

NEW CATALYSTS BASED ON GRAPHENE OF INTEREST TO THE ENERGY INDUSTRY

DESCRIPTION OF THE INVENTION

The technology consists of advanced materials based on graphene functionalised with organometallic compounds for use in the conversion and storage of energy by catalytic and electrocatalytic processes. Specifically, the reactions catalysed by these new materials are related with the generation and use of hydrogen.

To establish the so-called hydrogen economy it is necessary to develop efficient solutions as regards ways of obtaining and storing this gas. With regard to storing it, for example, because hydrogen has an incredibly low density, storage systems tend to be too heavy and bulky. The chemical storage of hydrogen is an attractive avenue for hydrogen transportation systems. In the same line, the catalytic reactions addressed by the invention are, in particular, the oxidation of alcohols and more generally the hydrogenation / dehydrogenation of liquid organic molecules such as acids or amines.

Specifically, the invention refers to a material that comprises a support made of graphene or some other carbon material, such as carbon fibres or nanotubes, and a complex made up of a polycyclic hydrocarbon such as pyrene attached to an N-heterocyclic carbene and a transition metal. The support and the complex are linked by means of pi-stacking interactions, which allow the metallic

complex part to maintain its molecular properties intact, including its catalytic properties. The invention represents a substantial advance with respect to the traditional catalyst support techniques in solid matrices.

The combination of molecular complexes and graphene offers a wide range of possible applications in the development of highly active catalytic materials and are also easily separated from the products obtained and reused. This reuse of materials is a very appealing characteristic from the industrial point of view. The properties of the advanced materials obtained can be modified by controlling the steric and electronic properties of the metal centres. Furthermore, variations in the properties of the graphene can foster the catalytic process through synergic effects such as increasing the stability of the metal centres or by promoting reactivity in the surface of the materials.

Hence, the proposed technology answers the need to develop graphene-based catalysts, in which some metal centre has been introduced in such a way that the intrinsic properties of the graphene and of the metal that make them suitable for application in catalysis remain unmodified.

SECTORS FOR COMMERCIAL APPLICATION

The technology is useful for industry in the catalytic chemistry, energy, and electronic components and semiconductor sectors.

TECHNICAL ADVANTAGES AND COMMERCIAL BENEFITS

The main advantage of the methodology developed is that it is a converging synthesis procedure and can be easily modulated. The preparation of graphene derivatives and the synthesis of organometallic compounds are two fields that have received a great deal of attention from researchers. The technology presented here consists in combining the two disciplines by preparing new advanced materials. The interaction of the organometallic compounds is produced through non-covalent interactions with the surface of the graphene by means of a single reaction step. The principal characteristic of this process is that the specific properties of the graphene are not altered and can be modulated easily. Moreover, the catalyst can easily be separated from the products and is therefore retrievable. Thus, the main advantages of the technology are:

- The activity of the catalyst is not altered by the presence of the graphene support.
- The process of separating catalyst and reaction products is efficient.
- The catalyst can be recycled up to ten times without any loss of activity.

The main innovative aspect of the technique lies in the fact that it allows the new materials to be adapted to the technology that already exists on the market. New devices based on these materials can be prepared directly and the chief advantage is that the properties can be modified in accordance with the needs of the

NEW CATALYSTS BASED ON GRAPHENE OF INTEREST TO THE ENERGY INDUSTRY
system.

STAGE OF DEVELOPEMENT OF THE TECHNOLOGY

The laboratory phase for the synthesis and characterisation of these hybrid compounds has finished. A search is currently being performed to detect applications in catalytic and electrocatalytic processes.

INTELLECTUAL PROPERTY RIGHTS

A Spanish patent has been applied for with the reference P201331680 and filing date 11/18/2013. In process of internationalization by PCT.

COLLABORATION SOUGHT

- License agreement for use, manufacturing or commercial exploitation.
- R&D for further development of the invention or for exploring its applications in other industrial sectors.

RELATED IMAGES

CONTACT DETAILS

Hugo Cerdà
Oficina de Cooperación en Investigación y Desarrollo Tecnológico (OCIT)
Universitat Jaume I de Castelló
Tel: +34 964387487
e-mail: hcerda@uji.es
Web: <http://ujiapps.uji.es/serveis/ocit/>