PhD position at IFP Energies nouvelles (IFPEN)
in *Physical Sciences*

Improvement of the safety of Li-ion batteries subjected to fast/cold charge constraints

The Li-ion battery is the technology selected by all car manufacturers to provide the energy storage required for electrified vehicle deployment. A battery, during its lifecycle, can encounter a wide range of operating conditions. Some of those operating conditions can accelerate battery degradation and can lead to safety issues.
An experimental campaign on the effect of operating at cold temperature condition, conducted on NMC811-SiC cylindrical cells, has highlighted safety issues. The physical mechanism believed to cause these safety issues is Li-plating.
Two mechanisms linking Li-plating and safety are discussed in the literature: dendritic growth and “dead Li”. The work proposed in this thesis should provide additional information on the mechanisms involved and their consequences on safety. This study will be performed on a new cell generation based on a silicon graphite composite on the negative electrode.
This thesis subject is a continuation of IFPEN's previous work on this topic and will benefit from the acquired experience, models and numerical tools already developed. Indeed, the PhD student will be able to rely, among other, on two recent theses carried out at IFPEN on thermal runaway event. The thesis proposed here will make it possible to complete the knowledge of the mechanisms taking place at cold temperature and fast charging operation. It will be necessary to qualify their criticalities and their impact on thermal runaway by a combined experimental and numerical approach. This work will update the existing IFPEN aging model and enrich the thermal runaway model developed at IFPEN. Finally, the collaboration within the framework of this thesis with the Gustave Eiffel University (https://www.univ-gustave-eiffel.fr/) will offer the opportunity to integrate the effects of aging on battery system design and to propose strategies for the use of the battery that can prevent and relay safety events encountered at low temperatures and fast charging operating conditions.

Keywords: Li-ion battery, multiphysics modeling, safety, thermal runaway, BMS, Lithium plating.

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PhD location	IFP Energies nouvelles, Lyon, France/ Université Gustave EIFFEL, Laboratoire Licit-Eco7, Bron, France, (https://licit-lyon.eu/)
Duration and start date	3 years, starting in fourth quarter 2023
Employer	IFP Energies nouvelles, Lyon, France
Academic requirements	University Master degree in relevant disciplines
Language requirements	Fluency in French or English, willingness to learn French

To apply, please send your cover letter and CV to the IFPEN supervisor indicated here above.

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