About this (France/Canada) PhD Opening

APPLICATION DEADLINE: April 13, 2026 11:59 pm (CEST, Grenoble) through a continuous recruitment scheme
LOCATION: based in Grenoble, France
UMR5279-**LEPMI**, **L**aboratory of **E**lectrochemistry and **P**hysicochemistry of **M**aterials & **I**nterfaces
with a (>6 month-long) scientific stay in Sherbrooke, Quebec (Canada)
IRL3463-**LN2**, **L**aboratory of **N**anotechnologies & **N**anosystems
TYPE OF CONTRACT: Temporary (36 month-long position)
JOB STATUS: Full-time
HOURS PER WEEK: 35
OFFER STARTING DATE: Oct. 1, 2026

https://www.usherbrooke.ca/ln2/

SHAPE
Collaborative Research Project
Self-HeAling Polymers Electrolytes
for high performance
Safe & Sustainable-by-Design (SSbD)
Solid-State µBatteries (SSµBs)

https://lepmi.grenoble-inp.fr/en

BENEFITS

Salary: € 2,300 gross salary/month (from 2026 onwards) including a competitive health/medicare package
Employer: CNRS
Duration: 3 years (Oct. 2026⇨Oct. 2029)
PhD Degree: Univ. Grenoble Alpes (UGA/France) with a scientific immersion within the (rich) scientific ecosystems of the Université de Sherbrooke (UdeS/Quebec/Canada), 3iT, and C2MI

ELIGIBILITY CRITERIA & APPLICATION PROCESS

Applicants should provide a single e-application file combining
•a curriculum vitae
•a cover letter
•a full record of B.Sc. & M.Sc. grades and ranking
•a summary of their past research experience
•a list of scientific products (articles published in international peer-reviewed journals, chapters in books/handbooks, and oral & poster communications).
Please do exclusively apply onto the CNRS job platform, mentioning the CNRS job offer# UMR5279-PATRAN-002 in your application file: https://emploi.cnrs.fr/Offres/Doctorant/UMR5279-PATRAN-002/Default.aspx

•Dr. Patrice Rannou (DR-CNRS/ORCID/LinkedIn): **patrice.rannou@grenoble-inp.fr**
•Dr. Denis Machon (Full Prof. Univ. Lyon/Full Prof. UdeS/LinkedIn). **denis.machon@USherbrooke.ca**
Last but not the least, the applicant should arrange that at least two reference letters are sent directly to the above-mentioned contact addresses.

SELECTION PROCESS

The deadline for application is April 13, 2026 11:59 pm (CEST, Grenoble, France). We encourage candidates to apply as soon as possible as the search for candidates will continue until the position is filled.
Applications will be evaluated through a three-step process, under a continuous recruitment scheme:
Step 1: Eligibility check of applications based on the submitted application (single) e-file
Step 2: 1st round of selection: The applications will be evaluated by the PhD co-supervisors. The applicants will be notified of the results (*i.e.* Go/No Go for Step 3)
Step 3: 2nd round of selection: Shortlisted candidates will be invited for an interview session via a visioconference. All applicants qualified for Step 3 will be notified of the final decision.

PROFILE/SKILLS/QUALIFICATIONS/TIMING (English/French level required: C1/C1)

The PhD candidate (functional soft matter chemist/materials scientist) should preferably hold (or be about to earn) a Master degree or have a university degree equivalent to a European Master's degree (5-year duration) in Materials Science or Organic/Polymer Chemistry dealing with functional soft matter or Electrochemistry. A previous (practical) experience in the synthesis (core competence) and/or multiscale structure (SAXS/WAXD)/property (ionic or electronic conductivity) correlations of functional (i.e. electronically/ionically conducting) materials or into the elaboration and advanced characterization of (negative or positive) electrodes for electrochemical energy storage devices (supercapacitors or batteries) and/or micro/nanoelectronics-based (clean room) manufacturing processes will be especially appreciated. A demonstrated ability to perform independent work, to work across borders of chemistry and physics of functional soft matter or materials science for energy (storage or conversion) within multi/inter-disciplinary research teams, and excellent communication and writing (Both French and English) skills are equally important criteria with respect to academic qualifications and scientific merits for the selection of the PhD candidate. The position is immediately available and submitted to a continuous recruitment scheme.

TITLE: **S**elf-**HeA**ling **P**olymers **E**lectrolytes for *high performance, safe and sustainable-by design* solid-state microbatteries

ACRONYM: SHAPE

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SHAPE
Collaborative Research Project
Self-**HeA**ling **P**olymers **E**lectrolytes
for high performance
***S**afe & **S**ustainable-**by**-**D**esign (**SSbD**)*
Solid-**S**tate **µB**atteries (**SSµBs**)

KEYWORDS
•1 Solid-state electrochemical energy storage
•2 Thin-film batteries
•3 Self-healing polymer electrolytes
•4 Multiscale structure/ionic transport properties
•5 Internet of Thing (IoT) & embarked micro/nano-electronics

SUMMARY OF THE PROJECT
A contemporary and acute scientific and technological challenge linked to addressing (in part) the UN SDG#7 consists in shifting paradigm from **L**ithium-**i**on **B**attery (unsafe **LiB** relying on a liquid or a gel electrolyte) to **S**olid-**S**tate **B**attery (**SSB** featuring (inorganic or polymer) solid-state electrolyte). Beyond electrochemical energy storage and electric transportation key drivers, developing *Safe & Sustainable-by-design (SSdD)* and higher performance µbatteries are also (very much) awaited to satisfy the increasing demand for miniaturized embarked electronics, e.g. to power **I**nternet **o**f **T**hing (**IoT**) objects. To tackle this problem, we innovatively propose to combine a new generation of **S**elf-**H**ealing **P**olymer **E**lectrolyte**s** (**SHPEs** designed and synthesized, and characterized at LEPMI) with *on-chip* **S**olid-**S**tate **µB**atterie**s** (**SSµBs** assembled, characterized and cycled at LN2) relying on porosified Silicon (-)electrodes. Performing *in-situ* and *operando* advanced X-ray scattering and imaging of SHPEs thin films melt-infiltrated within porous Si (-) electrodes and SSµBs will allow for PoC demonstrations of the *high-risk high-gain* TRL 1⇨3/4 collaborative research project SHAPE both at the materials and energy storage device levels, respectively.

RESEARCH TOPIC
•*Safe and Sustainable-by-Design* (SSdB) Electrochemical energy storage through thin-film µbatteries
•United Nation Sustainable Development Goal (SDG) 7 (https://sdgs.un.org/goals/goal7)
•Clean Industrial Green aiming toward achieving a climate-neutral (European) continent by 2050
•Circular (electro)chemistry for electrochemical energy storage

SCIENTIFIC AREA
•*On-chip* energy storage µsources for powering micro/nano-electronics applications (e.g. Internet of Thing: **IoT**)
•Functional soft matter for electrochemical energy storage
•SSbD and higher energy density solid-state thin-film µbatteries

RATIONALE
Through educating and training (@ UGA + @ UdeS) a co-supervised PhD student, the collaborative project **SHAPE** unites for the first time the skills, know-how and expertise of the JRU UMR5279-LEPMI and of the IRL3463-LN2 into a synergistic TRL-1⇨3/4 collaborative research project, building bridges across the Atlantic. Relying on **P**roof-**o**f-**C**oncept (**PoC**) demonstrations at the material (**S**elf-**H**ealing **[1,2] P**olymer **E**lectrolyte**s [3]**: **SHPEs** vs. **PEs**) and device (solid-state µbatteries **[4,5,6]**) levels, it ambitions to enable the scientific grounds (including a potential key IP portfolio) for a (much awaited) next generation of solid-state µbattery to power IoT devices **[5,6,7]**).

CONTEXT & ISSUE TO ADDRESS
A contemporary and acute scientific and technological challenge linked to addressing (in part) the **UN SDG N°7 [8]** consists in shifting paradigm from (unsafe) LiB (relying on a liquid or a gel electrolyte) to SSB (featuring solid-state electrolyte). Beyond electrochemical energy storage and electric transportation key drivers, developing *safer-by-design* and higher performance µbatteries**[4,5,6]** are also (much) awaited to satisfy the increasing demand for miniaturized embarked electronics, e.g. to power IoT objects **[5,6,7]**. Inorganic electrolytes are currently envisioned as the next generation electrolytes of choice for solid-state µbatteries**[4,5,6,7]**, but they exhibit significant cons beyond their inherent pros. In particular, one cannot ensure the integrity and functionality of the key-enabling (solid-state electrolyte/electrodes) interfaces while the battery experiences internal strains (due to lithiation/delithiation

processes) during cycling, leading to unpredictable and/or erratic performance' fluctuation up to spurious battery malfunction and ultimately failure.

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RESEARCH METHODOLOGY

To tackle this problem, we propose to combine here for the first time (to the best of our knowledge) a new generation of **S**elf-**H**ealing **[1,2]** **P**olymer **E**lectrolyte**s** **[3]** (**SHPEs** designed, synthesized, and characterized at LEPMI) with *on-chip* solid-state µbattery **[4,5,6,7]** (assembled, characterized and cycled at LN2) relying on porous Silicon (-) electrodes. We ultimately aim at PoC demonstrations, i.e. a TRL 1⇨3/4 research project. Through the joint submission of proposals to selected beamlines of (French & European) large-scale facilities (e.g. Soleil, ESRF, Max IV)), the LEPMI+LN2 teams will join forces to perform *in-situ* and *operando* X-ray scattering and imaging **[10]** of SHPEs **[1,2,3]** thin films infiltrated within porous Si (-) electrodes and SSµBs **[4,5,6,7]** to allow for PoC demonstrations at the materials and energy storage device levels, respectively.

EXPECTED OUTCOMES/RESULTS

As a "chemistry neutral" (i.e. a 2.0 solution applying to monovalent and multivalent cation-based batteries) and innovative blueprint **[9]** for on-wafer µbattery to power micro/nano-electronic devices **[4,5,6,7]**, the advantages of SHPEs are sixfold: **(i)** their tunable-by-design (ca)ionic (e.g. Li^+) conductivity, **(ii)** their potential integration into a micro/nano-fabrication process (SHPEs **[1,2,3]**), **(iii)** their light-weight attribute leading to energy denser µbatteries, **(iv)** their inherent softness (viscoelastic feature), which can adapt internal material strains, **(v)** their self-healing properties **[1,2,3]** to reshape the electrolytes within the battery though temperature cycles, benefiting from a bioinspired behavior **[11]** encoded into their chemical structures, and **(vi)** enabling temperature as a physical parameter to control and regulate the **S**tate **o**f **H**ealth (**SoH**) and **S**tate **o**f **C**harge (**SoC**) of these µbatteries 2.0; thereby implementing a smart **B**attery **M**anagement **S**ystem (**BMS**).

FURTHER READING/SELECTED REFERENCES

[1]: *Adv. Energy Mater.* **12**, 2102652 (2022). **DOI**: 10.1002/aenm.202102652
[2]: **a)** *Polymers* **15**, 1145 (2023). **DOI:** 10.3390/polym15051145. **b)** *Mater. Today* 78, 181 (2024) **DOI**: 10.1016/j.mattod.2024.06.018
[3]: **a)** *Chem. Rev.* **120**, 6783 (2020). **DOI**: 10.1021/acs.chemrev.9b00531 **b)** *Science*; **378**, abq3750 (2022). **DOI**: 10.1126/science.abq3750
[4]: *Energy Environ. Mater.* **5**, 133 (2022). DOI: 10.1002/eem2.12202
[5]: *ACS Energy Lett.* **7**, 267 (2022). **DOI:** 10.1021/acsenergylett.1c01854
[6]: *Adv. Energy Mater*. **12**, 2103641 (2022). **DOI**: 10.1002/aenm.202103641
[7]: *Nature* **589**, 195 (2021). **DOI**: 10.1038/d41586-021-00021-2
[8]: https://sdgs.un.org/fr/goals/goal7
[9]: *Adv. Energy Mater.* **12**, 2102785 (2022). **DOI**: 10.1002/aenm.202102785
[10]: *Adv. Energy Mater.* **12**, 2102694 (2022). **DOI**: 10.1002/aenm.202102694
[11]: *Chem. Rev*. **123**, 701 (2023). **DOI**: 10.1021/acs.chemrev.2c00575