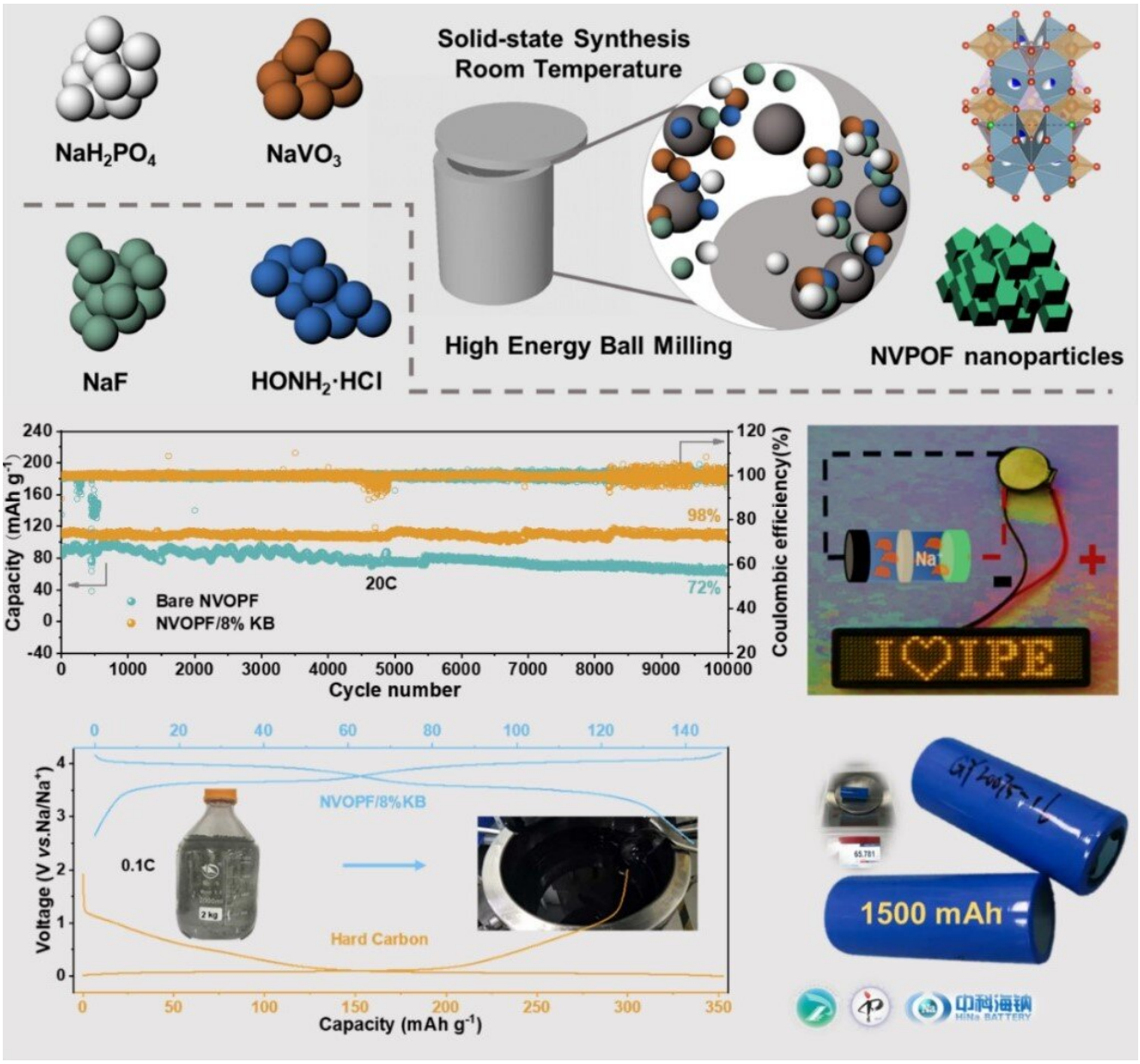
One-step method to improve performance of cathode materials in Na-ion batteries

May 24 2021, by Li Yuan



The electrochemical performance of sodium vanadium fluorophosphate

synthesized by mechanochemical method. Credit: Chinese Academy of Sciences

Na-ion batteries are promising in large-scale energy storage owing to the abundant raw material resources, low cost and high safety.

Sodium vanadium fluorophosphate ($Na_3(VOPO_4)_2F$) with a theoretical energy density of 480 Wh/Kg is regarded as a strong candidate among various cathode materials. However, the intrinsic low conductivity and high energy-consumption during synthesis process hinder its commercialization.

Researchers from the Institute of Process Engineering (IPE) and Institute of Physics of the Chinese Academy of Sciences developed one-step mechanochemical method to rapidly prepare the polyanionic compound sodium vanadium fluorophosphate as the cathode materials for Na-ion batteries, which exhibited excellent rate performance and cycle stability.

This work was published in *Nature Communications* on May 14.

The prepared $Na_3(VOPO_4)_2F$/KB composite delivered a high discharge capacity of 142 mAh g-1 at 0.1C. The extra capacity beyond the theoretical specific capacity (130 mAh g-1) benefited from the interfacial charge storage.

Moreover, a specific capacity of 112 mAh g-1 can be obtained even at 20 C, which means this Na-ion battery could be fully charged/discharged in three minutes.

Superior cycle stability of this composite was demonstrated by an ultrahigh cycling stability with 98% retention over 10,000 cycles.

High resolution transmission electron microscopy revealed that the nanocrystallines of $Na_3(VOPO_4)_2F$ about 30 nm were embedded in the carbon framework, which facilitated the rapid conduction of electrons and Na ions.

The reversible structural evolution and negligible volume change of $Na_3(VOPO_4)_2F$/KB composite during charging/discharging were also demonstrated by in situ X-ray diffraction and ^{23}Na nuclear magnetic resonance spectrum.

"The method provides a feasible strategy to improve the rate performance and cycle performance of cathode materials. Besides, the kilogram-scale product indicates the mechanochemical method is suitable for rapid large-scale production electrode materials for Na-ion batteries," said Prof. Zhao Junmei, a co-corresponding author of the study.

More information: Xing Shen et al, Rapid mechanochemical synthesis of polyanionic cathode with improved electrochemical performance for Na-ion batteries, *Nature Communications* (2021). DOI: 10.1038/s41467-021-23132-w

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