Achieving stable K-storage performance of carbon sphere-confined antimony via electrolyte regulation

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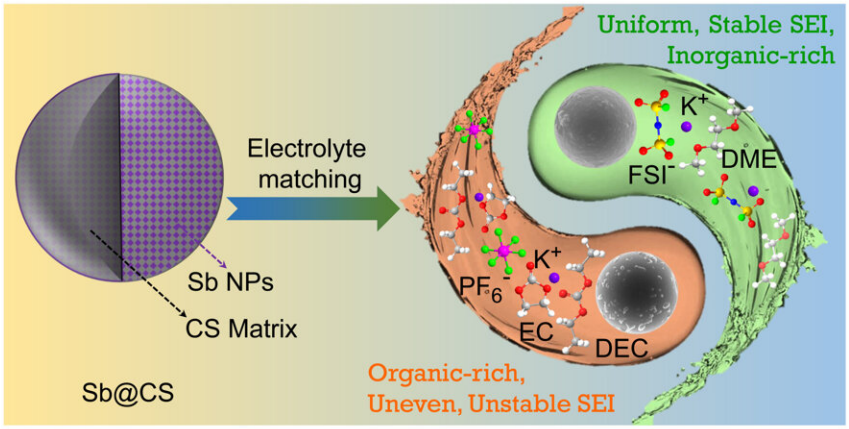

The internal microstructure of Sb@CS with uniform distribution of C and Sb exhibits completely different properties in two typical electrolytes, but the electrochemical performance can maintain stability after electrolyte exchange. Credit: *Journal of Energy Chemistry*

Potassium-ion batteries (PIBs) have been considered one of the most

promising alternatives to lithium-ion batteries (LIBs) because of their competitive energy density with significantly low production costs. Moreover, alloy-type materials are expected to be the high-performance anode of PIBs owing to their intrinsic chemical stability and high theoretical specific capacity. Unfortunately, severe incompatibility between the active alloy-type materials and electrolytes, especially for the formation of unstable solid-electrolyte interfacial (SEI) films, often leads to insufficient cycle life.

Herein, the formation mechanism of SEI films in the K-storage systems based on carbon sphere confined Sb anode (Sb@CS) was investigated in commercially available electrolytes. Physical characterizations and theoretical calculations revealed that the solvents in the dilute electrolyte of 0.8 M KPF_6/EC + DEC were excessively decomposed on the interface to generate unstable SEI and thus result in inferior K-storage stability.

On the contrary, a salt-concentrated electrolyte (3 M KFSI/DME) can generate inorganic-dominated stable SEI due to the preferential decomposition of anions. These findings are of great significance for revealing the interfacial reaction between electrodes and electrolytes as well as improving the stability of Sb-based anode materials for PIBs.

Recently Nanjing University of Aeronautics and Astronautics and others published a manuscript entitled "Achieving stable K-storage performance of carbon sphere-confined Sb via electrolyte regulation" in the *Journal of Energy Chemistry*.

Herein, Sb@CS (Sb confined by carbon sphere) was fabricated through a hydrothermal method as the anode material of PIBs. Furthermore, the K-storage activity of this material in two typical electrolytes was systematically investigated.

Electrochemical tests combined with DFT calculations proved that the unstable SEI film formed during the first discharge profile was the intrinsic reason for the battery performance degradation. The dynamic change of the SEI film was also proved by electrolyte-exchange experiments. This study provides a novel strategy for preparing a stable and ultra-thin artificial SEI film on Sb-based K-storage anodes for PIBs.

More information: Ningning Chen et al, Achieving stable K-storage performance of carbon sphere-confined Sb via electrolyte regulation, *Journal of Energy Chemistry* (2022). DOI: 10.1016/j.jechem.2022.09.006

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