Technology Offer

Title: Preparation of photoelectrocatalysts for application in solar-energy-based processes (Ref: 08 IT 55Y2 0IGJ)

Abstract:

An Italian university proposes a sustainable electrochemical process for depollution of wastewaters as well as for electro-synthesis of particular concern. The technique is based on the use of semiconductor electrodes suitably modified in order to achieve high quantum yields with solar radiation. The technology is proposed to enterprises interested in a possible application of renewable energy (solar energy).

Description:

Photoelectrocatalysis represents an attractive way to increase the efficiency of a photocatalytic process: it consists of applying an external electric field to the photoelectrode, which determines more effective production of charges inside the semiconductor structure, therefore increasing its performances (an effective separation of photo-generated charges is obtained, thereby increasing the lifetime of electron-hole pairs).
Among semiconductor materials, Ti dioxide in its different crystalline forms, Sn dioxide and Zn oxide, characterised by considerable stability in aqueous solution and low cost, are the most widely used in photocatalysis. One of the main drawbacks in using these materials is their low efficiency to exploit solar radiation. TiO2 photocatalytic reaction usually has a low rate of electron transfer to oxygen and a high rate of recombination between electron and hole pairs, which result in a low quantum yield of <5% only.
The proposed technology involves the use of photocatalytic electrodes constituted by mixtures with different TiO2 phases and alloyed systems based on Ti dioxide, Sn dioxide and Zn oxide. In all cases nanostructured materials will be considered, suitably modified in order to increase quantum efficiency in the visible region of the solar spectrum.
The technology can be proposed as a Green Engineering Process to produce active pohotocatalysts for innovative processes for the selective production of organic species of great added value, as well as to perform sustainable advanced oxidation processes to remove organic and inorganic compounds from wastewaters up to negligible concentration levels.

Innovations and advantages of the offer

The proposed technology is able to produce suitable semiconductor materials that allow:
1) Higher quantum yield with comparison to the classical photocatalytic processes (due to the presence of an external electric field).
2) Higher quantum yield for the near-UV radiation absorption and higher reaction rates in the case of VIS (visible) irradiation (due to the modified structure of semiconductor electrode materials).
3) Better use of solar energy in “green processes”.

So, when specifically used for oxidation processes, the integrative advanced oxidation processes offer the prospect of relatively higher efficiency than either photocatalytic oxidation or electrochemical oxidation alone. The modified structure of the semiconductor materials allows a better exploit of the solar energy. The external electric field allows higher efficiency and higher activity of the semiconductor materials. The combination of electrochemical and photocatalytic technologies is obtained in photoelectrocatalysis, which can be exploited in “green processes” when the proposed photocatalysts, able to be excited by UV-VIS solar radiation, are used.

Contact Details

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