A PhD project

proposed by **ACC**, a major player as battery manufacturer for electric vehicles,
INERIS, the French public expert in risk management for sustainable development,
and **ICMCB**, the Institute of Condensed Matter Chemistry at the University of Bordeaux

Nos réf. : Ineris - ID 2746600

Publication date: 25/07/2022
Place: INERIS, Verneuil-en-Halatte (Oise) – accessible by train/bus, 40 min North of Paris
Position: PhD student
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CONTEXT

Electric Vehicle (EV) market is booming in the coming years. Indeed, major car manufacturers announced full electrification of their vehicles for European market in the coming years. Many actors, as ACC Automotive Cells Company, started implementation of battery Giga-factories in Europe to fulfill the demand. A main cost of EV is related to the battery pack, which integrates Lithium-ion batteries. Challenges thus addressed to Li-ion technology are performances, cost and safety.

SCIENTIFIC CONTENT

To optimize the performance and range of electric vehicles, the challenge is to increase the specific energy of the battery pack. One option is to use large cells containing more energy, leading, once integrated in module and pack to a more energy-dense design with more crucial safety issues. A series of protections are implemented to protect cells from mechanical deformation, electrical abuses, water intrusion, but only few passive or active protection is existing to protect cells from internal short circuit (ISC). Many ISC tests have been developed in the past, but, they are either too severe (full nail penetration) or too soft (L shape Ni-particle), leaving a large gap where most of real-life short circuit failures happen. Recently, innovative ISC tests have been presented like the one from NASA using phase change material or the local internal heater method. Even if already interesting results have been reported, they have to be implemented in battery casing.

This thesis project has the first objective to develop a new nail penetration test (NPT) method able to mimic ISCs, arising during operation of the cell. The thermal, electrical and mechanical effects induced by these ISCs will be studied, as well as the impact on the different components of the cells (electrode materials, separators, collectors etc.). The second objective will be, with the support of two master students supervised by the PhD candidate, to develop experiments to understand especially the chemical mechanisms involved during thermal runaways. The project will thus mostly consist of experimental developments and analyses, in addition simulations will be performed when considered as an added-value to support the understanding of the mechanisms involved.

LOCATION

The thesis project is built and managed by three entities: INERIS, ICMCB and ACC. The PhD student will be located at INERIS, Verneuil-en-Halatte, and will work in ACC/ICMCB in Bordeaux 15% of its time.

Ineris was created in 1990 as a result of the merger between the French Centre for Studies and Research into Collieries (Cerchar) and the Institute of Applied Chemical Research (Ircha). The Institute's mission is to contribute to the prevention of risks caused by economic activities to health, environment, and the safety of people and goods. The PhD will be performed in the Chemical and Electrochemical Reaction Unit of the Fire Explosion and dispersion Department. The candidate will integrate a dynamic team of 10 people working specifically on battery safety, relying on outstanding dedicated testing facilities (e.g. the STEEVE platform for abuse testing of cells and batteries). https://www.ineris.fr/fr

The research activity of the **"Energy: Materials and Batteries" group** at **ICMCB (Doctoral School of Chemical Sciences)** is focused on the synthesis and characterization of materials (new materials, models or materials close to applications) and on the analysis of the mechanisms occurring during the operation of devices for electrochemical energy storage (batteries, microbatteries, supercapacitors ...).

Automotive Cells Company (ACC) was founded in August 2020 and will combine the expertise of three major companies with complementary skills and experience. ACC's ambition is to become an European leader for car batteries that allow clean and efficient mobility for all.

CANDIDATE PROFILE

The candidate has a Master and/or an Engineer Degree, with a mention. He/she likes developments of experimental test benches and of characterizations to bring an in-depth fundamental understanding to mechanisms involved during operations of batteries in extreme conditions. He/she has a general engineer level with knowledge in Chemistry, Physico-Chemistry and Electrochemistry, or he/she has a specialty on these domains. He/she has a very good English level. He/she has an ability to take initiative, to work in a collaborative team and to exchange results with partners involved in the project, both orally and in writing.

GENERAL INFORMATION:

Thesis start: October/November 2022
Duration: 3 years
Salary (gross monthly): 1975 €
PhD status: INERIS fixed term contract position, and PhD student from the University of Bordeaux (Doctoral School of Chemical Sciences)
PhD academic supervisor: Laurence Croguennec and Dany Carlier

HOW TO CANDIDATE:

Send a resume, a cover letter describing your motivation and interest to work on the proposed subject and any recommendation letter to arnaud.bordes@ineris.fr and amandine.lecocq@ineris.fr .
Application should be received before 15/09/2022

This position is open to disabled persons.