

Funded thesis (2025-2028)

Development of a Metal-Organic Framework-based sensor prototype for the detection of molecular iodine

Scientific project.

This thesis project concerns the development of instrumentation to detect and monitor the progression of a nuclear accident, in order to implement the most appropriate accident management as soon as possible. Different types of sensors can be considered to detect fission products in the containment of a nuclear reactor during a severe accident.

Today, several technologies exist for the detection of radioactive gases (in particular those based on iodine) that may be emitted during a nuclear accident. However, these technologies show limitations that make their use impossible in a severe accident situation. In order to solve this problem, we propose in this project to develop specific sensors using porous materials of the Metal-Organic Framework (MOF) type for the selective detection of radioactive agents and in particular molecular iodine I₂. Indeed, MOFs have both a very high porosity allowing to concentrate tiny quantities of species (ppb), but also an adaptable framework for the immobilization of iodine within the material.

Thus, this thesis work will focus on the manufacture of nanometric MOFs, specific to molecular iodine, and which can be adapted to already existing detector technologies. This research work will be mainly carried out on the Villeneuve d'Ascq campus. A first part will involve two research teams, one for the manufacture of nanometric MOFs for the capture of radioactive agents (UCCS, C. VOLKRINGER) and the other for the manufacture of specific sensors (IEMN, Y. COFFINIER). Finally, the resistance to accident conditions of the developed sensor will be studied in close collaboration with the Nuclear Safety and Radioprotection Authority on the Cadarache and Saclay sites. Profil du candidat.

Candidate profile.

We are looking for a chemist or physical chemist with a bac+5 level, with knowledge of the synthesis and characterization of materials. Signal processing skills are appreciated, but not mandatory.

Funding and salary.

This thesis subject is funded by the Nuclear Safety and Radiation Protection Authority, as part of the European FIND project. The contract will start on October 1, 2025, with a net salary of approximately 1800-1900 euros.

Contact and documents required.

The up-to-date CV and transcripts (if available) of the Master 1/Bac+4 and Master 2/Bac+5 are to be sent before April 15, 2025 to:

Christophe VOLKRINGER, christophe.volkringer@centralelille.fr

Yannick COFFINIER, yannick.coffinier@univ-lille.fr

Jean DENIS, jean.denis@asnr.fr