

# Samuel Bowman, Math and Science

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## Nanoporous biocarbons as a storage system for natural gas as fuel for vehicles

*Samuel Bowman, Jacob Burress, and Peter Pfeifer*

Natural gas is a promising fuel source because it is safe, inexpensive, cleaner than gasoline, domestically produced, and already has an infrastructure for its distribution. Methane, the main component of natural gas, however, does not have a high energy density, and to store enough in today's natural gas storage tanks to power vehicles, the gas must be compressed to 3600 psi. To be strong enough to hold up at those high pressures, Compressed Natural Gas (CNG) tanks must be bulky and cylindrical, and occupy the trunk space in today's CNG cars, which is considered prohibitive to the cars' market success. ALL-CRAFT's purpose is to develop nanoporous biocarbons which can store methane at relatively low pressures, allowing future tanks to be flat and sleek, ideally occupying the space below the car, making natural gas vehicles attractive consumer products. As a long-term goal, ALL-CRAFT is optimizing biocarbons for hydrogen storage for fuel cells. Nanoporous carbons are like sponges, soaking up molecules of adsorbent gas. The nanoporous biocarbons store up to five times more methane than an empty tank at the same pressure, despite the fact that the carbon obviously takes up space. It does this using van der Waals forces which act on the methane molecules at short distances. These forces cause the methane to form a supercritical fluid film on the surface of the carbon. The extremely high surface area of ALL-CRAFT's carbon samples—recently approaching 4000 square meters of surface per gram of carbon sample—means that our carbons can hold 180 times their volume in methane. Biocarbons can be made from myriad biomass sources. ALL-CRAFT hopes to perfect a process for making them from corn cob; using just the cob is advantageous because this does not displace corn as a food source like Ethanol does.