

# PhD scholarship Application Form

## CSC-ENS Program 中国留基委与法国高师集团合作奖学金

For identified Chinese candidates

**FIELD: Chemistry** (eg: Maths, Physics, Sociology...)

Thesis subject title:

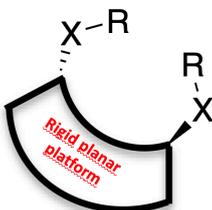
**Synthesis and applications of a highly preorganised  
bifunctionalised chiral platform**

- Laboratory name: Laboratory of Chemistry
- PhD supervisor (contact person):
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- Thesis research project for the identified candidate:

*keywords : diols, axial chirality, hélicoidal compounds, chiral ligands, asymmetric catalysis*

**Summary:** *Synthesis / characterisation of a new class of highly preorganised chiral compounds with chelating properties supported by a rigid planar platform with various potential applications. The project will include development / evaluation of the performances of derivatives with potential applications in domains such as*

- *New chiral catalysts*
- *« chiral building blocks » with axial chirality*
- *Access to helicoidal compounds with control of the helicity*



X = heteroatoms such as O or N

## Project

This subject constitutes a new research subject (recently initiated in the team) and will be the continuation of promising preliminary results consisting in the synthesis of a first family of enantiomerically pure chiral compounds based on an original planar rigid platform.

Our project takes profit of the very strong preorganisation (elbow shaped) of the platform bearing two chiral centers with heteroatoms pointing in two different half-spaces. Those building blocks will be used as precursors for the conception of compounds with constraint geometry with potential applications in asymmetric catalysis, materials for optic, chiral recognition and chiral helicoidal compounds.

## Workplan

1- The first months of the PhD will be dedicated to the validation and development (for publication) of the access route to the enantiomerically pure family of precursors that has already been explored. It will allow the selected PhD student to become familiar with the specific chemistry involved in the project and characterization processes. The other objective will be to widen the variety of precursors by introducing other functional groups or substituents. It will also be of interest to control the functionalisation of the planar rigid base for more specific applications (solubility, grafting on materials etc..)

2- The developed molecular platforms being unprecedented, they will come with new properties compared to existing structures and will be tested for a wide range of applications. The second part of the PhD will thus be dedicated to the evaluation of performances in domains such as

- Chiral recognition / separation
- Asymmetric catalysis / synthesis
- Non-linear optics
- Chelating properties<sup>1</sup>, chiral bidentate ligands
- Helicoidal compounds
- foldamers
- material chemistry
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It will be of interest to compare the properties of this class of compounds with Binol based compounds<sup>2</sup> or chiral cyclohexyldiamines, and for different kind of applications such as supramolecular aggregates auto-assembling or catalytic properties of chiral complexes issued from our platform

We are open to opportunities to collaborate or to co-supervise the PhD student with a Chinese partner for the characterization parts of the project and for evaluating the performances of our new class of derivatives in various application domains.

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<sup>1</sup> Bunzen, J.; Bruhn, T.; Bringmann, G.; Lüthzen, A. *J. Am. Chem. Soc.* **2009**, 131, 10, 3621-3630

<sup>2</sup> Brunel, J.M. *Chem. Rev.* **2005**, 105, 3, 857-898; Yu-Lut Leung, S.; Lam, W.H.; and Wing-Wah, V. *PNAS*, **2013**, 110, 20, 7986-7991

## Presentation of ENS de Lyon

The École Normale Supérieure de Lyon is an elite French public institution that trains professors, researchers, senior civil servants as well as business and political leaders. Students choose their courses and split their time between training and research in sciences and humanities. Built on the tradition of the ENS de Fontenay-Saint-Cloud, founded in 1880, the ENS de Lyon is a symbol of French Republican meritocracy and it remains committed today to disseminating knowledge to the widest audience and to promoting equal opportunity. The ENS de Lyon is part of the Université de Lyon and supports quality research that has earned it a Fields medal (Cedric Villani, 2010) and many CNRS medals. It encourages interdisciplinary studies to foster a better understanding of complex contemporary issues.

Expertise and research of the institution are based on strong disciplinary competence (around 1100 publications/year in Humanities, Letters, Social Sciences, Mathematics, Physics, Biology and Chemistry), interdisciplinary and international cooperation (262 exchange partnerships with 26 countries) as well as partnerships with national research organizations (CNRS, INRA, INSERM, INRIA, Universities). ENS de Lyon supplies its laboratories with state-of-the-art equipment and facilities and provides support services to researchers in their initiative (Innovation and Technology Transfer Office, Office of International Affairs, HR ...). ENS de Lyon provides administrative and language resources for visiting students, postdocs and faculty members. ENS de Lyon has obtained in 2019 the HRS4R "Human Resources Strategy For Researchers" label.

ENS de Lyon has also developed junior laboratories for Master's and/or PhD students to create their own research laboratory for a two-year period, and has incubated 30 start-up companies since 1999 (270 jobs created).

## Key figures

ENS de Lyon is one of the leading French research and teaching institution (ranked 7th in the Times Higher Education « 2018 best world small university » ranking) with a very selective entrance examination at pre-Master level (less than 1/100 success rate) with a ratio of 2200 students for 800 researchers and teaching staff and 450 PhD students. ENS de Lyon has extensive experience in Research and training programs. ENS de Lyon manages national, European and international funding (participation in 55 European H2020 projects) and administers a Research Fund, to finance high-level scientific projects.

## Presentation of ENS de Lyon Laboratory of chemistry (<http://www.ens-lyon.fr/CHIMIE>)

The Chemistry Laboratory is a joint unit operated by the CNRS, the École Normale Supérieure of Lyon and Université Lyon 1.

The Chemistry Laboratory spans a range of specialties in chemistry and physical chemistry. It develops interdisciplinary research projects at the frontiers with biology, material sciences and physics. The research themes cover a wide spectrum of expertise in experimental chemistry (organic, inorganic and materials synthesis) together with characterization and modeling. The scientific interdisciplinary projects of the laboratory, which are partly related to societal issues (environment, health, defense, information and communication technologies, textiles) are centered on three themes:

- systems for biology: imaging, diagnosis and therapy;
- systems with specific properties: properties for applications related to optics, magnetism, to supramolecular heterogeneous catalysis, to the detection of gaseous molecules, to chiral recognition or to the development of functional textiles;
- computational modeling: reactivity (exploration of reaction pathways in heterogeneous catalysis), spectroscopy (modeling of excited states for magnetic or optical systems), and development of models for enzymatic and biomolecular systems.

The laboratory has state of the art instrumentation and working spaces (new building since 2018).

### ▪ Publications of the laboratory in the field :

This is a completely new project with an unprecedented chiral platform (never described) but the laboratory has extensive experience in organic synthesis and chirality. The PhD student will thus benefit of this experience and stimulating environment.

Examples of publications of the laboratory:

- « Synthesis of unnatural steroids, the « Bistro » strategy » Maurin, P.; Moraleda, D.; Pellissier, H.; Santelli, M., *Synlett*, **2015**, 26, 725
- "Magnetogenesis under physiological conditions with probes that report on (bio-)chemical stimuli." Touti, F.; Maurin, P.; Hasserodt, J. *Angew. Chem., Intl. Ed.* **2013**, 52,4654
- "Synthesis of Cryptophane-223-Type Derivatives with Dual Functionalization" Baydoun, O.; De Rycke, N.; Leonce, E.; Boutin, C.; Berthault, P.; Jeanneau, E.; Brotin, T, *J. Org. Chem.* **2019**, 84 (14), 9127-9137
- "Chiroptical study of cryptophanes subjected to self-encapsulation". Baydoun, O.; Buffeteau, T.; Daugey, N.; Vanthuyne, N.; Chapellet, L.L.; De Rycke, N.; Brotin, T. *Chirality* **2019**, 31, 481