H_2/Br_2 Flow Battery for Grid-Scale Energy Storage

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Office of Science

Purpose

Develop a low-cost, energy-storage system with high power density at 80% efficiency

Use H_2 and Br_2 in a flow battery

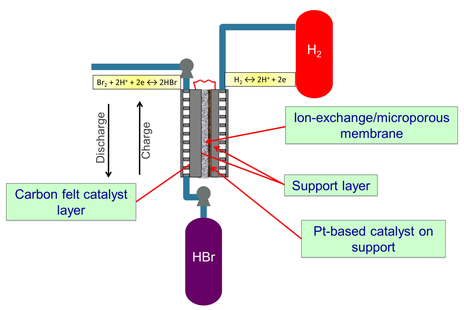
Progress (past year)

Improve cell performance of system with low-cost chemicals with excellent kinetics

Future Plans

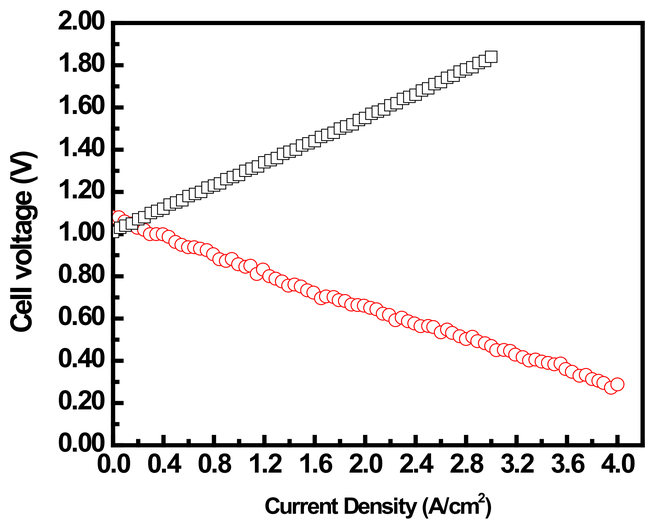
Scale-up; cycleability and durability

Project 16 k+ cycles w/< 20% power loss

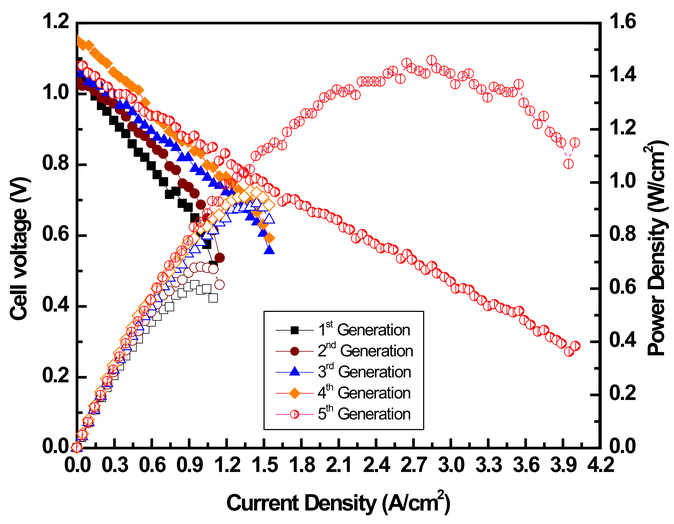


No noticeable side reactions up to 1.8 V

No mass transfer limit at 4 A/cm^2



23°C

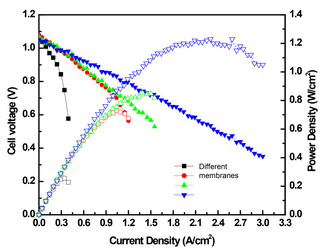


High peak power (1.4 W/cm^2)

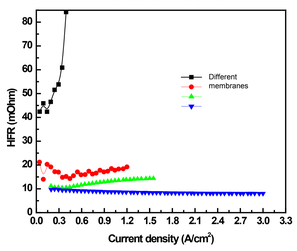
High power at high efficiency

Voltaic efficiency	PD (W/cm^2)
80 %	0.99
90 %	0.60

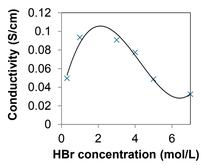
Thinner membranes reduce ohmic losses



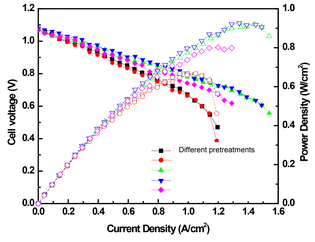
Some membranes show reduction in impedance with increase in current

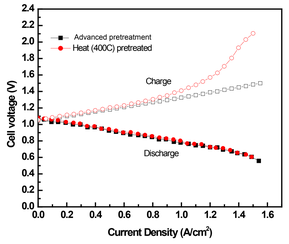


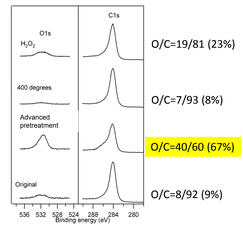
Membrane conductivity is a function of HBr concentration



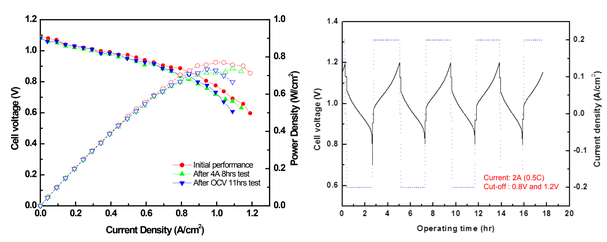
Pretreatment reduces impedance, increases surface oxygen, and decreases side reactions





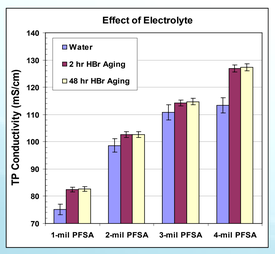


Good short-term durability but some capacity decay

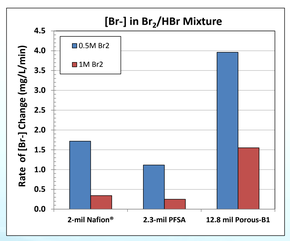


Membrane Development

Stability

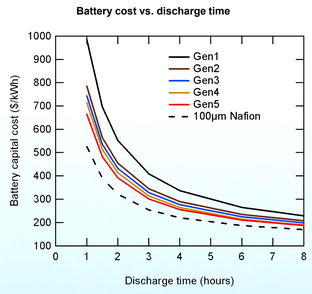


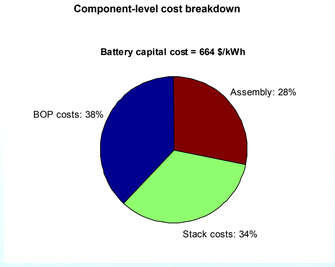
Br$^-$ Crossover



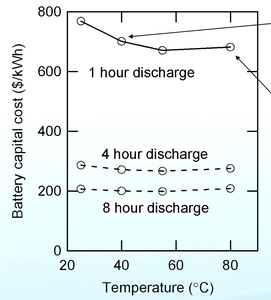
Modeling

System Costs





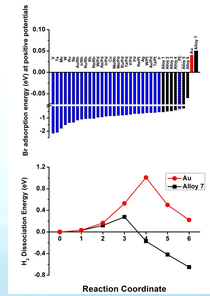
Performance Optimization



Below ~55°C the cost *falls* because the cell impedance is decreasing, leading to higher power at a given efficiency and a smaller (less expensive) stack

Above ~55°C the cost *rises* because the equilibrium potential is falling, leading to the reactants storing less energy

Bromine resistant catalysts



Acknowledgements

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