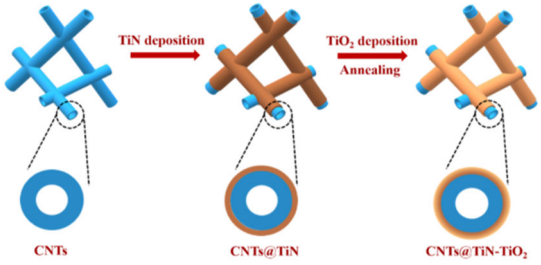
OIST | Innovation

Novel Cathode for Long-Life Lithium-Sulfur Batteries

Summary

Lithium-Sulfur (Li-S) batteries are promising candidates to meet the demand for light weight, high energy density batteries in applications such as aviation and automotive. However, current Li-S batteries suffer from critically limiting issues with sulfur loading and polysulfide dissolution and shuttling. Existing physical and chemical solutions, such as sulfur-hosting porous nanocarbon materials and polar non-carbon oxides, sulfides, and nitrides, do not fully address these problems.

A team of researchers led by Prof. Yabing Qi has developed a novel Li-S battery cathode design which includes a carbon nanotube (CNT) sponge coated with TiN and TiO_2 layers. This cathode structure prevents sulfur polysulfide dissolution and shuttling, substantially improving both areal capacity and cycling stability.



Controlled deposition of TiN and TiO_2 layers on CNT sponge by ALD. The resulting Li-S battery has enhanced cycling stability and aerial capacity.

Technology

The rational design of heterostructures as catalyst systems for lithium polysulfide conversion in Li-S batteries is limited by traditional fabrication processes. This technology uses atomic layer deposition (ALD) to create precise cathode TiN-TiO_2 heterostructure layers on a three-dimensional conductive carbon nanotube (CNT) sponge scaffold, to achieve optimum catalytic properties. The corresponding Li-S batteries show enhanced electrochemical performance, with a capacity retention of 85% after 500 cycles. Furthermore, due to the highly porous structure and interconnected conductive pathways of the CNT sponge, its areal capacity can achieve 20.5 mAh cm^{-2}.

Applications

- Lithium sulfur battery

Advantages

- High areal capacity
- Long cyclic stability
- High sulfur loading

Category
Chemistry & Materials Science

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Intellectual Property
Patent Pending

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