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Materials Synthesis
Thermodynamics
Energy Storage

REPRESENTATIVE PUBLICATIONS

N. P. Stadie, E. Billeter, L. Piveteau, K. Kravchyk, M. Döbeli, M. V. Kovalenko, "Direct Synthesis of Bulk Boron-Doped Graphitic Carbon" **Chem. Mater.**, 29 (7), 3211 (2017).

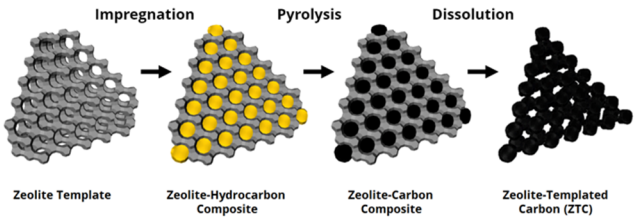
N. P. Stadie, S. Wang, K. V. Kravchyk, M. V. Kovalenko, "Zeolite-Templated Carbon as an Ordered Microporous Electrode for Aluminum Batteries" **ACS Nano**, 11 (2), 1911 (2017).

N. P. Stadie, E. Callini, B. Richter, T. R. Jensen, A. Borgschulte, A. Züttel, "Supercritical N_2 Processing as a Route to the Clean Dehydrogenation of Porous $Mg(BH_4)_2$" **J. Am. Chem. Soc.**, 136, 8181 (2014).

N. P. Stadie, M. Murialdo, C. C. Ahn, B. Fultz, "Anomalous Isosteric Enthalpy of Adsorption of Methane on Zeolite-Templated Carbon" **J. Am. Chem. Soc.**, 135, 990 (2013).

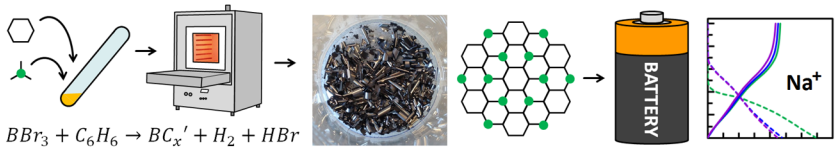
RESEARCH OVERVIEW

Porous materials abound in useful applications and are also fundamentally interesting; after all, at what length scale do large macromolecules end and solid-state frameworks begin? Our group is focused on the design, synthesis, and characterization of porous adsorbent materials based on carbon using a *templating approach*.



We have practical interests in the gas-solid interface (for storing chemical fuels) as well as the ion-solid interface (for electrochemical energy storage) in these materials, and control of this interface via structure (e.g., pore size) and chemistry (B-, N-, S-, P-doping, etc.) are goals of this work.

En route to exploring synthetic routes to high surface area carbon-based materials of differing chemical nature, we also explore analogous pathways to bulk, nonporous materials (i.e., graphites). We use solid-state synthesis techniques to substitute carbon for heteroatom dopants within the graphitic structure; a challenge in this work is in the accurate characterization of the resulting changes in composition and/or structure, which often have coupled effects. This challenge necessitates the use of multiple techniques, from microscopy and diffraction methods to Raman spectroscopy and sometimes unusual (light-element specific) techniques like elastic recoil detection analysis.



A parallel effort in our group is in the thermodynamic characterization and modeling of physical adsorption systems at the gas-solid interface, especially in understanding the unusual phenomena that exist under "high pressures" (for us, defined as the region of the phase diagram wherein the gas phase is *significantly non-ideal*). We not only seek the practical information of "how much" gas is stored on a particular solid under these conditions, but we also seek to know "how strong" the interaction is. Neither property is particularly easy to measure at high pressures, but the results have important implications for questions in wide-ranging applications such as on-board automotive fuel storage (e.g., hydrogen storage) and geological energy resources (think deep underground!).