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<th><strong>Title</strong></th>
<th>Alkaline-based hydrogen bromine fuel cell</th>
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<td><strong>Author(s)</strong></td>
<td>Nguyen, TV; Yarlagadda, V; Konwar, D; Chan, GKY</td>
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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: $\text{H}_2 \rightarrow 2\text{H}^+ + 2e^-$, Positive: $\text{Br}_2 + 2e^- \rightarrow 2\text{Br}^-$,

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

**Acid System**

Membrane

H+

$2\text{Br}^- + 2\text{H}^+ \rightarrow 2\text{HBr}$

---------- Overall: $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr} + \text{electricity}$, $E_0 = 1.09V$

**Alkaline-based H2-Br2 System**

Negative: $\text{H}_2 + 2\text{K}^+ + \text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{K}^+ + 2e^-$, Postive: $\text{Br}_2 + 2e^- \rightarrow 2\text{Br}^-$,

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

**Alkaline System**

Membrane

K+

$2\text{Br}^- + 2\text{K}^+ \rightarrow 2\text{KBr}$
Overall: $\text{H}_2 + 2\text{KOH} + \text{Br}_2 \rightarrow 2\text{KBr} + 2\text{H}_2\text{O} + \text{electricity}$, $E_0 = 1.92\text{V}$

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 H2-Br2 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 H2-Br2 fuel cell.

**Acidic System**

**Alkaline System**

$\text{HBr/Br}_2$

In

$\text{KOH In}$

$\text{KBr/Br}_2$

In

$\text{H}_2 \text{ In}$

$\text{H}_2 \text{ In}$

$\text{H}_2 \text{ Out}$

$\text{H}_2$

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:

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