Public Abstract

First Name:Jacob
Middle Name:William
Last Name:Burress
Adviser's First Name:Peter
Adviser's Last Name:Pfeifer
Co-Adviser's First Name:
Co-Adviser's Last Name:

Graduation Term:SS 2009
Department:Physics
Degree:PhD

Title:Gas Sorption in Engineered Carbon Nanospaces

In recent years, the search for inexpensive, abundant energy sources has been a prominent public policy concern. The challenges of energy shortages, greenhouse gases and air pollution have compelled the public and private sectors to invest in the development of alternative energy sources. My research focuses on the development of nanoporous carbons as high-capacity storage materials for natural gas (methane) and molecular hydrogen in on-board fuel tanks for next-generation clean vehicles. The carbons are produced in a multi-step process from corncob, have surface areas of up to 3500 m2/g, porosities of up to 0.8, and store, by physisorption, exceptional amounts of methane and hydrogen. Adsorbent-based storage materials are attractive due to their low operating pressure (relative to compressed gas), reversibility, ease of fueling, and absence of thermal management issues. To shed light on the mechanisms leading to the exceptional storage capacities attained, extensive characterization of the surface and pore structure of samples was performed. The best gravimetric and volumetric storage capacities, among the carbons investigated in this thesis, are 1) 250 g CH4/kg carbon and 130 g CH4/liter carbon (199 V/V) at 35 bar and 293 K and 2) 80 g H2/kg carbon and 47 g H2/liter carbon at 50 bar and 77 K. This is the first time the DOE methane storage target of 180 V/V at 35 bar and ambient temperature has been reached and exceeded. The hydrogen values compare favorably with the 2010 DOE targets for hydrogen, excluding cryogenic components. Methane and hydrogen storage capacities were measured on custom-built gravimetric and manometric instruments, and validated on instruments in external laboratories. The materials have shown record storage for methane in activated carbons, and show promise for hydrogen storage.