

Name:

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Research Group (if relevant):

Advanced Processes for Biological and Chemical Treatments-GAOX

Research Centre (if relevant):

N/A

Department/School(s) (if relevant):

Faculty of Engineering

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Supervisor(s):

Dr. Fiderman Machuca Martinez

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Funding body:

N/A

Area (field) of study:

Mathematical modelling and experimental of solar heterogeneous photocatalysis

Thesis Title:

Evaluation of the dye sensitized process for the degradation of a pharmaceutical compound

Abstract:

Solar heterogeneous photocatalysis is a potentially viable treatment at pilot level and on an industrial scale, since it uses solar radiation for catalyst activation and this is the most abundant source of renewable energy on the planet; solar energy is composed approximately of 50% visible radiation and 4% ultraviolet radiation. Hence, due to TiO_2 limitations most of the visible radiation is being wasted.

Several strategies have been implemented to take advantage of the longer wavelength region; notably doping the titanium dioxide with some elements such as N, S, and C, by coupling with others semiconductors or using dyes as sensitizers, these last are widely used in the energy production field by solar cell.

Dyes adhere to the catalyst's surface and to achieve its excited state by photon absorption in the visible range of the solar spectrum, then one electron is transferred from their highest occupied molecular orbital (HOMO) to their lowest unoccupied molecular orbital (LUMO) and



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subsequently to the conduction band (CB) of titanium dioxide. Therefore, sensitization with dyes is a simple and viable technique to take advantage of more solar energy.

In addition, dyes not only can transfer electrons to catalyst, also a dye molecule can form its excited triplet-state through visible light absorption and subsequent transfer its energy excess to ground triplet state oxygen generating singlet oxygen or it can transfer one electron to oxygen dissolved for generating radical anion superoxid. Dye-sensitization has been applied for degradation of chlorophenol, hydrazine, pesticides, phenol and benzyl alcohol. However, studies to pilot level or industrial scale with natural solar radiation are not found

Collaborations:

N/A

Publications:

J. Diaz-Angulo, I. Gomez-Bonilla, C. Jimenez-Tohapanta, M. Mueses, M. Pinzon, F. Machuca-Martinez, Visible-light activation of TiO_2 by dye-sensitization for degradation of pharmaceutical compounds, Photochem. Photobiol. Sci. (2019). doi:10.1039/C8PP00270C.

Presentations:

250th ACS National Meeting & Exposition (2015)

9th European meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA9).

Straburgo, Francia, June 13-17, 2016II Seminario Internacional: Nuevos Conceptos del Uso de la Radiación Solar para la Descontaminación de Aguas Aug. 2016

3rd Iberoamerican Conference on Advanced Oxidation Technologies (III Cipoa). Guatape, Colombia, 14-17, Nov. 2017.

10th European meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA10). Almeria, España, 4-8, July 2018.