Modern Aqueous Batteries Exceed Conventional Boundaries

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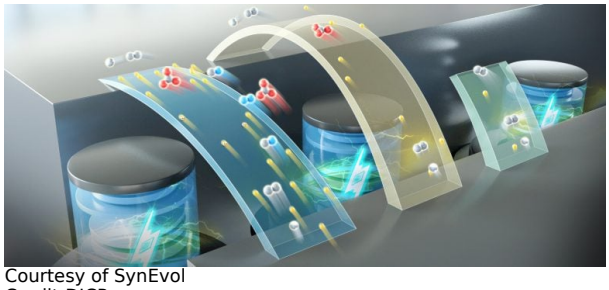

Courtesy of SynEvol
Credit:DICP

Despite having a high energy density, conventional lithium-ion batteries are less safe due to the usage of organic electrolytes that can catch fire.

The safety of aqueous batteries is greatly increased by using water as the electrolyte solvent. However, aqueous batteries usually have a lower energy density because of the low battery voltage and the limited solubility of the electrolyte. This indicates that there is not much electricity stored in an aqueous battery per unit volume.

The Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) and Prof. Fu Qiang's group from DICP collaborated to develop a multi-electron transfer cathode based on bromine and iodine, realizing a specific capacity of over 840 Ah/L and achieving an energy density of up to 1200 Wh/L based on catholyte in full battery testing, according to a recent study published in Nature Energy.

Researchers employed a mixed halogen solution of iodide ions (I–) and bromide ions (Br–) as the electrolyte in order to increase the energy density of aqueous batteries. In a multi-electron transfer reaction, they first transferred I–to the iodine element (I2) and subsequently to the iodate (IO3–). I– was oxidized to IO3– on the positive side during the charging process, and the H+ that was produced was transmitted to the negative side in the form of a supporting electrolyte. H+ was conducted from the positive side throughout the discharge process, resulting in the reduction of IO3– to I–.

The multi-electron transfer cathode that was created possessed a specific capacity of 840 Ah/L. Based on the created catholyte, researchers were able to attain an energy density of up to 1200 Wh/L when combining the cathode with metallic Cd to build a whole battery.

Researchers also verified that the addition of Br–to the electrolyte might produce polar iodine bromide (IBr) during the charging process, hence promoting the formation of IO3–through interaction with H2O. In order to get a quick and reversible discharge of IO3–, IO3– could oxidize Br– to Br2 and take part in the electrochemical reaction. Because of this, the bromide intermediate that was created during the charge and discharge process enhanced the electrochemical reaction's kinetics and reversibility.

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