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Borocarbonitrides from Borane-Trialkylamines via Thermolysis for High-Performance Lithium-Ion Battery Electrodes

Single-source borane-amine precursors yield BCN nanosheets/films with high capacity and stability as next-gen lithium-ion battery anodes.

Rechargeable batteries, like lithium-ion batteries (LIBs), have revolutionized the field of electrochemical energy storage devices, and LIBs remain the device of choice in this field even after 3 decades since commercialization. With the demand for energy storage systems increasing across many industries, work has focused on improving LIB energy storage, particularly by modulating the anode construction. The current commercial anode is composed of graphite, but over time lithium gets plated at low electrochemical potentials, which is unsafe due to the instability of lithiated graphite and ill-suited for high-power applications. Thus, alternative anode materials are desired for next-generation LIBs. Graphene and graphene-based materials are promising for the design of LIBs due to their favorable thermal, electrical, and electronic properties. Purdue researchers have developed graphene doped with nitrogen and boron, known as boroncarbonnitrides (BCN), to create ultrathin 2D materials with good electrochemical properties for LIBs. Syntheses for BCN can be found in the literature already but require different sources for each precursor. Researchers at Purdue University have developed novel syntheses for BCN that come from a single-source precursor (borane amine complex) and can make a variety of nanomaterials like nanospheres, nanosheets, and porous films for use in LIBs.

Technology Validation:

-Electrochemical performance characterized using cyclic voltammetry, charge-discharge cycling, cycling performance, and capacity retention

o Precursor borane-amines used in LIBs had specific capacity of 120 mAh/g, but derivatives have specific capacities between 150-270 mAh/g and up to 450 mAh/g

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Category
Energy & Power Systems/Energy Storage
GreenTech/Carbon Management
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation

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o Stable and high charge capacity with Coulombic efficiency of 99% after 200 cycles

Advantages

-Single source of pre-cursors (B, N, C)

-Can produce variety of nanomaterial morphologies

Applications

-Lithium-Ion Batteries for energy storage systems

TRL: 3

Intellectual Property:

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