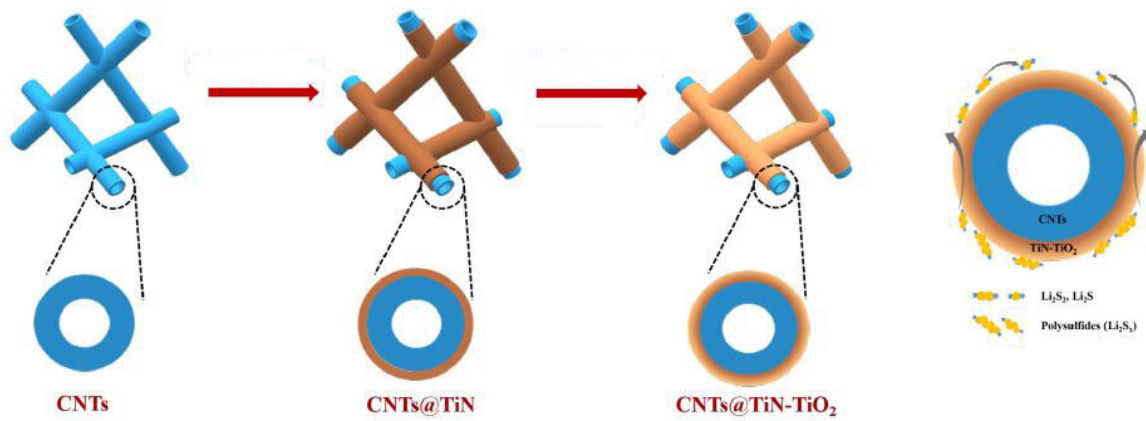


Speed and absorption key to optimizing a new type of rechargeable battery

August 6 2021



To optimize the battery, the researchers created a structure that could speed up the reaction process and absorb the unwanted polysulfides. They used a carbon nanotube framework (CNT) and coated it with a layer of TiN-TiO₂. The TiN acted as a material absorbing any polysulfides that were created in the process, whereas the TiO₂ sped up the conversion from lithium polysulfides to the final products—Li₂S₂ or Li₂S. Credit: *Nature Communications* (modified).

Rechargeable batteries are a necessity to meet the world's growing energy demands in a sustainable fashion, but not all are equal. Researchers in the Energy Materials and Surface Sciences Unit at the Okinawa Institute of Science and Technology Graduate University have worked to optimize a promising candidate of such energy sources—lithium sulfur batteries. The study was published in *Nature*

Communications.

"Lithium sulfur batteries can store more energy than the lithium ion batteries that are already commercially available," said Dr. Hui Zhang, first author of this study. "To put this in numbers, an electric vehicle that runs on lithium ion batteries can drive an average of 300km before it needs to be charged. With the improved energy storage provided by lithium sulfur batteries, it should be possible to extend this to 500km."

The main challenge that has prevented lithium sulfur batteries from becoming commercialized is that the intermediate product is susceptible to dissolving. During the construction of the [battery](#), the sulfur will react with the lithium to form a product. There are two stages to this. In the first stage, the product will be lithium polysulfide, which can easily dissolve into polysulfides. If this happens, the polysulfides will impair the performance of the battery, resulting in its lifespan being greatly reduced. To optimize the batteries, the lithium polysulfide needs to transform to the final product, either Li_2S_2 or Li_2S , as quickly as possible. To do this, the researchers utilized two different materials— TiO_2 , which absorbs the unwanted polysulfides, and TiN , which accelerates the process.

"Using these two materials, we developed a hybrid that is low cost and easy to apply," said Dr. Luis Ono, second author of this study. "We found that it had an excellent ability to improve the battery performance."

These materials are very sensitive. To maximize the battery's efficiency, the researchers worked on the scale of nanometers. They found that 10nm of TiN and 5nm of TiO_2 created the most efficient product. With the polysulfides being absorbed and the whole process being accelerated, the batteries performance was greatly improved. This translated to a shorter charging time, a longer life between charges, and a greater

overall lifespan. To establish this, the researchers ran the battery for 200 cycles and found that its efficiency was almost the same.

"We will continue to further optimize the materials to improve the performance," said Professor Yabing Qi, senior author of the study and head of the Energy Materials and Surface Sciences Unit at OIST. "There are a lot of brilliant minds working on [lithium sulfur batteries](#) and it's a really promising and exciting technology."

More information: Hui Zhang et al, Long-life lithium-sulfur batteries with high areal capacity based on coaxial CNTs@TiN-TiO₂ sponge, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-24976-y](https://doi.org/10.1038/s41467-021-24976-y)

Provided by Okinawa Institute of Science and Technology

Citation: Speed and absorption key to optimizing a new type of rechargeable battery (2021, August 6) retrieved 20 April 2024 from <https://techxplore.com/news/2021-08-absorption-key-optimizing-rechargeable-battery.html>

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