**Laboratoire Hétérochimie Fondamentale et Appliquée**
UMR CNRS 5069 – Université de Toulouse
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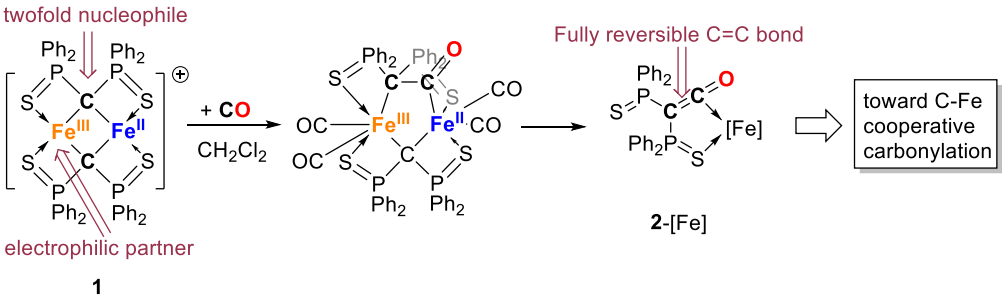
# Post-Doctoral Position

## Four electrons Carbon-Iron cooperativity for $CO_2$ activation.

**Team :** SHEN, (https://www.lhfa.cnrs.fr/index.php/equipes/shen)
**Supervisor :** Dr Marie Boutignon (marie.fustier-boutignon@univ-tlse3.fr)
**Duration :** 18 months
**Funding:** Emergence@CNRS Chimie 2026, from March, 30th 2026 to September, 30th 2027, gross salary from 3041 € to 4216 € /month depending on experience.

**Context:** The ubiquity of iron sulfur clusters in enzymatic systems involving electron transfer reactions has made the study of small sized iron clusters a topic of high interest.[1],[2] Getting inspired by nitrogenases cofactor, which present some activity in the reduction of $CO_2$ and CO,[3] we developed a set of high-spin, poly-iron structures, where iron is surrounded by carbon and sulfur only, using geminal dianions stabilized by thiophosphinoyl moieties as a versatile ligand.[4] During our study of the reactivity of complex **1** with carbon monoxide (Scheme below), we could show that the ligand can act as a terminal carbene to form a ketene, and that the iron centers do retain this ketene in their coordination sphere.[5] The ketene proved to be particularly reactive, with instant C=C bond cleavage in the presence of protic molecules.




**1** **2**-[Fe]

This project aims at the development of appropriate reaction conditions to favor C=C bond cleavage in the coordination sphere of iron, reforming $CFe_2$ interactions and releasing a carbonylated product in a first stage, in a first step toward C-Fe cooperativity. In a second stage, using $CO_2$ instead of CO with appropriate reagents will be explored, eluding any redox change at iron in a fully ligand based, 4e-promoted transformation.

**Applicant Profile :** Applicant should appreciate challenging projects with air-sensitive compounds and using multiple characterization technique (paramagnetic compounds). He/she should have good writing and communication skills in English, be autonomous in her/his work and appreciate to work as part of a team. Experience in the synthesis and characterization of highly air-sensitive coordination complexes is required. Skills in electrochemistry, magnetic susceptibility measurement and Mössbauer / EPR spectroscopies will be appreciated. Please apply on LHFA emploi (from Jan, 14th 2026) and send a CV mentioning two referees, a covering letter and a summary of previous research work by email (see above).

[1] Tanifuji, K. et al.; *Coord. Chem. Rev.* **2023**, *475*, 214838.
[2] Kondo, M. et al.; *Acc. Chem. Res.* **2020**, *53*, 2140.
[3] Seefeldt, L. C. et al.; *Chem. Rev.* **2020**, *120*, 5082
[4] Ravel-Massol, R. et al.; *Chem. Eur. J.* **2023**, *29*, e202302130.
[5] Munshi, S. et al, *Chem. Commun.* **2025**, *61*, 8687.