

Flow batteries russia

Flow batteries consist of two containers filled with liquids that can be oxidised or reduced. The containers are separated by a thin membrane that prevents the liquids from mixing but allows the ions contained therein to pass through. By rising to the membrane, the liquids interact, as a result of which one of them becomes oxidised (gives up electrons) and the other becomes reduced (accepts electrons), leading to the generation of the electric current.

Unlike lithium-ion batteries, flow batteries do not require the use of special cooling systems, and their efficiency (i.e., the ability to regenerate accumulated electricity) does not decrease even after 10,000 charge-discharge cycles. However, the implementation of flow batteries is impeded by the use of expensive and environmentally unsafe vanadium salts. One solution could be the use of water-soluble polymers.

Such was the solution proposed by the scientists from Lomonosov Moscow State University, who have developed organic water-soluble polymer nanogels capable of reversible oxidation and reduction. The authors of the study chemically synthesised nano-sized polymer networks from individual water-soluble monomers (organic molecules), after which they attached redox groups of atoms capable of accepting and giving up electrons in chemical reactions to the resulting compounds.

At the last stage of the process, the physicists assessed the rate, at which the oxidation and reduction of nanogel molecules occurred depending on the content of redox groups. Experiments have shown that the concentration of such groups should be 50% of the total content of organic molecules in the solution. It is under these conditions that nanogels are most effective as the main electroactive component providing for the reliable operation of aqueous organic flow batteries.

Researchers claim to have developed a cheaper, faster method of assembling the field flow plate layers of the membrane electrode assembly used in vanadium redox flow batteries, which they claim outperforms traditional components.

Researchers from the Institute of Problems of Chemical Physics - part of the Russian Academy of Sciences (RAS) - claim their method of assembling graphite flow field plates is faster and cheaper than the existing approach and will make the technology more accessible to research.

Flow field plates are layers in the membrane electrode assembly that pump electrolytes to electrodes for oxidation or reduction and are typically milled in dense graphite plates in a process the Russian group described as time-consuming.

The researchers claim testing confirmed a vanadium-sulfuric acid electrolyte used with the new flow field plates "outperforms the cell with conventional graphite plates with the same parameters of the flow field."

"We have proposed a completely new design of MEA which will facilitate the research process and greatly reduce [the] entrance threshold for new research groups into this area," said research co-author Dmitry Konev. "In the future, this will help to achieve significant progress and will bring distributed energy resources from [a] niche positioning to [a] very high level of commercialization, including in Russia."

The device which featured the novel field flow plates has been described in the study Electrolyte Flow Field Variation: A Cell for Testing and Optimization of Membrane Electrode Assembly for Vanadium Redox Flow Batteries, published in Chemistry Europe, and showed 734 mW/cm² of peak power density and 84.3% energy efficiency.

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