

TRANSFORMATION OF BIOMASS WASTE TO OBTAIN CATALYSTS OF INTEREST TO THE CHEMICAL INDUSTRY

P PATENTED TECHNOLOGY

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ABSTRACT

The *Materiales Carbonosos y Medio Ambiente* (MCMA) research group at the University of Alicante has developed a new procedure to prepare heterogeneous catalysts from biomass waste based on highly dispersed metal nanoparticles.

This procedure is characterised by the fact that it is very simple, involves few synthesis steps, the synthesis conditions are mild and it is environmentally friendly. Moreover, it is easy to scale up to an industrial level, allows the revalorisation of any type of biomass-derived waste and has a low manufacturing cost. The synthesised catalysts show excellent catalytic behaviour using low noble transition metal contents and could become very promising candidates to replace current commercial catalysts in the production of molecules of great interest to the chemical sector, such as, for example, in the conversion of levulinic acid to gamma-valerolactone. Companies interested in acquiring this technology for commercial exploitation are sought.

TECHNOLOGY ADVANTAGES AND INNOVATIVE ASPECTS

ADVANTAGES OF THE TECHNOLOGY

The main **advantages** of this novel procedure are listed below:

- 1) It comprises **few steps** and is **very simple**.
- 2) It is carried out under **mild reaction conditions**: low pressure, moderate temperature and short reaction times.
- 3) It **avoids the use of hydrogen gas** at high temperatures.
- 4) The formation of **small metal nanoparticles** is favoured.
- 5) **High dispersion** of the metal nanoparticles on the carbonaceous supports is achieved.
- 6) **No aggregates** of metal particles are obtained.
- 7) The catalyst offers **many active sites** for the chemical reaction in which it is to be used, which gives **better results** than with commercial catalysts.
- 8) Drying of the catalyst is carried out at a lower temperature than conventional methods, which **prevents the electronic properties of the surface of the metal nanoparticles from changing substantially**.
- 9) It allows the **recovery of abundant biomass waste** (cocoa shells, almond shells, hemp, eucalyptus, etc.).
- 10) The catalysts obtained can be used in the **chemical conversion** of a multitude of **molecules of great industrial interest**.
- 11) **Lower production costs** than current synthesis methods.
- 12) **Lower environmental impact** than current synthesis methods.
- 13) **Porosity is achieved equal to or higher** than with the conventional activation process.
- 14) **Higher yields** are achieved compared to conventional chemical activation.

- 15) The process is **easily scalable to industrial scale**.
- 16) **Versatility** of the synthesis method: different types of hard or soft lignocellulosic biomass residues can be used (regardless of their composition and moisture content).
- 17) **Low metal content** (ruthenium, etc.) compared to commercial catalysts.
- 18) **Higher levulinic acid conversions** (98.4%) and **selectivities** towards GVL (100%) are achieved than in the current state of the art.
- 19) The catalysts show **excellent catalytic activity** under mild reaction conditions (low temperatures, etc.).
- 20) **High stability** of the catalysts obtained after several consecutive reaction cycles.
- 21) **No special equipment is required**: the equipment used is commercially available and affordable for any laboratory or industry.
- 22) The **precursors** used are **very cheap and abundant**.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

The main innovation lies in the **use of agricultural waste** (lignocellulosic biomass) to obtain **heterogeneous catalysts** containing **low concentrations of ruthenium in the form of highly dispersed metal nanoparticles**.

The present invention differs from current synthesis methods in that:

- 1) Activated carbons obtained from **biomass residues rich in lignocellulose** are used as support for the active phase.
- 2) **Ruthenium contents are much lower** than those present in commercial catalysts.
- 3) **Mild reaction conditions** are used.
- 4) The low temperature used for catalyst drying **prevents the electronic properties of the surface of the metal nanoparticles from changing substantially**.
- 5) The **metal nanoparticles are highly dispersed** on the surface of the activated carbon support, allowing **many active sites** for the chemical reaction of interest to take place with **high efficiency and selectivity**.
- 6) The **activating agents** used are **not dangerous for the environment** and, moreover, very low concentrations are used compared to conventional chemical activation, which **reduces synthesis costs and environmental impact**.
- 7) The method is **very simple**, with **few steps** and **short synthesis times**.

MARKET APPLICATIONS

The present invention is framed both in the **Circular Economy** sector and in the **obtaining of high added value chemical products**.

Specifically, a novel process has been found to prepare heterogeneous catalysts with low transition metal content from lignocellulosic biomass residues that can be successfully used in the **conversion of organic compounds** under mild reaction conditions, such as:

- In the selective hydrogenation of levulinic acid to GVL.
- In the decomposition of hydrogen-bearing molecules.
- In the production of ammonia.
- Other applications of interest.

This technology makes it possible to obtain carbonaceous materials with very low transition metal content, making them very promising **catalysts to replace those currently used in the conversion of organic compounds of interest** (for example, in the conversion of levulinic acid to GVL).

In this respect, the main sectors of interest are:

- The chemical industry.
- Pharmaceutical industry.
- Waste management (conversion of lignocellulosic biomass).

COLLABORATION SOUGHT

Companies interested in acquiring this technology for **commercial exploitation** are sought:

- Patent licensing agreements.
- Development of new applications.
- Technology and knowledge transfer agreements.

Company profile sought:

- Catalyst manufacturers.

