

FICHE NAVETTE: DOCTORANTS IDEX

SECTOR : Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: Electrical engineering and energy storage

RESEARCHER PROFILE:

First stage researcher,

INSTITUTION: Univ. Grenoble Alpes, University of Innovation

One of the major research-intensive French universities, Univ. Grenoble Alpes**1 enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL*2). The vibrant ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alpes is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ». This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations" "Digital technology").

* ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

Key figures:

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

¹ Univ. Grenoble Alpes

MANDATORY REFERENCES:

CDP TITLE: CIRCULAR

SUBJECT TITLE: Performance analysis of second life battery packs – modelling, safety and optimal energy management

SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): G2ELab (LEPMI – CEA)

DOCTORAL SCHOOL'S: EEATS

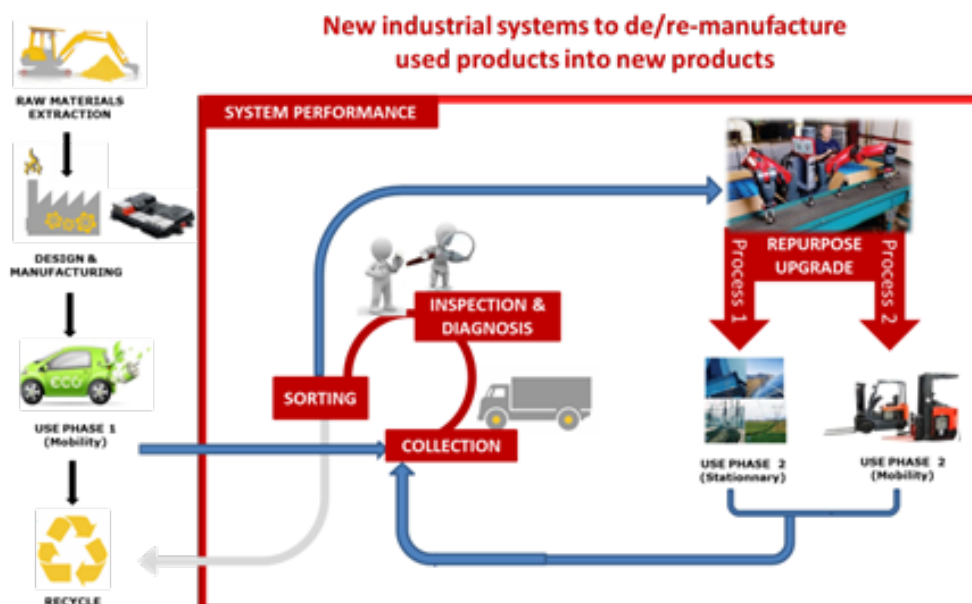
SUPPORTER'S NAME: Delphine RIU

SUBJECT DESCRIPTION:

Context

The thesis untitled “Performance analysis of second life battery packs – modelling, safety and optimal energy management” is embedded in the IDEX Cross Disciplinary Program “Circular Industrial Systems” (CIRCULAR). The goal of this project is to forge an interdisciplinary scientific community by working together to tackle the scientific challenge of creating circular industrial systems able to transform post-used products into new products. This will address the resources-efficiency challenge for the industry of the future. In this project, it is proposed to develop a new circular economy scenario based on upgrading and re-purposing strategies (so called reuse-oriented strategies), resulting in component reuse that leads to the manufacture of totally new products from the transformation of post-used components. The scenarios’ environmental, economic and societal sustainability will also be proved.

In particular the project aims at proving the reuse-oriented strategies implementation on the case of the batteries for electric vehicles that can be reused, after redesign and remanufacture, on mobile and stationary equipment. The figure hereafter shows the new electrical vehicles batteries life cycle. Currently, the electric vehicle market is developing very fast in France and Europe and the waste management needs to be urgently dealt with. Batteries are high-tech and high value, the recycling processes cannot recover an acceptable and sustainable value. The second use phase is then envisaged to enlarge the batteries life cycle but needs some requirements to be developed. Different aspects must be taken into account. The battery pack design, the battery pack management, the safety and durability of the second use batter pack should study in details to validate the circular strategy evolved, in order to imagine new uses for a second life with an effective loss of performances.



Content

Lithium-ion batteries used in embedded systems are considered unusable when they have lost 20% of their initial capacity. These batteries have undergone cycles of use under various conditions (temperature, discharge regime ...) which lead to a specific ageing. If these batteries can no longer be used in embedded systems, they can, before final recycling, be used in second life in less demanding uses. After a diagnostic step necessary to check the batteries in order to eliminate the most degrading one and to sort them accordingly their state of health, the batteries could be reused in pack for a new usage. The aim of the thesis is then to focus in particular on this last point.

The proposed thesis is based on an experimental and modeling approach. With four specific points:

- The study of the influence of the electrical architecture of the pack (series / parallel) on the performances and the ageing of the second life battery packs,
- The study of the influence of second life profiles on battery pack aging,
- The development of the associated ageing models,
- The adaptation of the management strategies of the pack with respect to ageing (with the definition of a specific Energy Management System).

First, the design of small packs of 4 to 6 batteries will be proposed with batteries at the end of their first life (aged cells or modules supplied by our industrial partner and the CEA). The packs will differ by architecture of cells, placed in series and/or parallel. Packs made only with fresh cells will serve as a reference. The electrochemical performances of elements and packs will be measured in order to know the initial state. Moreover from bibliography issue, different profiles of second use will be proposed. Soft profiles or more degrading profiles will be used to study the aging of the packs. From these different tests, an aging model will be proposed taking into account the loss of performances and efficiency. Finally, the last year of the thesis will be devoted to the Energy Management System adapted to the actual behaviour of the cells. The aim is to adapt the dynamic performances to the pack according to the uncertainties linked to the aging and for the stationary conditions.

The thesis will be carried out in a quality scientific environment and will involve researchers from two laboratories of the University Grenoble Alpes (G2Elab³ and LEPMI⁴) and the CEA of Grenoble. The value chain cluster is still under structuring but companies as SNAM (Recycling) or LANCEY (Reuse) are willing to join the consortium to support R&D and develop new businesses.

Project deliverables

- D1 - State of the art report (6 months),
- D2 - Design of test bench for study battery packs with different electrical architectures (12 months),
- D3 - Electrical model of single cell and battery pack (18 months),
- D4 – Design and optimal EMS at the cell level (24 months),
- D5 – Design and optimal EMS at the pack level (30 months),
- D6 - PhD report (36 months).

³ <http://www.g2elab.grenoble-inp.fr/>

⁴ <http://www.lepmi.grenoble-inp.fr/>

ELIGIBILITY CRITERIA

Applicants:

- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

Applicants will have to send an application letter in English and attach:

- Their last diploma
- Their CV
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Address to send their application:

delphine.riu@g2elab.grenoble-inp.fr and Pierre-Xavier.Thivel@lepmi.grenoble-inp.fr

SELECTION PROCESS

Application deadline: **15/07/2018** at 17:00 (CET)

Applications will be evaluated through a three-step process:

1. Eligibility check of applications in April and May 2018
2. 1st round of selection: the applications will be evaluated by a Review Board in the middle of May 2018. Results will be given in end of May 2018.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session in Grenoble on June 2018.

TYPE of CONTRACT: temporary-3 years of doctoral contract

JOB STATUS: Full time

HOURS PER WEEK: 35

OFFER STARTING DATE: 03/04/2018

APPLICATION DEADLINE: 16/07/2018

Salary: between 1768.55 € and 2100 € brut per month (depending on complementary activity or not)

Financements de la thèse : si co-financements, préciser la durée de chacun des financements et l'organisme ou l'institution partenaire