Post-Doctoral Project

Kinetic of organic pollutants degradation under ecocompatible conditions. FTIR-ATR analysis at the mineral-water interface

Starting date : January , 2024

Duration : 18 months

Supervisor : Xavier Carrier (LRS), xavier.carrier@sorbonne-universite.fr
Co-supervisor : Guillaume Morin (IMPMC), guillaume.morin@sorbonne-universite.fr
Co-supervisor ; Alberto Mezzetti (LRS) alberto.mezzetti@sorbonne-universite.fr

Context

Organic contaminants are widely spread in the environment through activities related to energy production (hydrocarbons), agriculture (pesticides), chemical industry (chlorinated solvents, plasticizers). In addition, so-called emerging contaminants such as pharmaceuticals, cosmetics and steroid hormones are currently the subject of particular attention. The identification of eco-compatible chemical reactions leading to the efficient degradation of these organic contaminants and their byproducts represents a major environmental challenge for the preservation of the quality of natural environments. To meet these challenges, the IMPMC (Guillaume Morin, CNRS) and the LRS (Xavier Carrier, Sorbonne University) are collaborating within the framework of the DEPOLECO ANR program to identify new mechanisms capable of degrading a wide range of organic pollutants, without strong oxidants, under physicochemical conditions compatible with natural environments (soils, aquatic environments).

Work program

The proposed Post-Doc work will focus on the in-situ spectroscopic analysis of the degradation kinetics of three priority model pollutants, from the most to the least polar, using optimized mineral substrates. The disappearance of the molecule and the formation of degradation products on the surface of the solid will be followed by Fourier transform infrared spectroscopy in attenuated total reflection mode (FTIR-ATR). This technique will allow the direct detection of molecules adsorbed on the surface of nanoparticle film deposited on the ATR crystal and covered with circulating water at a fixed pH. ATR-IR is perfectly adapted to the study of interfacial phenomena for solid-liquid reactions since it excludes most of the contribution of water used as a solvent. In-situ monitoring of degradation kinetics, will first permit to precisely evaluate the efficiency of different substrates for the degradation of priority pollutants. In addition, by varying the physicochemical conditions of the experiment, the kinetic monitoring will allow progress in the understanding of the reaction mechanisms involved at the solid-liquid interface. Additional techniques may be carried out to detect reactive oxygen species and, in collaboration with INRAE ECOSYS, to identify degradation products of the contaminants, either dissolved or recovered after a desorption step.

The outcome of this work should allow us to design eco-compatible and efficient materials for pollution remediation in soils and aquatic environments for large-scale applications.

Qualifications

We are looking for a candidate with a strong background in spectroscopy, surface chemistry and materials chemistry. Knowledge in environmental (geo)chemistry would be an asset.

Laboratoire de Réactivité de Surface *:* *http://www.lrs.upmc.fr/*
Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie : *http://impmc.sorbonne-universite.fr/*