Integrated hydrogen storage for fuel cell cars

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There is a drive to displace fossil fuels in power generation and transport with sustainable alternatives. One approach that has been discussed over the last few decades is a future zero-carbon, hydrogen economy wherein hydrogen is generated from renewables and used to feed fuel cells in cars. Fuel cells are essentially electrical batteries that can be fed chemical energy continuously to generate electricity. Unfortunately, hydrogen gas is a hazardous substance and so safe storage in a fuel tank in such a vehicle has been a roadblock to advances in this area.

Now, Saumen Dutta and Sri Harshith Dosapati of Vellore Institute of Technology at VIT University, in Tamil Nadu, India, have discussed how hydrogen storage might be integrated into the vehicular fuel cell itself. Writing in *Progress in Industrial Ecology—An International Journal*, the team explains how switching to renewable is now of paramount importance given carbon emissions and their impact on climate as well as the likelihood that fossil fuel sources will become increasingly scarce or inaccessible for geological and political reasons.

The team's work focuses on carbon nanotubes as a storage option for hydrogen as opposed to simply pressuring the gas which comes with the risk of explosion. Carbon nanotubes would provide a vast surface area within a small volume on to which hydrogen molecules would be adsorbed into a much more stable form than pressurized gas. They write that they have achieved uptake at a level of just over 1.14 weight percent at 50 megapascals of pressure at the relatively mild temperature of 283 Kelvin, nominally about 10 degrees above room temperature. The team used germanium-doped carbon nanotubes to achieve this.

They then coupled this storage system to a fuel cell and could demonstrate a constant flow rate of hydrogen into the fuel cell. The cell could consume this chemical energy source and steadily develop more than 10 kilowatts of power.

In a working vehicle, the team explains that lightweight composite materials could be used to contain the doped carbon nanotube powder and to ensure the pressure is maintained to facilitate storage. Some of the power generated would be required to maintain the contents of the integrated fuel tank at the requisite storage temperature of 283 Kelvin. Obviously, in hotter climates this would require a far smaller proportion of the fuel cell output than would be needed when driving in the cold. Optimisation of the synthetic and fabrication procedures for such a storage method would bring it closer to economic viability.

More information: Saumen Dutta et al. Hydrogen storage system integrated with fuel cell, *Progress in Industrial Ecology, An International Journal* (2020). DOI: 10.1504/PIE.2020.109851

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