The depletion of fossil fuels has shifted our focus towards utilization of alternative resources such as **lignocellulosic biomass for the production of energy, fuels and chemicals**. Lignocellulosic biomass refers to wide variety of feedstocks such as agricultural residues, woody/forestry wastes, energy crops, aquatic plants and manures. Cellulose, hemicellulose and lignin are the three main components of biomass. **Lignin**, an amorphous polymer which accounts for 30% of the organic carbon in the biosphere, is underutilized and only employed as a combustible material for its high heat value. The structure and aromatic units present in lignin makes it a valuable source for the production of a wide range of products ranging from macromolecules (e.g. **phenol-formaldehyde resins**) to value added chemicals such as **vanillin**, **guaiacol**, **syringaldehyde** and **eugenol**, which find applications in **food and pharmaceutical industries**. Future methods of lignin valorization must be based on **new materials and green technological approaches** just because the existing methods don't meet the necessary environmental and economic requirements. This project aims to develop a **novel method** for the **transformation of lignin-based model compounds into valuable chemical precursors**. The principle is to assist the photocatalytic oxidation process with **low-frequency ultrasound (US)** and **new catalytic materials** possessing **excellent redox and sonophotocatalytic properties**. The objective is to improve the photocatalytic selective oxidation of lignin-based model compounds through the physical effects of low-frequency sonication (e.g., effective mass transfer, microstreaming, *in situ* photocatalyst regeneration, etc, effects often inaccessible through conventional methods) and **understanding the mechanism of the synergistic action of green sources of energy (ultrasound and solar energy)** to control the production of high-value chemicals during a liquid phase **sonophotocatalytic selective process**. The exploration of all resulting products formed in the gas and liquid phase, along with their selectivity according to the physicochemical, optical and redox properties of the involved catalysts, will allow to gain a detailed knowledge that is central to fully understand the parameters and mechanisms in this **new concept of biomass treatment**. In this project will be used our well-defined (e.g. **ultrasound-assisted sol-gel**) methods for the synthesis of **nanostructured metal oxide-based semiconductors**. It will be carried out the study of the physicochemical properties of semiconductor materials (before and after (sono)-(photo)-catalytic test reactions) and testing them in the selective sonophotocatalytic oxidation of lignin-inspired model compounds (in liquid-phase) as a **promising method of lignin-based molecules valorization**. A systematic basic research of the **effect of green and unconventional source of ultrasonic energy on low-temperature photocatalytic transformation of lignin-derivate model compounds** will be carried out. We believe, based on our experience and preliminary results, that **optimization** of the **physical effects of low-frequency sonication** will have a **tremendous positive influence** in improving the already challenging process of **selective photocatalytic transformation** of aromatic molecules in liquid phase. To get insight into this **sonophotocatalytic approach**, the whole spectrum of basic kinetic studies and photocatalysts' stability/recycling studies will be carried out. To obtain the best synergistic effect of working under ultrasound and light (UV-Vis) irradiations, the **design and fabrication of new (sono)-(photo)-reactors** are considered. We believe that, by taking use of materials science/nanoengeniering and the principles of Green Engineering, it is possible to adapt a well-known sonophotocatalysis-based Advanced Oxidation Process (for total mineralization of organic wastes in water) to a process which will be able to convert selectively lignin-based wastes towards valuable chemicals. A positive outcome of the proposed project has the potential of strong influencing on the field of **green materials synthesis and processes, renewable energies and clean/effective chemicals production from organic wastes**.[1] Therefore, the final outcome of the proposal will lead to **profound benefits to humanity** in the long term. These pioneering studies will permit us to understand and optimize (a) the synergistic effect of combining ultrasound with heterogeneous photocatalysis (new hybrid technology), and thus (b) predict photocatalyst performances manipulated by the full control of ultrasound effects during the selective oxidation of lignin-based molecules, what will result in (c) activity/selectivity/stability improvement of promising photocatalysts working thanks to solar light utilization and sonication which **open the possibilities for better ways of management and valorization of lignin-containing organic wastes**. The uniqueness of this project rests on a combined approach of understanding/design/synthesis of an effective semiconductor-based photocatalyst with optimized composition working in optimized sonophotocatalytic conditions for the valorization of lignin-based model compounds.[1]http://photo-catalysis.org/displayNews.php?id=860