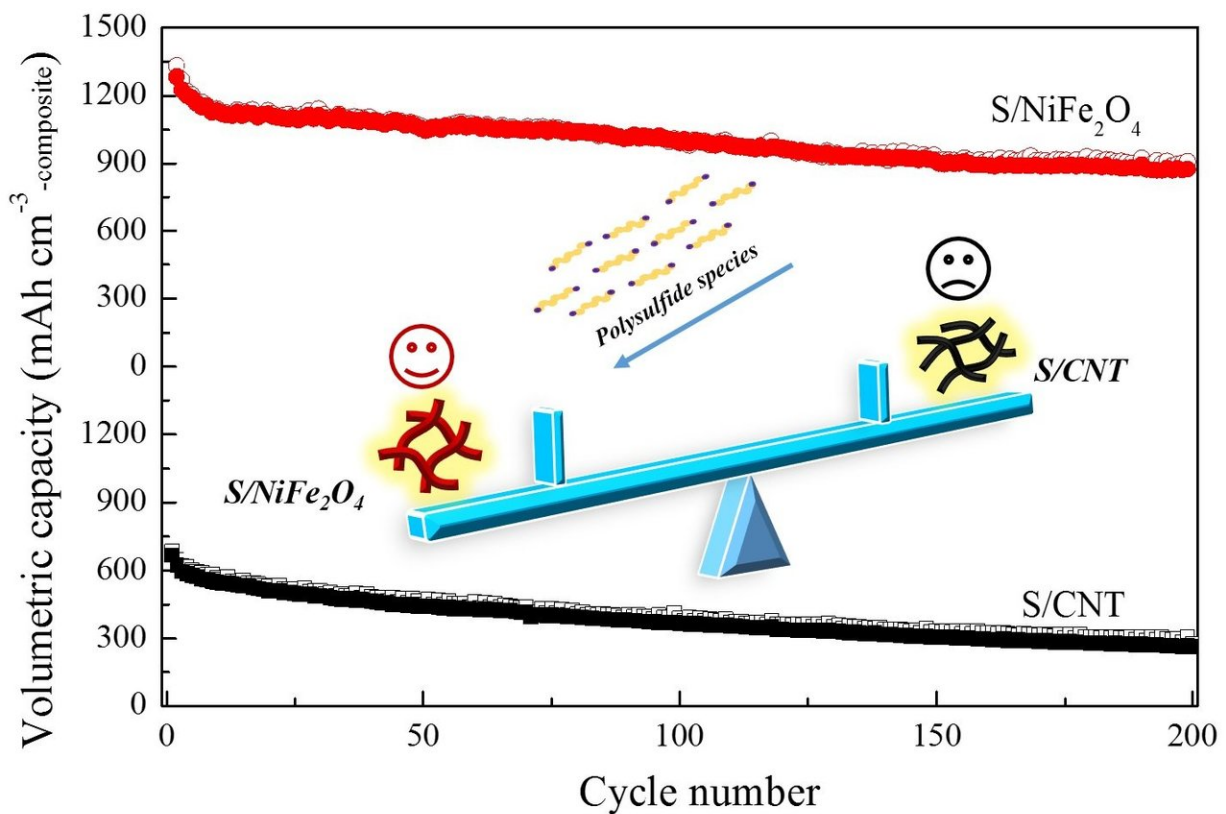


Nickel ferrite promotes capacity and cycle stability of lithium-sulfur battery

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Compared to S/CNTs, S/NiFe₂O₄ has higher volumetric capacity and cycling stability. Credit: ©Science China Press

Lithium-sulfur (Li-S) battery could become practical if 20 percent of the theoretical energy densities (2600 Wh/kg or 2800 Wh/L) can be

achieved. Investigators have the ambition to reach energy density of 500 Wh/kg in the near future.

Xue-Ping Gao from Nankai University, says, "Currently, the [volumetric energy density](#) of 500 Wh/L is not satisfied. But it was already realized in commercial lithium-ion batteries (LIBs) many years ago. The low volumetric energy density is a bottleneck of practical Li-S battery."

Intrinsically, sulfur has lower density than transition metal oxides as cathodes in LIBs. Worse, in order to improve the electrochemical performance, sulfur is usually forced to load onto various lightweight carbon hosts, leading to more lower volumetric [capacity](#) of sulfur-based composites, and undermining the volumetric energy density of Li-S battery.

Compared with carbon materials, heavy metal oxides not only offer good adsorption ability of polysulfides to suppress the shuttle effect, but also help to obtain dense sulfur-based composites with high tap density. Gao says, "Based on this, we developed nickel ferrite (NiFe_2O_4) porous hollow 1-D nanofibers via electrospinning technology. The as-prepared NiFe_2O_4 nanofibers were used here as a novel host of sulfur in order to increase the volumetric capacity of sulfur-based composites."

Gao details their experiment, "Firstly, the polysulfide adsorption test reveals the strong chemisorption towards soluble polysulfides by NiFe_2O_4 ." Both the stable adsorption geometry and adsorption energy of Li_2S_8 on (111) plane of NiFe_2O_4 are confirmed by Density Functional Theory (DFT) calculation as compared with carbon nanotubes (CNTs).

As a result, the S/ NiFe_2O_4 composite delivers an initial discharge capacity of 963.6 mAh/g, and good cycle stability. "Furthermore, the S/ NiFe_2O_4 composite shows nearly 2 times higher superior volumetric capacity than S/CNT composite. It comes as no surprise that the

S/NiFe₂O₄ composite has a much larger tap density than the S/CNT composite," he said.

In addition, other metal ferrites MFe₂O₄ (M = Co, Mg, Zn) have also been investigated as polar hosts of sulfur, and the results confirm the superiority of metal ferrites in fabricating sulfur-based composites with high gravimetric/volumetric capacities for the potential application of Li-S batteries with high gravimetric/volumetric [energy density](#).

More information: Ze Zhang et al, Sulfur/nickel ferrite composite as cathode with high-volumetric-capacity for lithium-sulfur battery, *Science China Materials* (2018). [DOI: 10.1007/s40843-018-9292-7](https://doi.org/10.1007/s40843-018-9292-7)

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