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IIT-H DEVELOPS ALTERNATIVE TO LITHIUM-ION BATTERIES

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The Electrochemical Energy Storage (EES) Lab at IIT-Hyderabad has developed a 5V Dual Carbon Battery utilising self-standing carbon fiber mats as both electrodes (cathode and anode). This new model sets aside the requirement of toxic, costly and heavy transitional metals.

Energy economy based on renewable sources has been put forward as a way out to reduce dependence on fossil fuel. Rechargeable lithium-ion batteries (LIBs) are projected to meet future electric mobility, electric aviation, and stationary grid energy storage targets by 2030.

However, LIBs need toxic and costly metals like cobalt, nickel, manganese and other materials to function. Geologically unsymmetrical distribution of lithium and cobalt along with geopolitics and unethical child labour centered on mining causes fluctuations in raw material cost. It affects market price stability of large LIB packs used in electric vehicles.

In the dual-carbon battery, both the electrodes consist of carbonaceous materials, and the ions from the electrolyte intercalate and de-intercalate into the electrode matrix.

The novel dual carbon battery consisting of zero transition metal may cut down the overall battery cost by 20-25% and is expected to curb the unpredictability in market price.

The use of ubiquitous carbon as electrode active material as well as current collector replacing heavy metals brings in the aspects of lightness and flexibility. The fabricated 5.0 voltage (nominal voltage 4.6 V) cell provides an energy density of 100-watt hour per kilogram approximately and can be extended up to 150-watt hour per kilogram with further modifications.

The research team believes that developed cells may find potential use in high voltage applications, sophisticated battery-run medical devices, regenerative braking systems in electric vehicles, and stationary grids.

“The study will be extrapolated to push the energy density limits further, and our broad vision includes introducing the dual carbon system as a cheaper LIB alternative to the Indian market,” said chemistry associate professor Surendra Kumar Martha, who led the research team.The research was carried out by Shuvajit Ghosh and Udita Bhattacharjee, PhD students at IIT Hyderabad, under the supervision of Mr Martha, in collaboration with Oak Ridge National Laboratory (USA) and Naval Materials Research Laboratory (Mumbai). Naval Research Board (DRDO) supported the project.

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Surendra Kumar Martha,

Chemistry associate professor, IIT-H

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