Group develops environmentally friendly liquid battery

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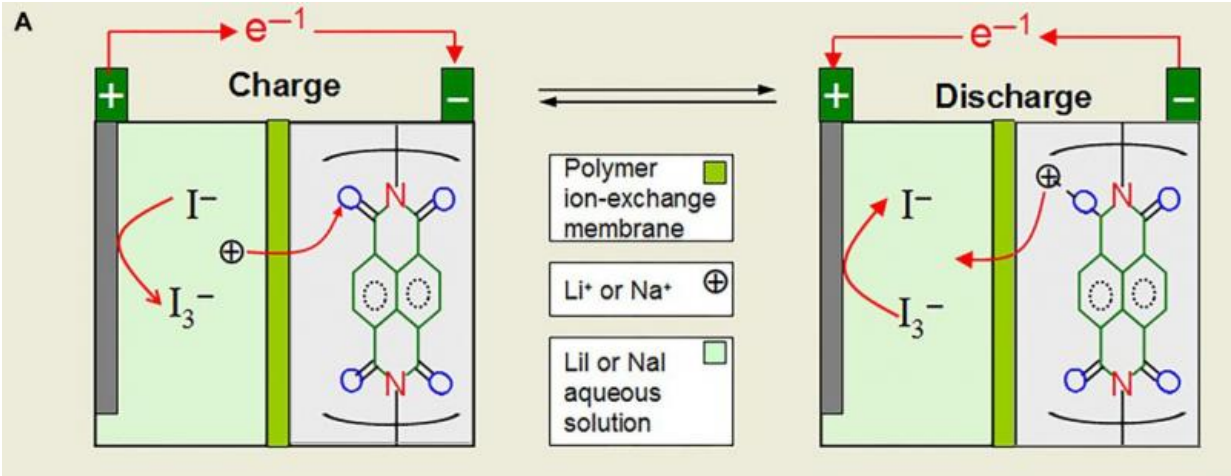

Schematic illustration of cell structure. Credit: *Science Advances* (2016). DOI: 10.1126/sciadv.1501038

(Tech Xplore)—A small team of researchers at Fudan University, in China has developed a liquid battery that is more environmentally friendly than others of its kind. In their paper published in the journal *Science Advances*, the team describes the idea for their battery, the parts of it that have been tested already and its many positive attributes.

Because of the large scale nature of power storage for large solar or wind collection schemes, liquid batteries are used, but to date, none of those developed are environmentally friendly or safe for those in the

immediate area (most contain components that are flammable, toxic, corrosive or need to be kept in a very hot environment). For that reason scientists continue to look for better alternatives. In this new effort, the team in China reports that they have developed an environmentally friendly Li (or Na) ion battery that is not just kinder to the environment, but has faster electrode kinetics and an extremely long life.

The battery (which is still in the proof-of-concept phase) is made using triiodide ions and a water-soluble iodide to make a cathode which is dissolved in a water based electrolyte that has either lithium or sulfur ions in it, an anode that is solid and made of a polymer of imide monomers, and a polymer membrane that sits between the anode and cathode to allow for diffusing ions. The creative team notes that neither the anode or cathode or the electrolytes rely on the use of metals, which makes the battery much nicer on the environment. They also note that testing revealed it capable of carrying out 50,000 cycles, which far surpasses other conventional batteries. It can also be discharged or charged as quickly as just 6.6 seconds, which is also much better than conventional batteries, and puts it in competition with super-capacitors. They also calculated that versions of their battery would have energy densities of between 63.8 and 65.3 watt hours per kilogram, which is in the same ballpark as other mass storage liquid batteries.

The team is not sitting on its laurels, they plan to continue their research to find ways to make such batteries bigger and with improved energy densities. Also, it is still not clear if the battery would be economically feasible.

More information: X. Dong et al. Environmentally-friendly aqueous Li (or Na)-ion battery with fast electrode kinetics and super-long life, *Science Advances* (2016). DOI: 10.1126/sciadv.1501038

Abstract

Current rechargeable batteries generally display limited cycle life and slow electrode kinetics and contain environmentally unfriendly components. Furthermore, their operation depends on the redox reactions of metal elements. We present an original battery system that depends on the redox of I−/I3− couple in liquid cathode and the reversible enolization in polyimide anode, accompanied by Li+ (or Na+) diffusion between cathode and anode through a Li+/Na+ exchange polymer membrane. There are no metal element–based redox reactions in this battery, and Li+ (or Na+) is only used for charge transfer. Moreover, the components (electrolyte/electrode) of this system are environment-friendly. Both electrodes are demonstrated to have very fast kinetics, which gives the battery a supercapacitor-like high power. It can even be cycled 50,000 times when operated within the electrochemical window of 0 to 1.6 V. Such a system might shed light on the design of high-safety and low-cost batteries for grid-scale energy storage.

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