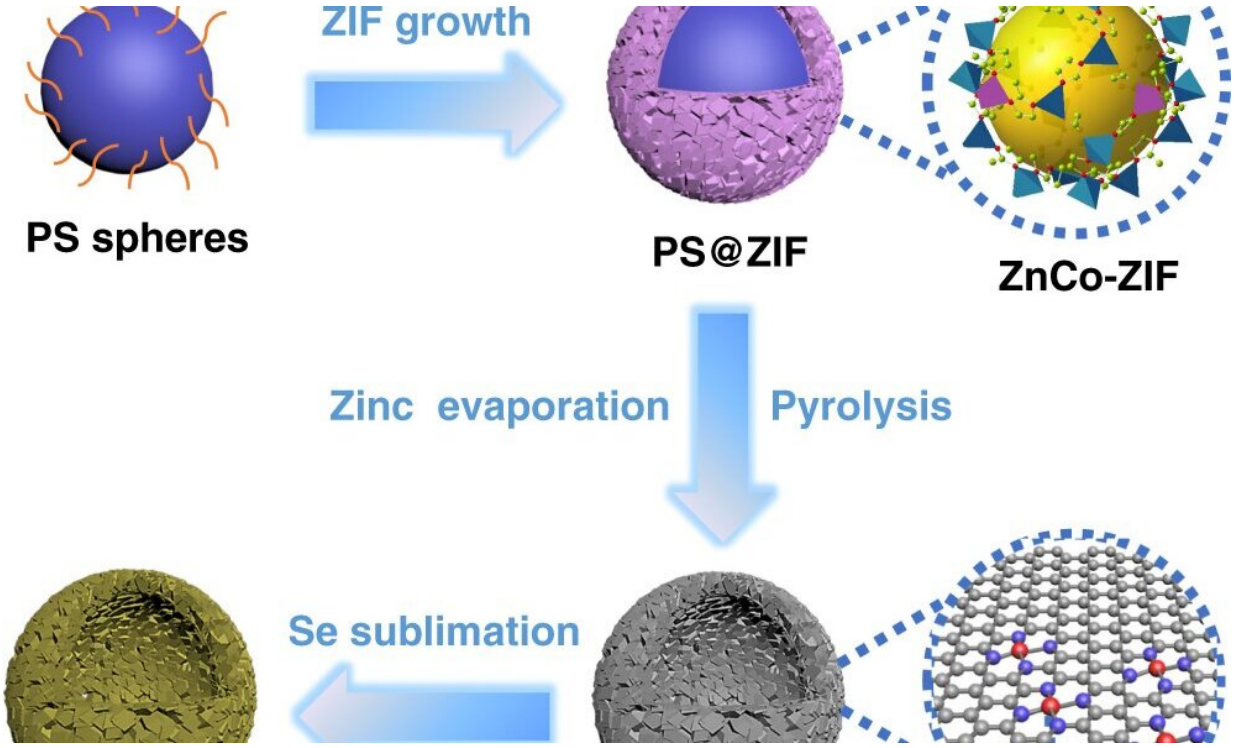
Team reveals simple method to produce high-performing lithium selenium batteries

November 16 2020



SAC preparation process. Credit: *Nature Communications* (2020). DOI: 10.1038/s41467-020-18820-y

Rechargeable lithium-ion batteries (LIBs) are considered the best hope for next-generation battery technology, thanks to their long-life cycle, high specific power and energy density. However, they have not met the ever-increasing demands of emerging technologies such as electric

vehicles. Li-Se battery technology is increasingly considered a real alternative to LIBs because of its high theoretical volume capacity and much higher conductivity.

In the first study of its kind, published by the *Nature Communications* journal, engineers from Surrey's Advanced Technology Institute (ATI), in collaboration with the team at University Technology of Sydney detail how they used a single-atom catalyst to create highly effective cathodes for Li-Se batteries. They demonstrate that their batteries have a superior rate capability and outstanding long-term cycling performance.

The Surrey team used to delicately control zeolitic imidazolate framework (ZIF) particles that were placed on the surface of polystyrene spheres. The core-shell of the ZIF was then converted into a hollow structured carbon material.

Through further fine-tuning, the team from the ATI successfully produced atomic cobalt electrocatalyst, nitrogen-doped hollow porous carbon, nitrogen-doped hollow porous carbon and cobalt nanoparticles. By embedding selenium in hollow structured carbon particles, carbon /selenium composites were produced.

The atomic cobalt electrocatalysts were used as cathode materials for Li-Se batteries and clearly showed superior electrochemical performance including a superior rate capability (311 mA h g^{-1} at 50 C) and excellent cycling stability (267 mA h g^{-1} after 5000 cycles with a 0.0067% capacity decay per cycle at a current density of 50 C) with the Coulombic efficiency of ~100%.

Dr. Jian Liu, one of the lead authors and associate professor of energy materials at the ATI, said:

"We truly believe that our atomic cobalt-doped synthesized material can

pave the way for lithium selenium batteries to be the go-to battery technology for future generations. While our results are incredibly encouraging, there is still some way to go to make our dream of high-capacity, sustainable battery technology a reality."

Professor Ravi Silva, director of the ATI at the University of Surrey, said:

"We are incredibly proud of the highly creative and excellent work that Dr. Liu's team has produced—a piece of research that may be a defining moment for sustainable battery technology development."

More information: Hao Tian et al. High-power lithium–selenium batteries enabled by atomic cobalt electrocatalyst in hollow carbon cathode, *Nature Communications* (2020). DOI: 10.1038/s41467-020-18820-y

Provided by University of Surrey