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Analysis of Hydrogen Adsorption in Engineered Carbon Nanospaces JACOB BURRESS, MATTHEW BECKNER, NICK KULLMAN, RAINA CEPEL, CARLOS WEXLER, PETER PFEIFER, Dept. of Physics and Astronomy, University of Missouri — We present a survey of how appropriately engineered nanoporous carbons provide materials for reversible hydrogen storage, based on physisorption, with exceptional storage capacities (∼80 g H2/kg carbon, ∼50 g H2/liter carbon, at 50 bar and 77 K). The H2 gas-carbon surface interface physics was investigated using supercritical hydrogen isotherms. Experimental case studies, with surface areas as high as 3500 m2/g, in which 40% of all surface sites reside in pores of width ∼0.7 nm and binding energy ∼9 kJ/mol, and 60% of sites in pores of width >1.0 nm and binding energy ∼5 kJ/mol, are also presented. We experimentally distinguish between molecules exhibit mobile or local adsorption, how lateral dynamics affect the hydrogen storage capacity, and how the two situations are controlled by the vibrational frequencies of adsorbed hydrogen molecules parallel and perpendicular to the surface. In our samples, adsorption is mobile at 293 K, and localized at 77 K. These findings present evidence hydrogen storage capacities in nanoporous carbons can be increased, without any chemical surface functionalization, by more than a factor of two by suitable engineering of the nanopore space. This material is based on work supported by the U.S. Department of Energy under Award No. DE-FG02-07ER46411.

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