3D COPPER AND CERIUM CATALYST: NEW TECHNOLOGY FOR EFFICIENT PURIFICATION OF GREEN HYDROGEN

CONTACT DETAILS:

Research Results Transfer Office-OTRI
University of Alicante
Tel.: +34 96 590 99 59
Email: areaempresas@ua.es
http://innoua.ua.es

ABSTRACT

Researchers from *Department of Inorganic Chemistry* at the University of Alicante have developed a new type of catalyst based on a monolithic structure with internal channels. It is characterised by an active copper metal substrate and an intermediate layer of copper oxide on which a dispersed phase of cerium oxide is deposited.

The main advantage over current monolithic catalysts is that both the monolithic copper structure and the intermediate layer and dispersed phase exhibit catalytic activity, making it a highly active and selective catalyst, particularly suitable for efficiently removing carbon monoxide from hydrogen-rich streams from hydrocarbon reforming.

Companies interested in acquiring this technology for commercial exploitation are sought.

ADVANTAGES AND INNOVATIVE ASPECTS

ADVANTAGES OF THE TECHNOLOGY

This technology offers the following **advantages**:

1) The active monolith has a **higher catalytic surface area per volume**, reducing the amount of material required.

2) The use of copper, a cheap and abundant metal, **reduces material costs** compared to catalysts containing noble metals, without sacrificing performance.

3) The intermediate CuO layer improves CeO_2 adhesion, facilitating electron transfer and **increasing catalytic activity**.

4) CeO_2 dispersion provides additional oxidation sites and **promotes selectivity towards CO_2 without oxidising hydrogen**.

5) The 3D channel design optimises turbulence and radial diffusion, reducing the reaction start temperature and **improving thermal efficiency**.

6) The copper monolith has superior thermal and mechanical conductivity, **reducing pressure loss** compared to ceramic monoliths.

7) **Scalability**: 3D printing allows the production of parts of any geometry, size and shape, adapting to different reactor configurations.

8) **Compatibility with existing chemical processes**: it can be integrated into existing reforming lines and hydrogen purification systems without significant structural changes.

The high activity and selectivity of this innovative catalyst, combined with lower pressure drop and thermal robustness, make this technology very attractive to the **energy** and **environmental industries**.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

This innovative catalyst combines a monolithic copper structure with an intermediate layer of CuO and a dispersed phase of CeO_2 (pure or doped). **The entire mass**, not just the active phase, **is catalytic**, which increases the useful surface area and reduces pressure drop.

The sintering process in an inert atmosphere and subsequent passivation create a highly active CeO_2/CuO/Cu interface for the selective

oxidation of CO in hydrogen-rich streams, with **greater activity and selectivity** than traditional monoliths on inert supports.

In addition, the manufacture of the monolith by **3D printing** allows the creation of **homogeneous or heterogeneous channel designs**, generating turbulence and better radial diffusion. This design flexibility opens the door to **specific adaptations for each industrial chemical process**, positioning the technology as a competitive and scalable option for the next generation of hydrogen purification systems.

Therefore, the innovation lies in the fact that most of the mass of the catalytic bed is active, which reduces the required reactor volume and improves heat and mass transfer. This innovation opens the way to **more efficient and compact processes** in the production of hydrogen and clean fuels.

MARKET APPLICATIONS

This innovation offers a monolithic copper catalyst with cerium for the selective removal of carbon monoxide in hydrogen-rich streams. Its applications cover sectors relevant to the environment and emissions control in the **chemical** and **petrochemical industries**.

Among the main sectors of application are:

- **Hydrogen purification** in hydrocarbon reforming plants (natural gas, biogas, etc.) using CO-PROX.
- **Pre-treatment of gases** for fuel cells (pure hydrogen for PEM, SOFC, etc.).
- **Control of carbon monoxide** in chemical synthesis processes (methanol, ammonia, etc.).
- **Decontamination of industrial gases** containing carbon monoxide and hydrogen (petrochemical industry, refineries, etc.).
- Renewable energy applications where **hydrogen free of CO impurities** is required for storage and transport.

COLLABORATION SOUGHT

It is looking for companies interested in acquiring this technology for commercial exploitation through **patent licensing agreements**.

Company profile sought:

- Companies with the capacity to produce and market **advanced catalysts**, especially in the energy, petrochemical or environmental sectors.
- Companies that carry out **hydrocarbon reforming** processes and seek to optimise the purification of the hydrogen stream.
- Companies operating in the production of **clean and sustainable fuels** (methane, methanol, etc.) that require highly selective carbon monoxide removal systems.

Types of companies sought:

1. Manufacturers of industrial catalysts.
2. Suppliers of equipment and solutions for green hydrogen production.
3. Hydrocarbon and natural gas reforming companies.
4. Industrial gas and emissions treatment companies.
5. Manufacturers of combustion and power generation systems with a focus on low emissions.
6. R&D&I companies in catalysis and advanced materials.
7. Technology start-ups focused on the circular economy and CO_2 capture.
8. Suppliers of gas purification solutions for the food and pharmaceutical industries.
9. Chemical process engineering and consulting companies seeking to incorporate high-performance catalyst technologies.
10. Government organisations and funding agencies that support the energy transition and emissions reduction.