



SINCHEM PhD subject

Development of innovative catalysts and processes for the valorization of bio-oils

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PROJECT DETAILS

One of the great challenges our society currently faces is the transition of the chemical industry based on fossil oil and gas towards one with sustainable and renewable sources of fuels and chemicals. Within this scenario, the concept of **biorefinery** has emerged as a suitable infrastructure to convert renewable biomass into value-added chemicals and fuels. The challenges that integrated bio-refineries face are indeed numerous, from the economical point of view up to the technological one. Among the conversion pathways of biomass, liquefaction and flash pyrolysis are attractive source of liquids visually similar to crude oil. These processes are regarded as a simple technology, with small capital asset and with the possibility of delocalizing the units in rural areas and subsequent transportation of the products to revamped refineries for its large-scale valorization. In these processes, biomass is subjected to a heat treatment in a temperature range between 250 ° C (liquefaction) and 500 ° C (fast pyrolysis). The product obtained, defined as bio-oil or bio-crude, has very different characteristics depending on the employed process conditions. This liquid is an acidic, hydrophilic, and unstable mixture with low heating value due to its high water content.

Topic of this thesis will be the evaluation of all the stages leading to the enhancement of bio-oils obtained by different technologies from various types of biomass (lignocellulosic residues, the organic fraction of municipal waste, microalgae, oleaginous microorganisms) .

In particular, we will study the techniques for the separation, purification and characterization of bio-oil and the catalytic processes for converting it into biofuels. Since bio-oil has a complex oxygenated composition resulting from the fragmentation of the components of biomass (containing acids, alcohols, aldehydes, esters, ketones, phenols, guaiacols, syringols, sugars, furans, and others), several valorization routes for bio-oil have will be investigated, such as catalytic cracking and hydro-treating. At RWTH Aachen the student will mainly study the selective deoxygenation of the bio-oils as second step in the valorization with major emphasis on noble metal free systems and transfer hydrogenation.