



Project update

Carbon concept to power natural gas vehicles

Project details	
Project title	Natural gas sorption materials, tailor-made in nano and macroscopic scale for optimal heat transfer, mass transfer and technically realizable gas storage capacities
Participant	University of Erlangen, Germany
Start date	2008
Key aims	<ul style="list-style-type: none"> • Enable widespread use of natural gas as a transport fuel • Support development of low emission vehicles operating on a fossil fuel • Reduce reliance on oil-based fuels and petrol- and diesel-engine vehicles.

Project summary	
<p>A storage system that provides natural gas as a practical, cleaner fuel for transport is being pioneered under E.ON's International Research Initiative.</p> <p>The project is using nanoscale technology to create a high capacity carbon structure that delivers the gas as a responsive source of power for vehicles, and offers fast refueling. Developing an alternative fossil fuel to petrol and diesel will reduce output of CO₂ and other pollutants. It is also an important step</p>	<p>towards zero emission transport until electric vehicles are more widely used. This project has been developed by the University of Erlangen. The joint applicants are Dr Bastian Etzold, a senior scientist in the Excellence Cluster Engineering of Advanced Materials, and Dr Nadejda Popovska, head of the Chemical Vapor Deposition research group in the Chair Chemical Reaction Engineering. The aim of the project is to replace the</p> <p>current method of storing gas in vehicles which uses costly, heavy, pressurized tanks, whose shapes are difficult to accommodate. The new system would use a technique known as adsorptive storage in which large volumes of gas adhere to layers of carbon-based material with microscopic pores offering a huge surface area. These structures can be adapted to provide light and diversely shaped tanks to fit in vehicles more easily, with fast refueling.</p>

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Researchers have begun investigating an innovative application of nanotechnology to create the special carbon structures at the centre of this project.

Two techniques play key roles in different parts of the manufacturing process: chemical vapor infiltration (CVI) is used to tackle the macroscopic structure, while the carbide-derived carbon method is the choice for the nanoscale engineering.

Experiments were carried out with both techniques in the early stages of the project. In combination they represent a new concept to produce the adsorptive gas storage material for natural gas fuel storage.

The carbon adsorbent is derived from carbides which are created from different templates.

One type of template, known as biomorphic, was made by pyrolysis of preformed rolls or sheets of paper and felt. Twelve different samples were

prepared and their characteristics, and the pyrolysis process, were both satisfactory.

The biomorphic templates then underwent CVI to convert them into a ceramic carbide. It was identified that paper templates need a low density to result in a homogeneous infiltration with the carbide. This helps achieve the required characteristics in the adsorbent material later in the manufacturing process.

The second type of template comprises aluminum oxide structures, which are similar to those used in catalytic treatments of exhaust gas. These were also subjected to CVI to build up layers of ceramic carbide.

A comparison between the templates indicated that the biomorphic carbides are superior, as these substrates are infiltrated with the carbide to a higher degree.

Both types of template were

converted to nanoporous carbon with gas phase etching, which removed the non-carbon content from the carbide. This produces the structured carbon adsorbent with nanoscale pores that provide vast surface area storage capacity for the natural gas fuel.

The advantages of both types of templates - but mainly of the biomorphic types - are that they allow the macroscopic and microscopic structure in the carbon adsorbent to be tailored for three benefits. These are high gas storage capacities, and optimized mass and heat transfer properties.

Other work carried out was the set up of a measurement rig for the uptake of natural gas by the adsorbents. Studied materials showed great potential and exceeded the uptake of commercially activated carbon. More work will be done to improve storage and heat transfer properties.

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