Université de Strasbourg

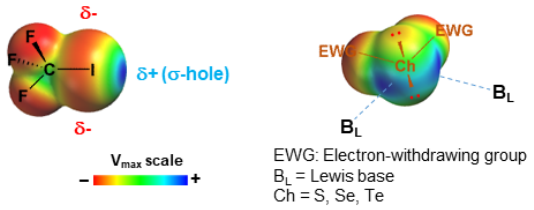
Institut de Chimie de Strasbourg (UMR 7177)
Team: Coordination, Ligands, Interactions & Catalysis
Supervisor: Dr. Victor Mamane (vmamane@unistra.fr)
Starting date: October-December 2024
https://clic.chimie.unistra.fr ; https://www.asymhole.cnrs.fr

Institut de Chimie de Strasbourg UMR 7177

Post-doctoral position

Development of New Enantiopure Organocatalysts Acting by Chalcogen Bonding

σ-Hole interactions occur between regions of low electron density observed in halogens, chalcogens and other bonded atoms (σ-hole donors), and electron-rich partners (σ-hole acceptors).[1] Among this class of noncovalent interactions, the halogen bond (XB) is probably the most prominent regarding its application in many domains.[2] In the last few years, the chalcogen bond (ChB) have attracted more attention with important contributions in the context of supramolecular chemistry, crystal engineering and catalysis.[3] Due to dissymmetric electron distribution around such atoms upon covalent bonding, the σ-hole region (blue area in the figure) is located at the antipode of the X- or Ch-R bond and spatially coincides with the LUMO orbital (σ*) of the X- or Ch-R bond. In contrast to monovalent halogens, chalcogen atoms exhibit two σ-holes due to their divalent character.



As for XB, ChB strength depends on the polarizability of the chalcogen atom (S < Se < Te) and thus, chalcogen interactions involving tellurium are the strongest. Tellurium derivatives are thus becoming the most promising for applications based on σ-hole interactions, with a few emerging in anion recognition and binding and in catalysis. Nevertheless, applications remain scarce, especially in catalysis.[4] In this domain, our group has recently introduced the telluronium salts as powerful ChB-catalyst.[5] These cationic tellurium derivatives possess three σ-holes able to participate in the non-covalent interaction with Lewis bases.[6]

In this project, new chiral platforms bearing sigma-hole donor tellurium atoms will be prepared, studied in solution and used in asymmetric catalytic reactions. Although early studies reported the use of σ-hole interactions for inducing stereoselective processes in the solid state, their involvement in solution is much more recent with very few examples in XB-based catalysis.[7] However, up to now, there is no example of efficient enantiopure ChB donor in non-covalent asymmetric catalysis.

All the chiral structures developed in this project will be studied in solution for their chiral recognition ability and their asymmetric induction in various catalytic reactions involving σ-hole interactions. This project is gathering several aspects of chemistry including organic synthesis, organocatalysis, asymmetric catalysis, supramolecular chemistry, multinuclear and multidimensional NMR, chirality determination (X-ray diffraction of crystals, circular dichroism in solution) and thermodynamics of association (isothermal titration calorimetry and NMR titration).

We are looking for a highly motivated and creative researcher with strong background in organic synthesis.

To apply, send your **CV** (max 2 pages), the **name of two former advisors** and a **cover letter**.

---

[1] P. Politzer, P. Lane, M. C. Concha, Y. Ma, J. S. Murray, *J. Mol. Model.* **2007**, *13*, 305.
[2] G. Cavallo, P. Metrangolo, R. Milani, T. Pilati, A. Priimagi, G. Resnati, G. Terraneo, *Chem. Rev.* **2016**, *116*, 2478.
[3] N. Biot, D. Bonifazi, *Coord. Chem. Rev.* **2020**, *413*, 213243.
[4] a) P. Pale, V. Mamane, *ChemPhysChem* **2023**, *24*, e202200481; b) P. Pale, V. Mamane, *Chem. Eur. J.* **2023**, *29*, e202302755.
[5] a) R. Weiss, E. Aubert, P. Pale, V. Mamane, *Angew. Chem. Int. Ed.* **2021**, *60*, 19281; b) L. Groslambert, A. Padilla-Hernandez, R. Weiss, P. Pale, V. Mamane, *Chem. Eur. J.* **2023**, *29*, e202203372.
[6] L. Groslambert, Y. Cornaton, M. Ditte, E. Aubert, P. Pale, A. Tkatchenko, J.-P. Djukic, V. Mamane, *Chem. Eur. J.* **2024**, 30, e202302933.
[7] P. Peluso, V. Mamane, *Molecules* **2022**, *27*, 4625.