Lately, there are growing concerns over the fate of the wide variety of contaminants of emerging concern (CECs), (e.g. Pharmaceuticals and Personal Care Products (PPCP), Persistent Organic Pollutants (POPs), endocrine disruptors (EDCs), etc.), which are present in effluents, often at trace levels, and often unmonitored. Its extensive usage in medicine, aquaculture and our life, has led to increase CECs concentrations in wastewater. It is known that, water recycling plays a prominent role, especially for water-consuming industries, thus, the purification of wastewaters becomes indispensable to achieve the ideal degree of quality. Limited efficiency of treatment with respect to CECs in conventional wastewater treatment plants (WWTPs) is well known. Many studies showed that Advanced Oxidation Processes could play an important role in removing CECs. Ozone based technologies appear as suitable alternatives since ozone is highly reactive with a broad range of contaminants at room conditions of pressure and temperature. However, low mineralization levels are usually attained since the by-products formed are not prone to further ozone oxidation. Electrochemical advanced oxidation process (electrooxidation and electroreduction, EAOP) and electrocoagulation (EC) are two promising techniques that have been used for the abatement of wide variety of organic contaminants. Electrochemical techniques offer the advantage of providing electrons which is a clean, versatile and effective reagent for the elimination of contaminants with high mineralization. Among AOPs, the electrocatalytic ozonation processes, combining electrochemistry with ozone is an efficient process due to its simplicity, strong oxidation potential, environment-friendly, and does not require additional reagents. Electrochemical processes combined with ozonation are chosen advanced treatments to be studied and developed in this work since they can operate at ambient conditions of pressure and temperature and are more efficient and compact when compared to other technologies.

The main objective of the project is to investigate the role of synergistic effects between ozone and plasma-deposited thin film electrode in hybrid electrochemical and ozonation processes of CECs degradation. The essence of the process is to find both the active, sustained, and photostable plasma-deposited thin-film electrocatalysts which enhanced the degradation process with the combined action of ozone.

Plasma Enhanced Chemical Vapour Deposition (PECVD) process leads to the production of the desired layer on the surface of any carrier and is a very versatile method, which falls into the scope of "green chemistry" due to low energy consumption and almost waste-free production process. Plasma polymerization allows for modification of the structure, giving the surface a more hydrophilic character, which is an interesting property for electrocatalytic ozonation application and it can lead to better contact between the contaminant and the electrocatalyst active sites.

Thus, the introduction of solid electrocatalyst and ozone is a cutting-edge approach aiming for water reuse at the lowest cost. The developed solution will be an innovative, modern wastewater treatment with a plasma-based electrocatalyst.

The novelty of the project is the evaluation of the improved effectiveness of elimination of CECs by application a new plasma deposited nanostructure electrodes for hybrid electrochemical and ozone utilization methods. As a model CEC neuro-active insecticides (imidacloprid, IMI), sulfonamide antibiotic (sulfamethoxazole; SMX), and endocrine disruptor (butylparaben, BuP) were selected.

This project will be focused on electrochemical processes like electrocoagulation, electrochemical oxidation and electrochemical reduction with the use of a novel nanostructure electrode fabricated by plasma deposition from organometallic precursors in the form of single-layer and multilayer (sandwich-like system) thin films on the conductive supports. The relevant elements of this project will be the evaluation of the role of synergistic effects between ozone and plasma-deposited thin films and the determination of its contribution to the degradation and reduction of toxicity during the treatment.

In connection with the problems described above, it is justifiable to undertake the research aiming the study on the role of synergistic effects between ozone and plasma-deposited thin films in hybrid electrochemical and ozonation processes. The project relies on basic research on fabrication, examination and selection of the proper plasma deposited electrode (characterized by increased electroactivity and higher ability to enhance the $^{\bullet}OH$ generation), as well as the degradation of CECs by electrochemical and ozone interaction. The project focuses on generating fundamental knowledge (in chemical engineering, plasma surface engineering, electrochemical engineering and environmental engineering) and theoretical understanding of a hybrid electrochemical-ozonation process, which can be used in wastewater treatment plants if the results are positive.