

## TITLE

# Ultra-Stable Silicon Anode by Three-Dimensional Nanoarchitecture Design

## CASE NUMBER

**C16224**

### VALUE PROPOSITION

- » Silicon anode with practical realization of stable high Si capacity.
- » Improved cycle lifetimes of lithium-ion batteries.
- » Improved rate performance for faster charge and discharge.
- » Hybrid design overcomes substantial volume change, improves conductivity, and stabilizes SEI films.

### UNMET NEED

- » As lithium-ion battery use has been growing in portable devices, electric cars, and grid energy storage.
- » Most lithium-ion batteries rely on a graphite anode, which has been found to have poor energy density.
- » Silicon has been recognized as one of the most promising anodes for next-generation lithium-ion batteries.
- » There is a need for silicon anodes that overcome the challenges of substantial volume change, intrinsic low conductivity, and unstable solid electrolyte interphase (SEI) films in current silicon anodes.

### TECHNICAL OVERVIEW

- » In order to address the poor energy density of graphite anode lithium-ion batteries, researchers at Johns Hopkins have developed a new silicon hybrid anode by 3D nanoarchitecture design for lithium-ion batteries.
- » While the nanoporous N-doped graphene acts as a flexible and conductive support, the amorphous hybrid silicate coating enhances the robustness and suppleness of the electrode, facilitating the formation of stable SEI films.
- » As a result, the electrode achieves excellent rate capability and cycling performance (817 mAh/g at 5 C for 10,000 cycles).
- » Even when paired with LiFePO<sub>4</sub> cathodes in full batteries, over 100 stable cycling can be readily realized.

### STAGE OF DEVELOPMENT

- » Data available in the publication.

### ASSOCIATED INVENTORS

*Materials Science and Engineering  
Whiting School of Engineering*  
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### TECHNOLOGY CLASSIFICATION

- » Energy
- » Engineering

### PUBLICATION

**Huang G, et al. Ultrastable Silicon Anode by Three-Dimensional Nanoarchitecture Design. ACS Nano. 2020 Apr 28;14(4):4374-4382**

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### ASSOCIATED REPORTS OF INVENTION (ROIs) AND INTELLECTUAL PROPERTY (IP) FILING NUMBERS

ROI#	TITLE	STATUS	PRIORITY DATE	IP FILING NUMBERS
C16224	Ultra-Stable Silicon Anode by Three-Dimensional Nanoarchitecture Design	Pending	3/16/2020	<b><u>Int'l Publ. NO. WO 2021/188579</u></b>