Proposal for a Doctoral Contract

**Host laboratory:** Institut des Sciences Chimiques de Rennes, (ISCR, UMR CNRS 6226)

**Project title:** Multifunctional molecules and materials: towards new generations of ultra-sensitive sensors.

**Thesis directors:** Jean-Luc Fillaut (DR CNRS): synthesis and macromolecular chemistry, molecular recognition and fluorescence.
Fabienne Gauffre (DR CNRS, ISCR): characterization, physicochemical studies, photophysics.

**Participation in the thesis:**
R. Marsac (CR CNRS, Geosciences): detection and speciation of metallic ions in natural aqueous medium; modelling of chemical equilibria in aqueous solution and at the solid-water interface.

**Description:**
The PhD researcher will have to work on the synthesis and photo-chemical studies of poly-functional molecules dedicated to the surface grafting of microstructured polymer materials and their application in the detection and identification of metallic ions by fluorescence.

**Scientific background:**
This project anticipates the development of polyfunctional molecular modules and materials for use in fluorescence-based metal ion detection in aqueous environments. It is part of a research project that was selected and funded by the National Research Agency (ANR).

The development of autonomous, miniaturized chemical sensors, associating sensibility and selectivity constitutes a scientific and technological challenge. A critical barrier for the development of fluorescence detection devices results from the fact that immobilization of detection probes without loss of sensitivity is very difficult to control. The performances of such molecular sensors will depend not only on the nature of the molecular probes but to the structuration of the sensitive layer. In most approaches, the probes are written upstream within the polymer matrix and the probe-analyte contact is conditioned by the diffusion of the analytes into the matrix. This research project proposes an original approach based on the spatially controlled post-functionalization of polymeric materials, by molecular fluoro-sensors, in order to overcome the limitations of the diffusion of the analytes in these matrices.

*Global scheme of the steps to be developed in the project on which the thesis is based.*
Activities of the doctoral researcher:

The PhD researcher will have to carry out the synthesis of functional molecules and their optimization for the functionalization of polymer materials and their application in fluorescence detection. The PhD researcher will first synthesize molecular tetrazoles which will have to meet 3 functions:

1. grafting by optical means to the surface of polymeric materials,
2. detection of targeted analytes and
3. communication of this detection information.

He (she) will then participate in the characterizations of the optical properties of these 3-in-1 modules, then in studying (yield, kinetics) of the surface grafting onto polyacrylate materials.

These photo-physical studies will be carried out within the Institut des Sciences Chimiques de Rennes and for studies in biphotonic activation in collaboration with a team of photo-polymerists (J-P Malval, A. Spangenberg, CNRS - IS2M, Mulhouse). Stays will therefore be scheduled for these studies in Mulhouse.

The functional molecules and materials will be dedicated to the detection and identification of metallic cations in aqueous solution. These studies will be carried out in close collaboration with Rémi Marsac (Geosciences, Rennes).

The PhD student will thus gain a strong interdisciplinary experience. In addition, it will participate in the management of the project through scientific monitoring, meeting preparation and communications (reports, presentation, participation in writing publication papers).

Profile of applicant:

The candidate must hold a Master’s degree in organic chemistry or polymer chemistry. Prerequisites will be for the candidate to be motivated by the research and the challenge of this collaborative research project. The taste for synthesis combined with curiosity will be essential to the success of this project. Practical experience in organic synthesis needed.

He/she should have expertise in organic synthesis and in the methods of characterisation of organic compounds (Mass, NMR) as well as, if possible, experience in spectroscopic methods (UV-vis, fluorescence). Knowledge of materials science in general (characterizations and physical properties) would be a plus.

Proficiency in French and English would be an advantage.

Research Fields
Organic chemistry, Photophysical chemistry.

Requirements
Master 2 Degree or equivalent

Benefits
Salary: 2135 €/month (about 1715 € net of taxes/month) (Financial support from ANR, CNRS contract)

Additional job details
For applying: send by email a detailed CV and a cover letter, including names of persons of people who can recommend you.

Contacts: jean-luc.fillaut@univ-rennes1.fr ; fabienne.gauffre@univ-rennes1.fr