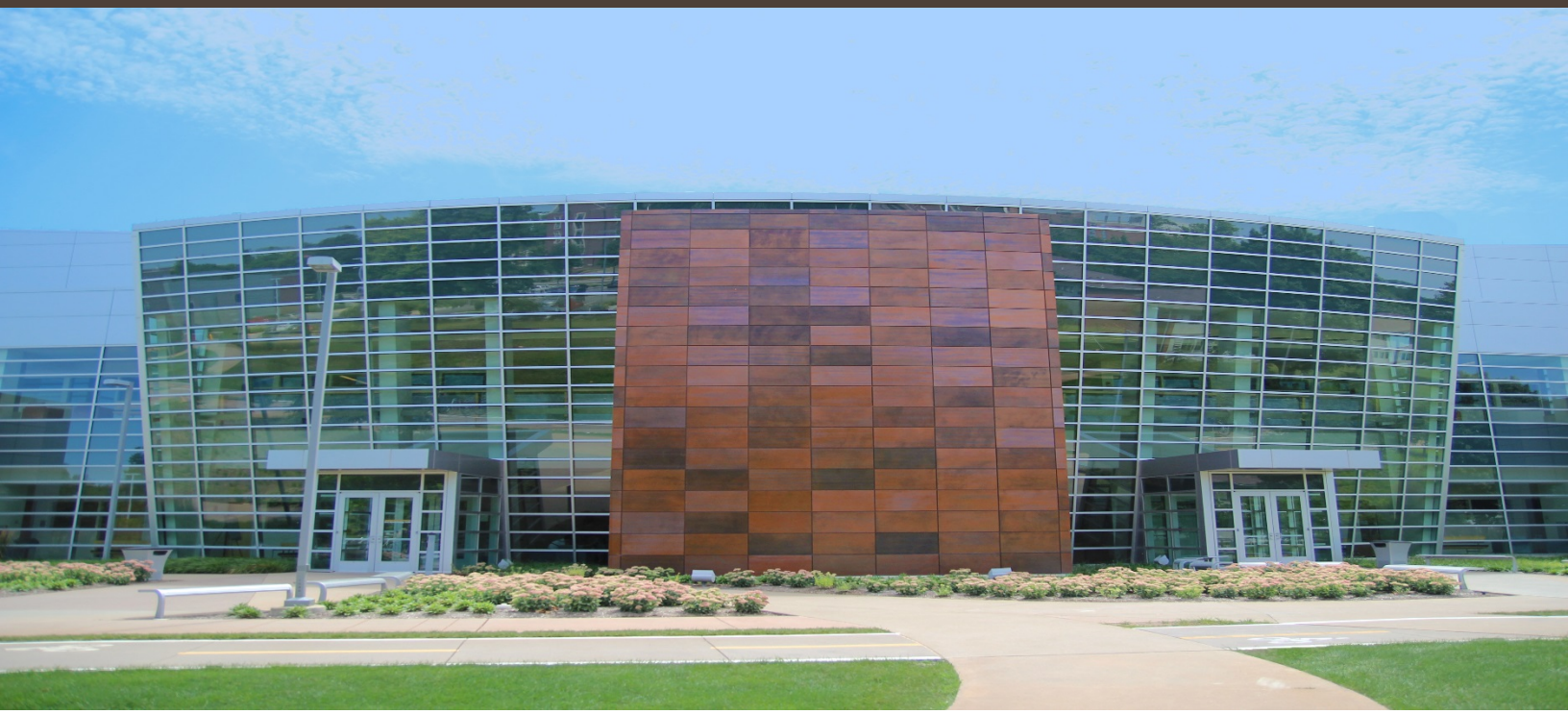

Large scale syntheses of cooperatively assembled materials for sodium-sulfur batteries

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Over the past 20 years, there has been tremendous progress in the synthesis of nanoporous materials with precisely controlled pore sizes and pore geometries through self-assembly. These materials enable fundamental investigations into the role of pore size and geometry on performance for diverse applications from drug delivery to battery electrodes. However generating large (>10's of g) quantities of these materials tends to be time consuming and challenging. Here we will discuss the fundamental processes associated with standard synthesis routes for nanoporous silica and describe how we can modify the evaporation induced self assembly method to reproducibly synthesize kilograms of materials with characteristics that match those from typical batch scale that produce ~100 mg. The ability to generate large quantities of materials has enabled new material doping schemes to be developed – here we will highlight the ability to dope carbon with various heteroatoms (N, P, S, B) at relatively high loadings (>10 at%). Additionally, codoping of N,S is synergistic with nearly 40 at % N possible. We will describe on how this high N doping of carbon effective traps sulfur to minimize polysulfide shuttling. Additionally the strong binding of sulfur to the N-doped carbon prevents sulfur degradation in common carbonate electrolytes, but this strong bonding limits the product to NaS_2 to lower the potential capacity of the battery. The trade-offs between the extent of doping as well as the size of the pores and the battery performance will be discussed in the context of sodium-sulfur batteries.