

JOB DESCRIPTION

Functions: Post-doctoral researcher in material chemistry (F/H) – Development of a self-healing strategy to revert particle disconnection in all-solid-state batteries

Emploi-type : Chercheur

Catégorie : A

Corps : Chercheur

Activities in the job description may evolve with knowledge of the position and the service requirements.

Presentation of Sorbonne University

Sorbonne University is a multidisciplinary, research-intensive, world-class university. Located in the heart of Paris, with a regional presence, it is committed to the success of its students and to meeting the scientific challenges of the 21st century. Thanks to its 54 000 students, 6 300 academic researchers and partner researchers, and 3,600 administrative and technical staff who make it a daily reality, Sorbonne University promotes diversity, creativity, innovation and openness to the world.

The university is structured in three faculties: « **Art and Humanities** », « **Medicine** » et « **Science and Engineering** » each disposing of an important autonomy in the application of the university's strategy.

To learn more about Sorbonne University: <https://www.sorbonne-universite.fr/en>

This position is available within the Faculty of Science and Engineering: <http://sciences.sorbonne-universite.fr>

Within Sorbonne University, **the Faculty of Science and Engineering** covers a large spectrum of scientific disciplines.

It is composed of **79 research laboratories**, 22 teaching departments and 6 UFR (Formation and Research Units) in chemistry, engineering, mathematics, physics, life sciences as well as Earth, Environment and Biodiversity. It also comprises the university's engineering school - Polytech Sorbonne -, the Paris Astrophysic Institute, the Henri Poincaré Institute, three marine stations located in Banyuls-sur-Mer, Roscoff and Villefranche-sur-Mer.

It is hosting 20 800 students among which 2 700 doctoral researchers and accounts for 4 800 academic and research staff and 3 252 administrative and technical staff.

Laboratoire de Chimie de la Matière Condensée de Paris (UMR 7574)

Laboratoire de Chimie de la Matière Condensée de Paris (UMR 7574) : <https://lcmcp.upmc.fr/>

within the **Reactive Materials for Energy deviceS (RMES) team**: <https://lcmcp.upmc.fr/site/rmes>

The postdoctoral researcher will integrate the LCMCP, laboratory internationally recognized in the field of Material Sciences for the elaboration of **functional inorganic and hybrid materials**, and the evaluation of their physico-chemical properties at multiple scales. The lab brings together all facets of chemistry of materials with a strong coupling between synthesis methods and processing of materials. These materials target applications with a strong societal impact in the fields of **energy, health, and environment**.

The **RMES team's** expertise covers organic/inorganic/hybrid materials, processing and sintering of ceramics and electrochemical characterization methods that place it in an ideal position to develop innovative ideas at the crossroads of material science disciplines, a scientific culture largely developed at the LCMCP. The RMES team is part of the French Network on Energy Storage (<https://www.energie-rs2e.com/en>) which nurtures strong scientific connections between research labs to accelerate the development of energy storage through dynamic collaborations and the development and mutualization of advanced in situ/operando characterization techniques, including at synchrotron facilities.

Project and main Activities

Context of the project:

Among next generation energy storage technologies for portative electronics and electric vehicle applications, all-solid-state batteries (ASSB) attract an intense research effort from researchers and companies. By replacing the liquid electrolyte and carbon negative electrode used in conventional Li-ion batteries by a solid electrolyte and a metallic lithium negative electrode, this technology has the potential to reach energy densities far superior to those of Li-ion batteries. However, several challenges need to be solved to enable this technology.

This post-doctoral researcher position will be part of the ANR-funded project SALT&PPER (<https://anr.fr/Projet-ANR-21-CE50-0013>), focusing on the issues affecting the interface between the positive electrode material (e.g. $\text{LiNi}_x\text{Mn}_y\text{Co}_{1-x-y}\text{O}_2$) and the solid-state electrolyte. Specifically, volume changes upon cycling of the active material create mechanical constraints and physical disconnection of particles. This eventually leads to increased resistance at the interface and to the failure of the electrochemical cell. So far, continuous pressure application on the cell stack is required for prolonged cycling rendering impractical the development of large format cells.

The project will answer this problem by exploring new interfacial strategies using low temperature methods and materials based on abundant elements. Careful selection of the material's physical properties and processing will be critical to help reconnect isolated particles without applying pressure. Assembly of all-solid-state batteries with the materials prepared will validate the selected strategy at the device level and improve our comprehension about interfacial reactions during prolonged cycling.

Mission:

The post-doctoral researcher will take part in the development of a self-healing strategy to help preserve the ionic and electronic conductivity in the composite electrode of oxide-based all-solid-state batteries. This includes synthesis and processing of inorganic and hybrid materials, structural and electrochemical characterization.

He/she will work in close collaboration with a doctoral researcher specifically involved in the SALT&PPER project, as well as with several doctoral and post-doctoral researchers working on different aspects of solid-state batteries.

The researcher will benefit from the expertise developed by the RMES team on processing of inorganic and hybrid ionic conductors, from the broad scientific expertise of the LCMCP, the multiple characterization platforms within the Faculty of Science and Engineering. She/He will also benefit from strong and dynamic interactions with members of the RS2E network (17 French leading research laboratories in energy storage research).

Excellent communication will be key to create synergy within the project and beyond, and the researcher will be expected to develop strong collaborative interactions.

Main activities:

- Synthesis of inorganic and hybrid materials
- Material processing
- Structural and physical properties characterization
- Electrochemical properties characterization
- Reporting on scientific results (meetings, communications in congress, scientific publications)

Knowledge and Skills*

Education, Qualifications and Training :

- PhD in Chemistry or Materials Science (or very close to completion)

Experience in areas including (but not limited to) :

- Inorganic/hybrid material synthesis and processing (molten salt)
- Assembly and electrochemical characterization of materials for energy storage applications (batteries, fuel cells, capacitors...).
- Air-sensitive synthesis and measurement techniques
- Multiple characterization techniques (PXRD, XPS, XAS, NMR...)

General and interpersonal skills :

- Ability to work as a team member and foster positive relationships.
- Demonstrate proactivity, availability, and reactivity in leading research projects.
- Excellent communication skills.

- Clear reporting and scientific writing.

General knowledge:

- Understanding of the organization of Research and Higher Education French system.
- Understanding of Sorbonne University's organization.
- Regulations applicable to one's own professional activity field.

Specific dispositions related to the position and exposure to occupational hazards

Contract: *12 months CDD contract, with possibility for further funding.*

Salary (depending on experience): *32k-37k€/year*

Expected starting date: *September 2023*

Interested candidate should send a CV, cover letter and contact information for two references (PhD advisor, supervisor) to Dr. Arnaud Perez (arnaud.perez@sorbonne-universite.fr).

Exposure to occupational hazards :

Non

Yes : **Chemical risk**