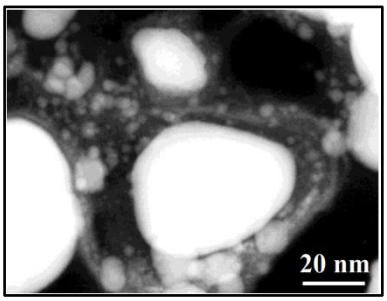
UWM RESEARCH FOUNDATION Technology Overview

Sn Wears Super Skin: A New Design for Ultra-Long Cycling and Ultra-High Rate Batteries

OTT ID #1437

TECHNOLOGY

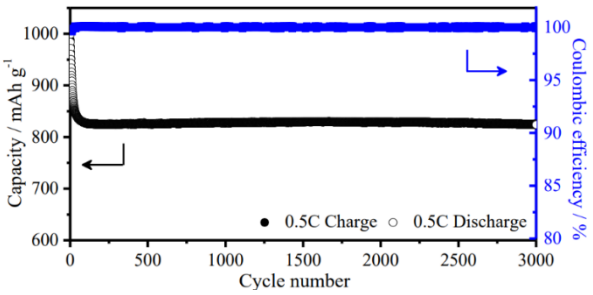
The laboratory of Dr. Junjie Niu, Associate Professor at the Department of Materials Science and Engineering, University of Wisconsin-Milwaukee has developed a battery system that leverages a Titanium dioxide (TiO_2) 'skin' and Tin (Sn) 'kernel' to achieve excellent Li uptake capacity, Coulombic efficiency and cyclic performance (gravimetric capacity of 727 mAh/g with a Coulombic efficiency of >99.8% after 3000 cycles at 1.0 C. A capacity of 662 mAh/g at a high rate of 5.0 C was obtained after 10,000 cycles. From the 50th to 10,000th cycle under 5.0 C, the capacity retention is >97% with a negligible decay of <0.00026% per cycle).



Scanning transmission electron microscopy image showing the Sn composites and cage arcitecture were maintained after 100 cycles.

The Sn 'Skin Grafting' approach developed by the inventors is scalable and Sn/Ti are readily available, such that replacing this current anode material, which this composite is possible. The Li-Sn battery system presented here, with long duration, fast charge/discharge rate, and impressive lifespan, opens a new avenue for applications in next generation batteries.

FEATURES/BENEFITS

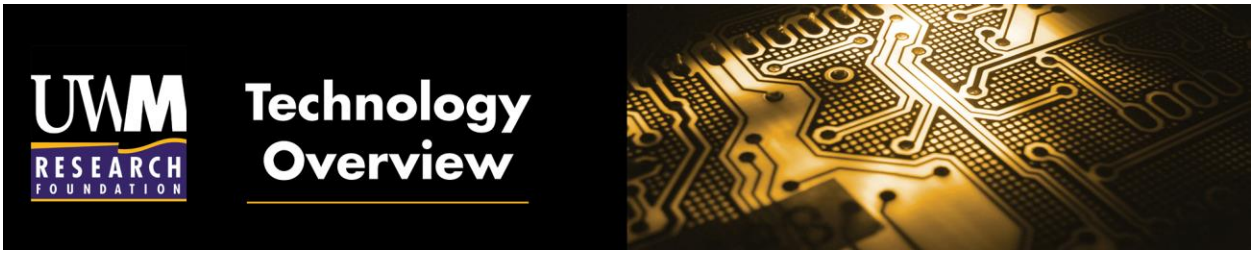


- **Excellent electrochemical properties** — The hybrid composite anode exhibits a good gravimetric capacity, excellent Coulombic efficiency after 3000 cycles, capacity retention and negligible capacity decay even after 10,000 cycles.
- **Scalable synthesis workflow –** The synthesis procedure lends itself to easy scale up.
- **Utilization of readily available materials –** Titanium oxide and Tin are readily industrial available materials.

INTELLECTUAL PROPERTY

US Provisional Patent Application filed.

We welcome feedback, as well as discussion of partnering options on this technology that would suit your business needs.



MARKET

Transparency Market Research expects the lithium-ion battery market to expand at 11.6% compound annual growth rate between 2016 and 2024. Growth in consumer electronics and clean fuels use in the automobile market are expected to be large drivers of growth for the lithium-ion battery market. The consumer electronics market is expected to account for half of the lithium-ion battery market by 2024 due to the demand for low-power capacity lithium-ion batteries.

Stratistics MRC predicts a compound annual growth rate of 18.7% by 2026 in the lithium-ion battery market driven by technological advancements, electrical vehicle, and smart device demand. They also cite government incentives for battery use as a driver of demand.

The improved cyclic performance, scalable synthesis, and use of readily available materials will make this technology an attractive option in the growing lithium-ion battery market.

PAPER(S)

Sn Wears Super Skin: A New Design for Long Cycling Batteries; Shuai Kang, Xi Chen, and Junjie Niu; Nano Letters 2018 18 (1), 467-474; DOI: 10.1021/acs.nanolett.7b04416

INVENTORS

Dr. Junjie Niu is an Assistant Professor in the Materials Science and Engineering Department UW-Milwaukee. He received his Ph.D. in Materials Physics and Chemistry at Zhejiang University. He joined Prof. Yury Gogotsi's group at Drexel as a Postdoctoral Researcher in 2009 after serving as a faculty member at Shanghai JiaoTong University. He then joined Prof. Ju Li's group at UPenn and then MIT's Department of Nuclear Science and Engineering & Department of Materials Science and Engineering as a Postdoctoral Researcher from 2011 to 2014. He joined UW-Milwaukee as an Assistant Professor in 2014. Dr. Niu also serves at the associate editor of Royal Society of Chemistry Advances. Dr. Niu's interdisciplinary research includes understanding fundamental science in physics/chemistry, and engineering nanomaterials in applications of energy storage, biomaterials and chemo-mechanics.

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