Alliance for Collaborative Research in Alternative Fuel Technology (ALL-CRAFT)
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ALL-CRAFT (http://all-craft.missouri.edu) is a partnership of the University of Missouri, Columbia (MU, lead institution) and Midwest Research Institute (MRI), Kansas City, to develop low-pressure, high-capacity storage technologies for natural gas (NG, methane) and hydrogen as fuels for advanced transportation. The immediate objective is to replace bulky cylindrical, heavy-walled compressed natural gas tanks (CNG, 3600 psi) in current NG vehicles by a flat, lightweight tank, with storage as adsorbed natural gas (ANG, 500 psi, solid-state tank), in next-generation clean vehicles. NG vehicles produce no ozone and smog, and up to 40% less greenhouse gases than gasoline or diesel vehicles. NG can reduce the US' dependence on foreign oil (85% of the NG consumed in the US is produced domestically; 12% comes from Canada). It is cheaper than gasoline or diesel at the pump, and can also be produced renewably in the form of biomethane (landfills, sewage treatment plants, farms). The flat tank design, made possible by the low pressure in the ANG tank, is central to a tank that can be mounted under the floor or in other unused space of a car. The tank will make NG vehicles a widely attractive alternative to gasoline or diesel vehicles. For hydrogen vehicles, the objective is a flat, lightweight tank with reversible storage as adsorbed hydrogen. Our storage materials are appropriately engineered nanoporous carbons.

Accomplishments. We have developed nanoporous carbon briquettes, made from waste corncob in a multi-step process (patent pending), with a storage capacity over 118 g methane/liter carbon, or 180 times its own volume (100% of volumetric DOE target), at 500 psi and ambient temperature. Corncob is a renewable raw material, ensuring low tank costs and production from domestic sources. We manufactured 300 disk-shaped briquettes (~25 kg), loaded them in a prototype tank and fuel delivery system developed by MRI, and installed the system on a NG vehicle on loan from the Kansas City Office of Environmental Quality. The tank, in a road test that began in January 2007, performs flawlessly and was showcased at a press conference in Kansas City, 2/16/07. For hydrogen, our best storage capacity is 8 weight% at 700 psi and liquid nitrogen temperature (130% of the 2010 DOE gravimetric target for hydrogen, excluding cryogenic components).

Next steps. With our record-breaking storage materials, objectives are: (A) develop 2nd-generation carbon materials for NG storage beyond the DOE target, at costs for integrated ANG tanks less than current CNG tanks; (B) work with automobile and other companies to bring a commercial ANG tank to market in 5 years; (C) develop surface-modified carbon for hydrogen storage that meets the 2010 DOE target at ambient temperature.

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