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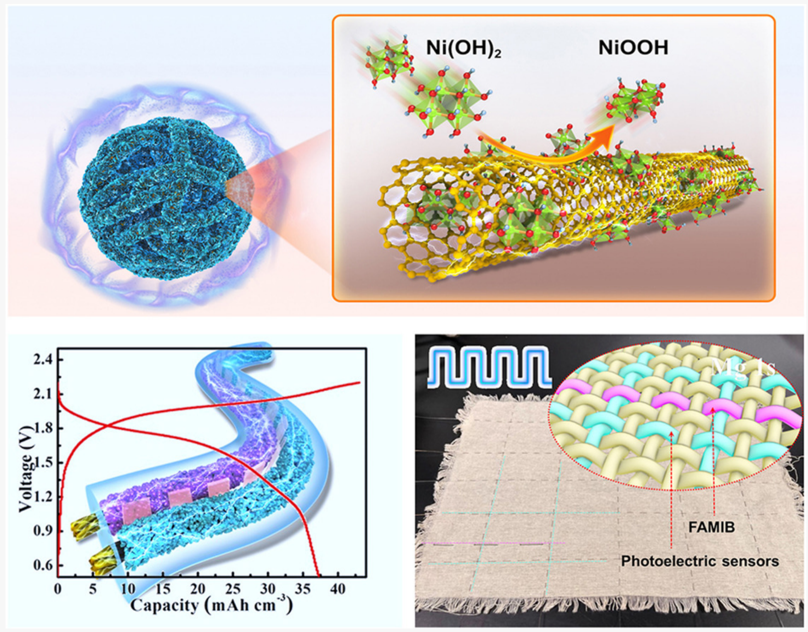
Unlocking the potential of NiOOH: a leap forward in aqueous Mg-ion battery technology

GA, UNITED STATES, April 1, 2025 /EINPresswire.com/ -- Scientists have achieved a significant leap in aqueous Mg-ion battery technology by engineering a breakthrough cathode material (nickel oxide hydroxide (NiOOH)), and systematacially reveal the stable Mg-storage mechanism in NiOOH nanosheets. This innovative design significantly enhances aqueous Mg-ion battery performance, resolving long-standing challenges of balancing high voltage and high capacity. The achievement paves the way for a safer, more versatile energy storage solution, poised to meet the growing demands of next-generation devices.



Flexible Fiber-Shaped Aqueous Mg-Ion Batteries Empowering Wearable Technology. This illustration highlights the innovative NiOOH/CNT cathode design for aqueous Mg-ion storage, showcasing its superior energy performance and flexibility. The fiber-shaped "r

The rapid growth of wearable and portable electronics has intensified the need for compact, efficient, and environmentally sustainable energy solutions. Aqueous Mg-ion batteries, with their inherent safety, high ionic conductivity, and non-toxicity, present an attractive alternative to traditional systems using organic electrolytes. However, limitations such as low energy density, sluggish ion diffusion, and structural degradation of materials continue to hinder their application. Overcoming these barriers calls for creative breakthroughs in both cathode and anode material design.

In a study published on June 22, 2024, in eScience, researchers from Nanyang Technological University and other leading institutions unveiled a layered nickel oxide hydroxide (NiOOH) cathode synthesized with carbon nanotubes (NiOOH/CNT) for aqueous magnesium-ion batteries (AMIBs). This advanced material leverages a proton-assisted Mg-ion intercalation mechanism to deliver a high discharge voltage, outstanding stability, and substantial energy density. The innovation opens the door to the development of flexible and wearable energy storage systems.

The study's highlight lies in its ability to address the dual challenge of performance and flexibility. The NiOOH/CNT cathode achieves an impressive specific capacity of 122.5 mAh/g, supported by a 1D-2D heterostructure that ensures fast electron transport and robust cycling performance. Meanwhile, the researchers prepared freestanding NiOOH cathode utilizing carbon nanotube fibers as the flexible substrates. Coupling with the $NaTi_2(PO_4)_3$ as a freestanding anode, a "rocking-chair" battery system is constructed with a remarkable discharge voltage of ~1.7 V. This system is not only efficient but also adaptable, with the fiber-shaped batteries demonstrating excellent mechanical flexibility, making them suitable for wearable technologies like photoelectric sensors embedded in fabrics.

Professor Lei Wei, one of the lead researchers, remarked, "This breakthrough redefines the potential of aqueous magnesium-ion batteries by combining safety, efficiency, and flexibility. It’s an exciting step forward in meeting the energy demands of modern electronics while ensuring sustainability and scalability."

Looking forward, the implications of this research extend beyond wearables. The enhanced safety, adaptability, and energy density of these AMIBs could transform applications in medical devices, textiles, and even larger-scale energy storage systems. By overcoming critical limitations, this innovation positions aqueous magnesium-ion batteries as a cornerstone of sustainable, next-generation energy storage solutions.

References
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