An Inexpensive Metal-free Organic Redox Flow Battery (ORBAT) for Grid-Scale Storage

Awardee: *University of Southern California, Loker Hydrocarbon Research Institute*
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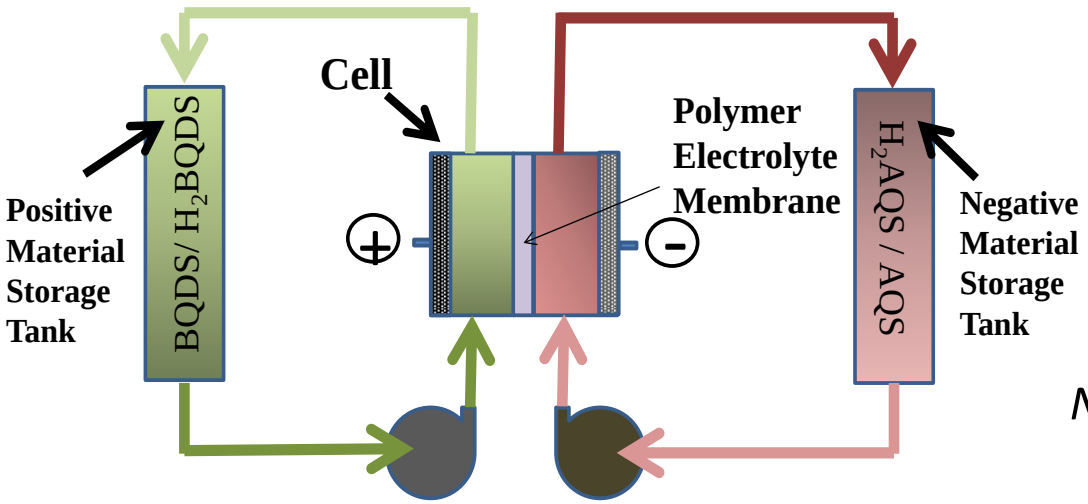
Advantages:

- *No toxic metals or organic solvents*
- *Extremely Low Materials Cost: $10-20/kWh*
- *Low System Cost <$100/kWh*

Demonstrated under ARPA-E Project :

- Identified stable and rechargeable redox couples
- Hundreds of cycles without loss of capacity
- Discharge rates up to 200 mA/cm^2



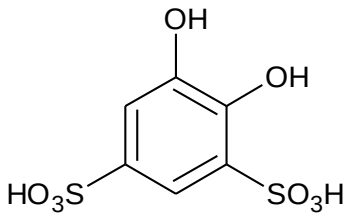
<u>Positive Electrode Reaction</u>

$BQDS + 2H^+ + 2e^- \Leftrightarrow H_2BQDS \quad E^o = +0.85\ V$

<u>Negative Electrode Reaction</u>

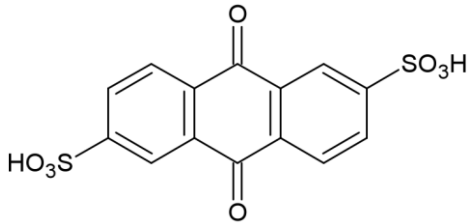
$AQDS + 2H^+ + 2e^- \Leftrightarrow H_2AQDS \quad E^o = +0.09\ V$

Positive Material:



BQDS = 1,2-benzoquinone -3,5-disulfonic acid

Negative Material:



AQDS = Anthraquinone-2,6-disulfonic acid