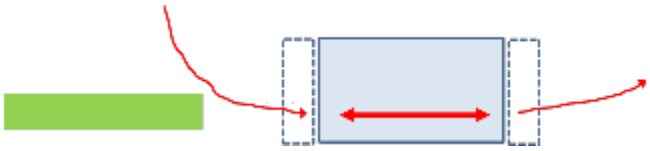
The hydrogen bromine (H2-Br2) fuel cell system is an attractive system for electrical energy storage because of its high round-trip conversion efficiency, high power density capability, and anticipated low costs. The hydrogen-bromine fuel cell system can be operated in the acid or alkaline modes as shown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

Acid-based H2-Br2 System

Negative: H2 ?? 2H+ + 2e-, Positive: Br2 + 2e- ?? 2Br-,



(Eored = 0.0V) (Eored = 1.09V)

Acid System

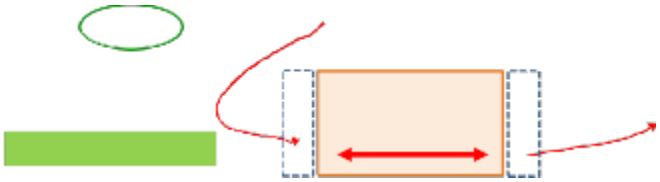
Membrane

H+

2Br- + 2H+ ?? 2HBr

========== Overall: H2 + Br2 ?? 2HBr + electricity, Eo= 1.09V

Alkaline-based H2-Br2 System



Negative: H2 + 2K+OH- ?? 2H2O + 2K+ + 2e-, Postive: Br2 + 2e- ?? 2Br-,

(Eored = -0.83V) (Eored = 1.09V)

Alkaline System

Membrane

K+

2Br- + 2K+ ?? 2KBr

==========

Overall: H2 + 2KOH + Br2 ?? 2KBr + 2H2O + electricity, Eo= 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 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

HBr/Br2

In

KOH In

KBr/Br2

In

H2 In

H2 In

H2 Out

H2

Electrode

(single phase)

Br2

Electrode

HBr/Br2 Out

H2 Out

H2

Electrode

(two phase)

KOH Out

Br2

Electrode

KBr/Br2 Out

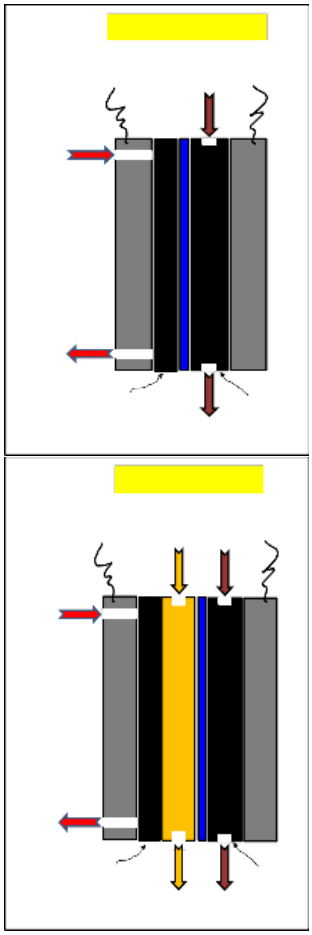


Figure 1. Cell configurations of the acid and alkaline H2-Br2 fuel cell systems

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).

Acknowledgements

This work was funded by the National Science Foundation through grant number EFRI-1038234 and
Research Grants Council of Hong Kong through a General Research Fund (GRF HKU 700210P).