REFERENCE: TII-2016-1

PROJECT TITLE:
Transformation of biomass into D-lactic acid using microwave and microbial fermentation reactors

PROJECT SUPERVISOR

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Overview:
This project will focus on the transformation of lignocellulosic biomass to value-added chemicals such as D-lactic acid, an important platform compound in chemical industry. The project will proceed with the catalytic followed by microbiological/enzymatic reactions on biomass and the analysis of their products.

Background and State of the Art:
Recently, the use of biomass, such as plant cellulose or other sources, as a source of renewable energy for the production value-added products, has acquired a special attention constituting the “green technology” in biorefinery. Nowadays the main industrial use of lignocellulose is direct combustion. Its usage as feedstock for value added compounds has a great potential for replacing petrochemical resources in industry. Nevertheless the polymeric carbohydrates that constitute the lignocellulosic biomass are in a complex matrix. Lignocellulose is made of lignin, hemicellulose and cellulose. Its proportion depends on the concrete biomass source, nonetheless cellulose use to be the most abundant one. Physical and chemical methods exist to degrade the biomass (cellulose, municipal solid waste, etc) but they require high-energy contributions and high temperatures. On the other hand, the chemical structure of biomass compounds difficults the initial access of microorganisms. All these factors decrease the efficiency of biofuel and other products generation. Thus, finding a successful process to hydrolyse cellulose would lead to a satisfactory usage of biomass as a feedstock to any industrial process.

The goal of this interdisciplinary project is the devise of an integrated system by means of the combination of a catalytic and a biological process for the efficient degradation of the biomass and to its conversion to value-added compounds for the chemical industry.

Project Contribution and Methodology:
Enzymatic hydrolysis of cellulose is the most common treatment found in bibliography. However, in this work, a new process of hydrolysing cellulose and taking benefit of it is followed to replace the expensive enzymatic process. Sulfuric acid is tested on dilute acid pre-treatment
of cellulose assisted by microwave reactor, and characterized with TOC (total organic carbon), HPLC (high performance liquid chromatography) and XRD (X-ray diffraction). Then the hydrolysed carbohydrates are used in fermentative processes, verifying their aptness for microbial feedstock. Lactic acid bacteria (LAB) are used in order to obtain optically pure lactic acid; extremely appreciating starting product for polylactic acid (PLA) production, a highly consumed bioplastic. Microwave pre-treatment converted 80 % of cellulose in our laboratory, then bacterial fermentation by *Lactobacillus delbrueckii* delbrueckii produces D-lactic acid 97% optically pure. The growing demand of PLA together with the capability of explode cellulose potential, places this work as a potential industrial application.

The researcher will study the fractionation and characterization of lignocellulose and/or cellulose materials and their application in microbiological processes.

**The ideal candidate:**

It is desirable that the candidate has a degree in Chemical Engineering, Biotechnology, Chemistry, Microbiology or Bioengineering. A good level of oral and written English is necessary.

**Benefits:**

After finishing the project, the candidate will receive a master and Ph.D. in a modern subject in the more and more importance gaining field of biotechnology.

**References:**


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