Cleaner, cheaper hydrogen from methane

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Researchers from the Institute of Chemical Technology (ITQ), Valencia's Polytechnic University (UPV) and the Superior Council of Scientific Investigations (CSIC) have developed ceramic membranes that make it possible to produce compressed hydrogen from methane in a cleaner, cheaper way. Results of the investigation have applications in the field of hydrogen fuel cell vehicles as well as the chemical industry, as this new method is capable of generating hydrogen from methane gas and electricity in just one step and with near-zero energy loss.

Hydrogen is an excellent fuel which, due to its high energetic density and zero greenhouse gas emission, is essential in a great number of industrial processes. Its combination with oxygen in the atmosphere produces energy and water as its sole by-product, making it one of the main

candidates to substitute fossil fuels as a source of energy for the transport sector.

CSIC research professor and head of the investigation José Manuel Serra says, "The development and introduction in the market of hybrid and electric cars will allow us to reduce the impact of transport in CO2 emissions in coming years, and as a result, the greenhouse effect on the planet. The next natural step, as proven by the investment made by large automotive industry brands, is the implementation of hydrogen-fuelled vehicles, which have greater autonomy and charge faster than electric ones."

Researchers at the ITQ have developed a gas separation membrane reactor which is operated electronically and allows for the endothermic production of hydrogen with a near-zero energy loss.

"Our investigations show that it is possible to generate compressed hydrogen in just one step with high efficiency from electricity and methane gas or biogas and, simultaneously, isolate the CO2 and not release it into the atmosphere. Our method allows for the hydrogen to be produced at high pressure in a distributed manner, which means it could be produced in petrol stations, residential areas, garages or farms. By using electricity from renewable sources, our system allows us to generate hydrogen with a very low carbon footprint. We can also store the leftover renewable energy in the form of compressed hydrogen for a later use when the electrical demand is higher, or as fuel for vehicles," Serra adds.

The work of investigators at the ITQ, developed together with the University of Oslo and American multinational company CoorsTek, will make it so that vehicles with a hydrogen fuel cell can be recharged with an energetic efficiency and simplicity similar to that of a battery electric vehicle. Due to methane gas, as a primary energy source, having a

noticeably lower cost than electricity, hydrogen could be a cheaper fuel for vehicles than electricity.

More information: Harald Malerød-Fjeld et al. Thermo-electrochemical production of compressed hydrogen from methane with near-zero energy loss, *Nature Energy* (2017). DOI: 10.1038/s41560-017-0029-4

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