PROCEDURE FOR EFFICIENT PRODUCTION AND SAFE STORAGE OF HYDROGEN FOR USE IN FUEL CELLS

DESCRIPTION OF THE TECHNOLOGY

Researchers from the Universitat Jaume I in Castelló, the Universidad de Zaragoza, and the Instituto de Tecnología Química of the UPV/CSIC have developed and patented a new procedure for the efficient production and the safe storage and transportation of hydrogen for use in fuel cells. The invention consists in a method of obtaining molecular hydrogen by means of catalytic dehydrogenation reactions. This method makes it possible to overcome the limitations of the systems currently employed for the sustainable and safe handling of hydrogen as an energy vector. The ability to obtain hydrogen at room temperature ensures its use in a large number of applications, particularly in the automotive and energy industry.

Hydrogen is an excellent fuel due to its high energy density and the zero emission of greenhouse gases. In combination with oxygen from the air, hydrogen can be used to obtain energy, the only by-product being water. This characteristic makes it an excellent candidate to replace fossil fuels as a source of energy for cars and other means of transportation.

However, the use of hydrogen as an alternative fuel has a number of drawbacks which have prevented the full implementation of the so-called *hydrogen economy*. The first of them is the fact that hydrogen is not readily found in the earth's crust and must be produced, in a process that is hardly ever sustainable. The second is the flammable nature of hydrogen gas and the need to transport it in compressed form, with all the dangers that this entails.

The invention described here overcomes these limitations by providing an efficient, sustainable and safe procedure for producing, storing and transporting hydrogen. The technology is based on the use of what are known as *Liquid Organic Hydrogen Carriers* (LOHC).

More particularly, it employs a combination of hydrosilanes and alcohols, which produce hydrogen using a catalyst immobilized in a carbon material. This novel procedure offers a number of advantages over currently existing technologies. On the one hand, it makes it possible to work at low temperatures, while, on the other, it is highly versatile due to the different silanes and alcohols available. Furthermore, it is a reversible system that allows for the reuse of both the products and the catalyst itself in successive cycles. Together, these advantages help to bring down the costs of obtaining and handling hydrogen. At the same time they also make transporting this fuel safer and, therefore, improve its applicability in non-stationary systems, such as cars and other types of vehicles.

SECTORS FOR COMMERCIAL APPLICATION

This technology is aimed at the energy production industry, and more particularly at sectors operating with sources of renewable energy that are free of pollutant and greenhouse effect emissions. More specifically still, the invention can be applied in companies devoted to the production and commercialisation of solutions for the storage and transportation of hydrogen, as an energy vector, based on the use of *Liquid Organic Hydrogen Carriers* (LOHC). Likewise, the automotive industry would be a final user of this technology, owing to the fact that it is intended to cover the need to ensure the safe transportation and storage of hydrogen for use in vehicle fuel cells.

TECHNICAL ADVANTAGES AND COMMERCIAL BENEFITS

The use of this technology can benefit firms in the energy sector. The combination of renewable energy production and the storage of hydrogen is an efficient way of holding and saving energy that can be used on demand. The potential business benefit is the development of a way to produce energy without pollution. The main advantages of the invention are:

- It is an energy system whose only by-product is water. It does not generate any of the greenhouse gases that characterise the use of fossil fuels and it is not vulnerable to climate conditions, as is the case of solar and wind power.
- It is a reversible system that allows hydrogen to be stored/generated depending on the demand in successive cycles. The silyl-ether resulting from the reaction can be transformed back to the initial

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hydrosilane or, alternatively, it can be used in the silicone industry.

- The heterogeneous catalysts used in the invention have been shown to have a catalytic activity that is higher than that of the homogeneous catalysts that are usually employed. Furthermore, the catalyst can be easily recovered and reused in new cycles.
- The use of the silane-alcohol system as an LOHC makes it possible to work at low temperatures to obtain hydrogen.
- The technology has great potential versatility due to the different silanes and alcohols available, with a wide range of hydrogen storage capacities.
- It can be easily adapted to non-stationary energy generation and usage systems, such as cars.
- The technology avoids the safety problems derived from storing hydrogen at high pressures and prevents its inflammable nature.

STAGE OF DEVELOPMENT OF THE TECHNOLOGY

Validated at the experimental level within a laboratory setting.

INDUSTRIAL AND INTELLECTUAL PROPERTY RIGHTS

This invention is protected by means of a Spanish patent with reference number P201730918 which was filed on 11/07/2017.

COLLABORATION SOUGHT

- Licence agreement for use, manufacture or commercialisation.
- Development of applications.

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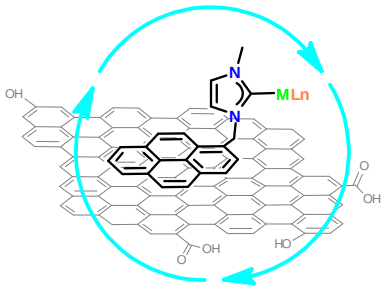

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