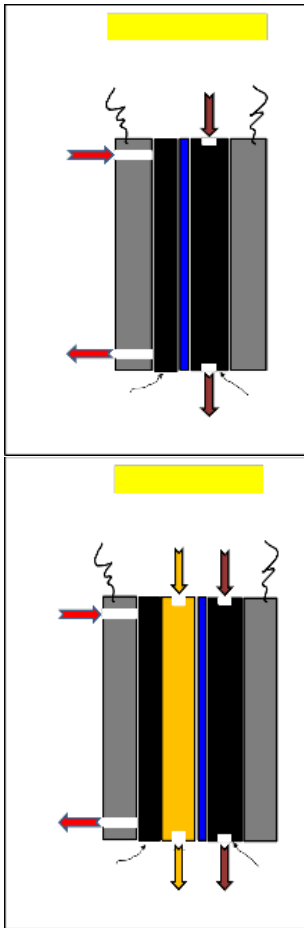


Figure 1. Cell configurations of the acid and alkaline H₂-Br₂ fuel cell systems

Reference:

1) T.V. Nguyen, V. Yarlagadda, G. Lin, G. Weng, C.-Y. Li, and K.-Y. Chan, "Comparison of Acid and Alkaline Hydrogen-Bromine Fuel Cell Systems," *ECS Transactions*, Vol. **58**, No. 37 (2014).

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