JOB OFFER

ANR PhD Position– ICCF (Photochemistry Team – POPPI Group, Université Clermont Auvergne) in collaboration with LPIM (P2M Group, Université de Haute Alsace)

Context

When subjected to environmental factors (heat, light, oxygen, etc.), **polymers age**, resulting in an **irreversible modification of their functional properties** (mechanical, optical, barrier, etc.). This is caused by changes in their chemical structure (particularly through oxidation reactions) and their macromolecular architecture (chain scission, crosslinking, chemi-crystallization). The (photo)ageing of polymers is traditionally studied through a **multi-scale analysis**, correlating changes in chemical structure (IR and UV-visible spectroscopies), macromolecular architecture (gel fraction, thermoporosimetry, DMA, etc.), and properties (thermal, mechanical, and permeability analyses, etc.).

However, the traditionally employed techniques suffer from a **lack of sensitivity**, making it impossible to early detect the consequences of (photo)ageing, which is particularly critical for applications requiring immediate replacement in case of property degradation (parts for electrical components, parts under mechanical stress, etc.). The **ANR JCJC project "FluoAge" (2025-2029)** aims to develop the **use of fluorescent probes to increase sensitivity** to changes caused by the (photo)ageing of polymers and thus achieve **early detection** of these changes.

The proposed **PhD thesis** (36 months) is part of the FluoAge project and focuses on the **study of detecting the consequences of (photo)ageing using fluorescent probes** sensitive to the change of the chemical structure of polymers (polarity and pH probes) and macromolecular architecture (mobility probes). The main objective is to relate the results of a multi-scale analysis of the (photo)ageing of model polymers to the evolution of the properties (band ratio, solvatochromic shift, quantum yield, lifetime, etc.) of fluorescent probes introduced by different methods (soaking, extrusion, etc.).

The thesis work will take place **within the POlymers, Photochemistry, Properties and Interfaces (POPPI) group from the Institute of Chemistry of Clermont-Ferrand (ICCF)** in collaboration with the Molecular and Macromolecular Photochemistry (P2M) group of the Laboratory of Macromolecular Photochemistry and Engineering (LPIM) in Mulhouse. The equipment necessary for the study of **(photo)ageing of polymers** (natural ageing racks, accelerated photoageing devices, ventilated ovens) and their multi-scale analysis (IR and UV-visible spectroscopies, DSC, DMA, oxygen permeameter, etc.) are available at ICCF. Studies of time-resolved fluorescence (TC-SPC) will take place at LPIM.

The recruited student will be responsible for the **preparation of samples** (compression, extrusion, soaking, etc.), their **accelerated and natural artificial (photo)ageing**, the **multi-scale characterization of their ageing**, and **fluorescence studies** (steady-state and time-resolved). He/she will also be responsible for an active and continuous bibliographic research, organizing meetings with the project team members, and participating in conferences, and, more generally, in the life of the laboratory.

Organization and resources

The candidate will carry out his/her work at the ICCF in Clermont-Ferrand. Several trips to LPIM in Mulhouse will be planned during the thesis.

Profile

- Holder of a Master's degree or an Engineering degree in Materials Science or Physical Chemistry with knowledge of polymers (and, if possible, their durability) and molecular photochemistry.
- Knowledge of basic polymer characterization techniques (FTIR and UV-visible spectroscopies, DSC, chromatography, etc.) and photochemistry (steady-state and time-resolved fluorescence spectroscopy).
- Proficiency in written and spoken English. Autonomy, proactivity, organizational skills, dynamism, intellectual curiosity, experimental rigor, good interpersonal skills, enthusiasm for research, and writing proficiency.

Contract type: ANR (36 months)

Location: Clermont-Ferrand /ICCF

Gross salary: approximately €2300/month

Experience: Master 2 or Engineering degree

Contract start date: end of 2025

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