NEW METAL-FREE ELECTROCATALYSTS FOR FUEL CELLS

PATENTED TECHNOLOGY

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ABSTRACT

The Carbon Materials and Environment Research Group of the University of Alicante has developed a new method for obtaining carbon materials with excellent properties such as electrocatalysts in fuel cells or metal-air batteries. The process is based on the thermal treatment of polyaniline (or its derivatives) at high temperature and allows to obtain metal-free carbon materials with a high performance, in a very simple, fast way and in a single stage. These novel materials are characterized by their excellent catalytic activity and selectivity in the oxygen reduction reaction in alkaline medium, they are very stable and resistant to methanol and carbon monoxide poisoning, and above all, they stand out for their low manufacturing cost, which makes them promising candidates to replace the current commercial platinum-based catalysts. We are looking for companies interested in acquiring this technology for commercial exploitation.

ADVANTAGES AND INNOVATIVE ASPECTS

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

1) It uses **low cost precursors.**

2) It does not require special equipment.

3) They are synthesized in a **very simple w**ay and in a **single-stage** without using a template or sacrificial materials.

4) The synthesis method has a **high yield.**

5) **Low cost** of the synthesis method: manufacturing cost to obtain this type of materials is **radically lower than current commercial catalysts.**

6) Synthesized carbon materials are easy to handle: they are dispersed easily in an aqueous medium at room temperature.

7) They have an **excellent electrocatalytic activity** for oxygen reduction reaction in alkaline medium.

8) They have a **great stability**, which gives them a longer useful working time (durability) than current platinum-based electrodes of fuel cells or metal-air batteries.

9) They are **resistant** to methanol or carbon monoxide **poisoning.**

10) The oxygen reduction reaction has a high selectivity, since it is carried out through a mechanism of four electrons whose final reaction product is water (with a minimum production of reaction intermediaries, less than 5%, which could damage the fuel cell).

11) They are environmentally friendly materials, since they are metal-free catalysts.

12) They can be used as electrodes in fuel cells and metal-air batteries.

13) They reduce the total cost of the fuel cell.

14) These are major candidates to replace existing commercial platinum-based catalysts in alkaline medium.

Although thermal treatment of polymers containing aniline in their monomer units is known within the state of the art, the present method differs from the other procedures in the following aspects:

1) **Heat treatment temperature** is higher than **1100ºC** (as opposed to the other treatments, whose working temperatures are lower than 800ºC, and therefore, insufficient to achieve a catalytic activity close to that obtained by platinum-based catalysts). Through this high pyrolysis temperature, carbon materials get a structural order, electrical conductivity and catalytic activity similar to commercial platinum-based catalysts, being, therefore, excellent substitutes for these, because production cost is radically lower.

2) No templates or sacrificial structures are used (which increase the number of stages of synthesis and the cost of manufacturing the catalyst).

3) The method described in this invention is very simple and is carried out in a single-stage.

4) The adequate selection of precursors, being polyaniline and its derivatives the most appropriate for obtaining carbon materials with excellent catalytic activity in an alkaline medium (similar to commercial platinum-based catalysts).

MARKET APPLICATIONS

This invention is framed in the **energy sector,** specifically in the area related to chemical transformations derived from the transfer of electrons produced in **electrocatalysts.**

This technology makes it possible to obtain metal-free carbon materials for application as excellent electrocatalysts (cathode) in the oxygen reduction reaction under alkaline conditions in hydrogen or methanol low temperature **fuel cells**, or in **metal-air batteries.**

Therefore, this technology finds its application in the following industrial sectors:

- Fuel cells.
- Metal-air batteries.
- Automobile.
- Energy production and storage.

COLLABORATION SOUGHT

We are looking for companies interested in acquiring this technology for commercial exploitation through:

- Patent licensing agreements.
- Development of new applications.
- Agreements regarding technology and knowledge transfer.

Company profile sought:

1) Manufacturers of catalysts and electrocatalysts for fuel cells.

2) Manufacturers of catalysts and electrocatalysts for metal-air batteries.