French Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes one of the PhD subjects proposed by the French Polytech network. The network is composed of 15 engineering schools/universities. The document also provides information about the supervisor. Please contact the PhD supervisor by email for further information regarding your application.

Supervisor information	
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PhD information	
Title	Coupling of plasma processes and composite materials (clays, activated carbons, MOFs, etc.) functionalized for the treatment of endocrine disruptors in water
Main topics regards to CSC list (3 topics at maximum)	V.12. Mechanism of environmental pollution and technology of control

Required skills in science and engineering	Plasma science, analytcical chemistry

Subject description (two pages maximum including biblio)

Endocrine disruptors (EDs) are a subject of major concern because they are present in the environment (water, soil) and in everyday materials (plastics, etc.). In July 2020, the Center - Val de Loire Region launched an EDs action plan which aims to inform the population of the dangers of these polluting molecules in order to reduce their use and therefore their distribution in the environment. In this context, this PhD aims to combine an innovative technology for the treatment of Endocrine Disruptors (non-thermal plasma at atmospheric pressure) present in water. The targeted Endocrine Disruptors are more particularly phthalates because they are abundant. The logic of the project is based on the generic sequence: Evaluation of the source of the parent molecule / Plasma treatment of the parent molecule in distilled water / Evaluation of the products of the treatment products / Comparison with the product of the parent molecule / Study of the coupling NTP / Activated carbons grafted with iron in distilled water and natural matrices. This research activity on the effects of Eds on health and on the means to reduce it is accompanied by awareness-raising actions among the general public, but also specialized audiences.

The interest of non thermal plasma (NTP) is that Advanced Oxidation Processes (AOPs) are promising techniques because they generate oxidizing species (O, O_3, HO•...) reacting with a large number of organic molecules in solution. Non thermal Plasmas (NTP) have been applied to treatment of various organic compounds and drug residues in water and they appear to be a relevant AOP technique for antibiotics removal. They were used in various ways and the efficiencies (conversion, energy yields,…) depend on the reactor configuration, the nature and concentration of the target molecules and the water matrix (distilled, pure or tap waters) [1-4]. The advantage of coupling NTP with material is to improve the efficiency of the process in terms of energy costs and/or products generated, among others. To optimize this coupling, it is necessary to work on the carbonaceous material (shaping, functionalization) [5] and to characterize its textural and chemical properties (before and after treatment) [6] and the operating conditions of the discharges. The effectiveness of the treatments will be assessed in terms of conversion of the pollutant, the products generated, regeneration of the carbon-based materials and their possible toxicity for the environment.

The objective of the thesis is to study the efficiency of plasma for the treatment of endocrine disruptors in aqueous matrices as a function of plasma parameters, coupled materials and nature of the EDs. In this work, a specific reactor will be developed, allowing to treat in flow the organic effluents with the plasma to study the effects of the species with a short lifespan produced by the plasma (HO•, atomic O...) and according to the power supplies implemented.

The analyses will focus on the liquid phase (degradation of the pollutant, molecules produced (uHPLC-MS), pH, total organic carbon, COD, BOD5...). The physical, chemical and morphological characteristics of the materials before and after their use will also be studied (pH_{PZC}, porosity, elemental analyses, contents of metallic elements, TGA-DSC-MS, SEM, RXD, XPS etc).

The plasma discharges will be characterized with electrical diagnostics, optical emission spectroscopy in order to have a better understanding of the interactions between the discharge and the liquid phase to optimize the depollution process and determine the energy cost of the treatment.

The work will be realized in GREMI lab for the study of NTP and coupling NTP / carbon-based materials grafted and ICMN lab for the study of functionalization of carbonaceous materials and characterization. These labs are internationally reputed laboratory in the development plasma processes and elaboration and functionalization of activated carbons, and advanced oxidation process . The PhD student will work under supervision of Dr O.Aubry (GREMI) and Dr B. Cagnon (ICMN).

References

[1] Ajo P. *et al.* (2018) J. Environ. Chem. Eng., doi.10.1016/j.jece.2018.02.007
[2] Panorel I. *et al.* (2013) Environ. Technol., doi.10.1080/09593330.2012.722691
[3] Magureanu M. *et al.* (2015) Water Res., doi.10.1016/j.watres.2015.05.037
[4] Baloul Y. *et al*. (2017) Eur. Phys. J. Appl. Phys., doi.10.1051/epjap/2017160472
[5] Secula M.S. *et al*. (2020) The Canadian Journal of Chemical Engineering, volume 98 (3), 650-658, doi.org/10.1002/cjce.23662.
[6] Ferreira de Oliveira T. *et al.* (2011) Desalination, 276, 359-365.