Aluminium-ion battery

Sustainable energy for the future

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The future and market size

By 2030, the battery market is projected to be worth $322 billon, and the renewable energy market at $2 trillion.

Fossil fuels will most likely be replaced by a mixture of wind, solar, battery storage and nuclear. In order to capitalize on wind and solar it's crucial to manufacture a cheap and sustainable battery chemistry.

Its therefore important to diversify to thrive in the future. Petroleum is one of the largest industry at $2 trillion, but it can decline after 2030.

The solution

I wish to propose the most affordable, environmentally friendly, ethical, and sustainable battery chemistry we have, also known as the aluminum-ion battery. With an energy density of 135Wh/kg(1) and a material cost of $14.8/kWh.

Considering that pre-made graphite foil, pre-made aluminum foil, AlCl3, and urea have an average cost per kilogram of $2/kg. We can calculate that it would require approximately 7.4kg of materials to produce 1kWh of energy, resulting in a material cost of 7.4kg x $2/kg = $14.8/kWh. All that's needed is to mix the electrolyte, create a jellyroll, and the battery is ready. The estimated cost is around $35-40/kWh.

(1) https://chemistry-europe.onlinelibrary.wiley.com/doi/full/10.1002/celc.202100183

Competition

It's perfectly suited for grid storage and to compete against CATL's upcoming sodium-ion chemistry which will initially cost $77/kWh.

Sodium-ion (CATL):

CATL has a P/E of 25, when Shell has P/E of 7.5. A greener company is worth more to investors.

Disadvantage over Aluminium-ion

-Lower recyclability.

-Difficult to produce, and more expensive.

-Theoretical energy density at 200Wh/kg. Aluminium-ion at 1060Wh/kg.

Hydrogen–bromine redox flow battery (Shell/Melody):

Disadvantage over Aluminium-ion

-Currently cost over $220/kWh. (Can potentially cost $28/kWh)

-Low energy density(no figures). (Limited to grid storage market segment)

Funding, partners and research

When it comes to research and mass manufacturing. We can look at Freyr and Norway's first battery factory. They received $573 million(2) in funding from the EU for lithium-ion manufacturing. However, it's crucial to remember that lithium-ion has ethical concerns and lacks substantial investment in mining for a steady future supply. Aluminium-Ion can be produced by using materials solely from Europe or the US(important for funding).

- Further research and preparation for mass manufacturing will be done with Fraunhofer- Gesellschaft(Open access research), Siemens/Sick(Manufacturing equipment), Rio Tinto/Hydro(Aluminium), SGL(graphite), Munroe & Associates(Cell Engineering).
- I've conducted further research on the electrolyte to push its stability and operating temperature to (-40℃ to 200℃).

(2)https://www.reuters.com/world/europe/five-norwegian-green-industry-projects-receive-573-mln-eu-funding-2023-07-14/