

## Co-operation profile details from Enterprise Europe Scotland

### 12 ES 28G2 3PBN - Method for the characterization and identification of materials with photovoltaic properties.

#### Technology collaboration OFFER

#### Abstract

A Spanish Research Institute in collaboration with a Spanish University has developed a method for determining a photocatalytic reaction, the photovoltaic properties of solid materials capable of acting as light absorbers in photovoltaic devices, which has applications in the energy sector and more specifically in the renewable energy sector.

Partners Interested in a patent license and in the exploitation of the existing know-how are being sought.

#### Description

Photovoltaic devices for solar energy currently used are based on light-absorbing materials with semiconductor character. They have an electronic structure with a valence band and conduction band, which in the absence of defects or impurities, are respectively filled and empty of electrons, and separated by an energy gap to the electrons (bandgap). When these materials absorb a photon of electromagnetic radiation with an energy equal to or greater than the width of the "bandgap", an excitation of an electron from the valence band to the conduction band is produced, generating electrical current and voltage and resulting in a conversion of light energy into electrical energy.

For the practical use of these systems, either to evaluate the efficiency or other characteristics of the absorbing material, selective electrical contacts are normally placed over these materials (which are in the form of thin film and relatively smooth surface). In one of the contacts the electrons are only transferred between it and the valence band, while in the other contact the electrons are only transferred between it and the conduction band. In this way, these two contacts tend to balance their electrical potential with the average electronic potential of the electrons and respective holes. This requires design and the establishment of selective contacts, which can be difficult especially if the absorbent material or its properties are unknown. In that case, it is not possible to know a priori the most appropriate contact materials and therefore the preparation of the contacts material in powder form or complex surface nanostructure is required.

In some cases photoluminescence measurements can be used to evaluate these materials, but these measures require very low temperatures, and do not apply for systems that use indirect bandgap semiconductors (i.e., those in which the electronic states of the edges of the valence band and conduction have different kinetic momentum; the transition of luminescence among those edges is prohibited) or use hot carriers, due to the fact that the luminescence is easily detectable when the kinetic energy in excess has already been lost.

Regarding the photocatalytic processes, it is known for a long time that excited electrons and holes that are produced in a semiconductor when this absorbs photons with energy greater than the width of its bandgap spread to the surface of the material, which is in contact with a fluid that contains chemical species capable of providing or capturing electrons. Then electronic transfers are produced between the solid and those species with chemical changes that can be detected and measured.

These photocatalytic processes are commonly used or proposed for the elimination of pollutants, the production of fuels such as hydrogen or the synthesis of specific chemical compounds. They have never been used as a method for analyzing photovoltaic properties of solid materials, although in some cases they have been used just to test if certain materials have got photocatalytic properties. In particular, they have never been tested in photovoltaic materials with and intermediate band features of the type described herein, or to check the possible use of hot carriers in photovoltaic applications.

The proposed technology consists in a method for the evaluation of material with interested photovoltaic properties based on the use of the photo-oxidation of formic acid, or any other photocatalytic reaction as photo-degradation of organic dyes as a pattern reaction. The method requires a photocatalytic reactor, in which the material to be studied is placed in contact with a fluid containing at least one of the chemical species whose chemical transformation can be triggered by irradiation of the system, with the consequent production of electrons and holes in the solid, followed by diffusion to the surface of these and the electronic transfer between the solid and the species or species. This procedure is quite interesting when it comes to evaluate materials entirely new, of which there is not information about their photovoltaic properties.

#### Innovative Aspects:

The main innovative aspect of this technology is that it allows the evaluation of the ability to photogenerate electrons and holes in materials that could be used in photovoltaic devices without having to build the device with electrical contacts.

Additionally, the method allows using the material in powder form, reducing the preparation time and associated costs.

## **Target partner expertise sought:**

- Type of partner sought: Industrial Partner
- Specific area of activity of the partner: Photovoltaic, Photocatalysis, solar energy
- Task to be performed by the partner sought: signing license and exploitation of the technology

## **Key information:**

Country of origin: SPAIN

Listed under: Building and Construction \ Materials \ Energy \ Chemistry & Chemical Engineering \ Engineering \ Renewables \ Drug Discovery and Drug Development \ Physical Sciences

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**To find out more, contact Enterprise Europe Scotland on 0141 228 2797 or email us at [info@enterprise-europe-scotland.com](mailto:info@enterprise-europe-scotland.com) quoting ref 12 ES 28G2 3PBN**