New anode material could produce efficient lithium-ion batteries for electric vehicles

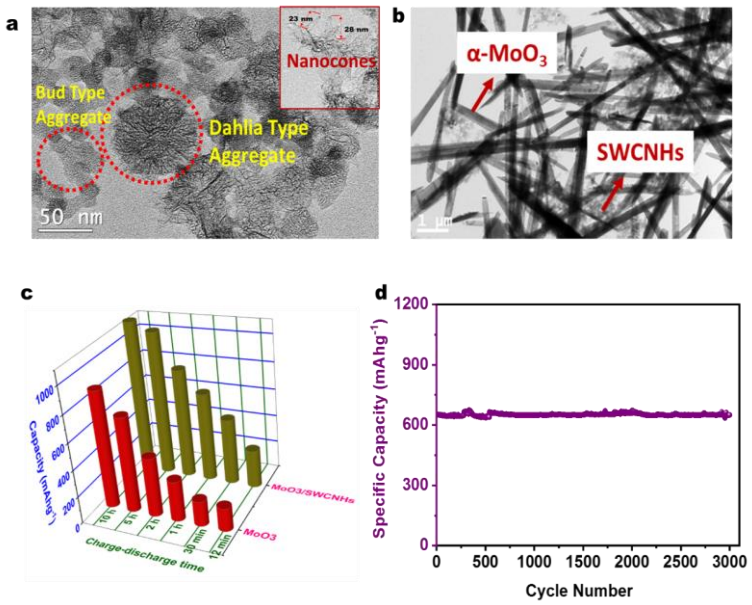
A new composite anode material made by Indian scientists based on carbon nanostructures could produce more efficient lithium-ion batteries (LIB) with longer life, which is essential for electric vehicles.

Existing LIBs use graphite as an anode with moderate theoretical capacity and limited fast charging capabilities. Hence, there is a need for developing anode materials with high energy density, fast charging capability, and long cycle life.

Scientists at the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), an autonomous R&D Centre of the Department of Science and Technology, Govt. of India, in collaboration with Department of Metallurgical and Materials Engineering, IIT Madras have developed a novel anode material for lithium-ion battery (LIB) for electric vehicles (EVs).

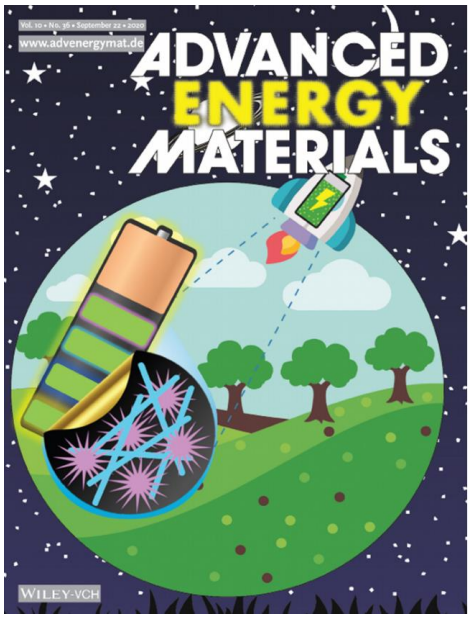
This high-performance and sustainable anode made of a composite material of α-MoO_3 and single-walled carbon nanostructures called carbon nanohorns (SWCNHs) showed high energy/power density, fast-charging capability, and long cycle life. The SWCNHs are carbon nanostructures composed of thousands of carbon nanocones and typically exist as spherical aggregates of 80–100 nm in diameter. The composite is considered low-cost and environmentally friendly due to its abundance and non-toxic elements present in the composite.

The research published in the journal Advanced Energy Materials highlights the synthesis of the α-MoO_3/SWCNHs composite material developed with the help of a facile microwave hydrothermal technique in high yield. A uniform network of α-MoO_3 and SWCNHs in the composite made its charging capacity two times that of the graphite and gave it an excellent cycle life. It also exhibited excellent fast charging capability (complete charge in 12 minutes).



Microscopic images (a, b), charge-discharge time (c), and cycle life (d)

According to the ARCI team, SWCNHs in the composite played a dual role as lithium-ion storage material and conductive additive. As a result, a robust network for fast transport of electrons and Li-ions is established, which led to remarkable electrochemical performance. With a scalable synthesis technique and superior cell performance, the α-MoO_3/SWCNHs composite anode could replace the existing graphite-based anode for the next-generation LIBs.



Lithium-ion batteries dominate commercial battery technology due to better energy and power densities, however their cycling stability properties have drawbacks. In article number 2001627, Raju Prakash and co-workers present the synthesis of a novel α-MoO_3 and single-walled carbon-nanohorns composite and demonstrate that a lithium-ion cell built from the composite material shows high-energy density, fast charging, and long-cycling life capabilities. These powerful cells could perhaps be used as a lasting energy source for spacecraft to explore the outer planets in our solar system.

The recent research published in Advanced Energy Materials (2020, 2001627; Impact Factor:25.24)

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