

MASTER DE CHIMIE DE PARIS CENTRE - M2S4
Proposition de stage 2024-2025
Internship Proposal 2024-2025

Parcours type(s) / Specialty(ies) :

- Chimie Analytique, Physique et Théorique / *Analytical, Physical and Theoretical Chemistry*
 Chimie Moléculaire / *Molecular Chemistry*
 Chimie et Sciences Du Vivant / *Chemistry and Life Sciences*
 Chimie des Matériaux / *Materials Chemistry*
 Ingénierie Chimique / *Chemical Engineering*

Laboratoire d'accueil / Host Institution

Intitulés / *Name*: Laboratoire de Chimie de la Matière Condensée de Paris (LCMCP)

Adresse / *Address*: 4 Place Jussieu 75005

Directeur / *Director*: Prof. CHANEAC Corinne

Equipe d'accueil / Hosting Team :

Adresse / *Address* : 4 Place Jussieu 75005

Responsable équipe / *Team leader*: Prof. LABERTY-ROBERT Christel

Site Web / *Web site* : <https://lcmcp.science/rmes-2/>

Responsables du stage / *Direct Supervisors* : Dr. PEREZ Arnaud and M. BOUAOUINA Jamal

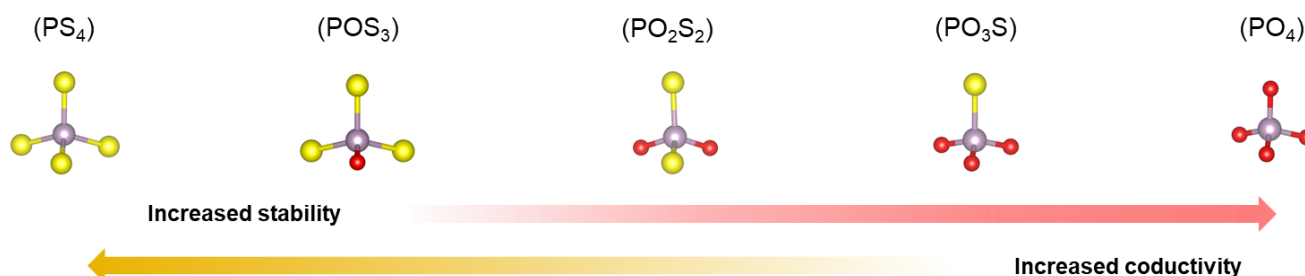
Fonction / *Position* : CNRS researcher ; PhD candidate

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Période de stage / *Internship period* * : **6 months**, starting from **January/February 2025**

Investigation of Lithium and Sodium Oxythiophosphate Ionic Conductors



Investigation of Lithium and Sodium Oxythiophosphate Ionic Conductors

Project description:

Solid electrolytes have recently gained significant attention for developing higher energy-density all-solid-state batteries [1]. Oxide and sulfide-type solid electrolytes, in particular, are the focus of intense investigation from material scientists all around the world. In our team, we develop low temperature synthesis routes to synthesize mixed oxide/sulfide molecular units as building blocks for to prepare new solid electrolytes. Oxythiophosphate compounds are particularly interesting as they could benefit from a balance between the features of sulfides (high ionic conductivity) and oxides (enhanced chemical and electrochemical stabilities)[2].

The goal of this internship is to synthesize, characterize, and investigate the ionic conductivity of Li and/or Na oxythiophosphate materials. By exploring new compositions and developing synthesis routes, we aim to study new materials that exhibit improved performance as solid electrolytes [3].

Objectives:

- Develop the synthesis of Li/Na oxythiophosphates using soft chemistry routes to obtain pure phases.
- Use X-ray diffraction (XRD) for phase identification and crystallographic analysis, and liquid/solid nuclear magnetic resonance (NMR) spectroscopy to verify the formation of oxythiophosphate units.
- Conduct electrochemical impedance (EIS) measurements to investigate the ionic conductivity of these materials.

Candidate profile:

- Pursuing a master's degree in materials chemistry, materials science, or a related field.
- Knowledge in inorganic synthesis, crystallography, and electrochemistry.
- Motivated to learn new techniques, conduct research, and pursue a PhD afterward.
- Good English skills in communication and writing.

Document to provide :

- Curriculum vitae (CV)
- Motivation letter
- Transcript of grades

Références / References:

[1] Janek, J.; Zeier, W. G. A Solid Future for Battery Development. *Nat. Energy* 2016, 1 (9), 16141. <https://doi.org/10.1038/nenergy.2016.141>.

[2] Xu, M.; Song, S.; Daikuhara, S.; Matsui, N.; Hori, S.; Suzuki, K.; Hirayama, M.; Shiotani, S.; Nakanishi, S.; Yonemura, M.; Saito, T.; Kamiyama, T.; Kanno, R. $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ -Type Structured Solid Solution Phases in the $\text{Li}_{9+\delta}\text{P}_{3+\delta}\text{S}_{12-k}\text{O}_k$ System: Controlling Crystallinity by Synthesis to Improve the Air Stability. *Inorg. Chem.* 2022, 61 (1), 52–61. <https://doi.org/10.1021/acs.inorgchem.1c01748>.

[3] Pompetzki, M.; Dinnebier, R. E.; Jansen, M. Sodium Dithiophosphate(V): Crystal Structure, Sodium Ionic Conductivity and Dismutation. *Solid State Sci.* 2003, 5 (11–12), 1439–1444. <https://doi.org/10.1016/j.solidstatesciences.2003.07.002>