Laboratoire de Chimie Physique et Microbiologie pour l'Environnement
LCPME
Unité Mixte de Recherche - UMR 7564
CNRS – Université de Lorraine

Available PhD positions at Lorraine University (Nancy, France)

Host laboratory: Laboratory of Physical Chemistry and Microbiology for the Environment (Electro-analytical Chemistry group, http://www.lcpme.cnrs-nancy.fr/lcpme/spip.php?rubrique8&lang=en)

Functionalized 1D mesochannels on electrodes

Electrochemical sensors are strong candidates for in-situ monitoring thanks to their fast response time, the low-cost of instrumentation and the possibility of mass production using microelectronics fabrication techniques. However, they still suffer from limitations in terms of sensitivity and selectivity. Sensitivity can be improved by miniaturizing the electrochemical sensor dimension to the micron scale, which suppresses the limitations due to analyte diffusion. Electrogeneration of silica thin films pierced with oriented and ordered 1D mesochannels onto microelectrodes endows selective properties to the sensor. In addition, 1D mesochannels can be functionalized with one or two redox active entities. This PhD will investigate how charge transfer across 1D mesochannels modified with electroactive groups onto microelectrodes can be harnessed to the improved electrochemical sensing of anions.

Pushing the limits of metallic/molecular monolayer nanoarrays

The rational design and fabrication of electrode materials with desirable architectures and optimized properties, especially in the form of regular nanoarrays, has been demonstrated to be of major importance for improving the performance of various electrochemical systems. An important remaining challenge is the production of well-defined monolayered arrays at the nanoscale, reaching one-dimensional resolution, with nanodot sizes below 100 nm. With the advent of new generation of ordered nanoporous silica membranes exhibiting vertically-aligned mesochannels of monodisperse and small diameter (2-3 nm range), discovered and developed in our group, a real opportunity is offered to evaluate the possibility of using them as a regular nanomask for the elaboration of monolayered nanoarrays with unprecedented spatial resolution and ordering. The main goal of the PhD project is to investigate this idea through both underpotential deposition of metals and electrografting of organo-functional groups.

Design, characterization, and electroanalytical applications of (multi)functional silica thin films

Ordered mesoporous materials have attracted considerable interest for electrochemical purposes. Combining electrochemistry and sol–gel in a so-called electrochemically assisted self-assembly method (EASA) lead to the generation of mesoporous silica thin films with unusual orientation of the hexagonally packed mesochannels perpendicularly to the underlying electrode surface. These resulting structural properties ensure much faster diffusion processes compared to less organized silica films, accomplishing one of the most important requirements for sensors applications. Incorporation of organo-functional groups would even extend the surface properties of such materials, but to date this has been restricted to rather simple moieties. The objective of this PhD project is to demonstrate that the scope of application of such organically modified silica films can be extended by incorporating more sophisticated organic entities, such as organometallic compounds exhibiting redox and/or photochemical properties.

Some information: Starting date: October 1st 2017 (3 years duration);
Gross monthly salary: 1,685 € (up to 2,025 € in case of teaching position); annual tuition: 400 €;
Language admission requirements: French (none); English (B1-B2).

First step application request: Candidates must provide a Curriculum Vitae and Detailed transcript of marks and testamur of the Master degree or equivalent, as well as a motivation letter.
For final application to Doctoral School, additional recommendation letters will be required (from the Master research training Coordinator (internship supervisor) and the Master Head of scholarship, or equivalents.

More information can be obtained from Alain Walcarius (alain.walcarius@univ-lorraine.fr) and **application documents** should be sent to the same address.

Deadline for application: April 18th 2017