**Minutes of ECN 9 Topics**

**Li-ion battery thermal runaway**

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**Summary**

The topic focuses on Li-ion battery thermal runaway which is currently a major issue concerning the safety of electric mobility.

The objective of the topic is multiple:

* To bring together the expertise of different laboratories working on the subject and to produce a review of the different characterization approaches and diagnostics currently employed.
* To create a community of people researching the thermal runaway subject to ease the exchange and stimulate collaboration among different groups following the ECN spirit.
* To define a reference thermal abuse case to be reproduced in different laboratories aiming at producing a coherent experimental database for model development and validation following the “Spray A” approach.

The topic reached a very good dynamic starting from the months preceding the workshop. Exchange online meetings were organized with the participation of different groups. The participating groups shared their research activities, objectives, and approach with an overall good complementarity of the approaches followed.

The groups participating in the discussion were: Karlsruher Institut fur Technologie, King Abdullah University of Science and technology, Converge, University of Tennessee, Ford, Lawrence Livermore National Laboratory, and Sandia National Labs. CMT and IFPEN were participating and organizing the topic.

From the discussion, the following takeaway messages were identified:

* It is a growing and dynamic topic with much activity and many questions to be addressed.
* Repeatability and representativity a major issue for experimental characterization.
* There is various type of diagnostics/expertise involved in the research subject: high added value in collaboration and creating a complementarity between experiments.
* The optical approach can provide macroscopic information on the thermal runaway, but quantitative measurements have still to be identified.
* On the numerical side different approaches are developed including 0-D, 1D and 3D approaches. All of them are strongly related (dependent) to the chemical modeling and to the detailed knowledge of the battery cell components composition.

The reference experiments proposed collected four volunteering laboratories (University of Tennessee, KAUST, IFPEN and CMT) but for logistic issues only two of them could participate (CMT and IFPEN). The analysis of the results enables to highlight a good level of reproducibility of the phenomena in the two experimental setup namely displaying similar venting and runaway temperatures. However, some differences in the temperature evolution highlighted some differences in the heating mode employed in the two experiments. A preliminary comparison of the video obtained indicated coherent results but an improvement in the image format (wider imaging area) is needed to quantitatively characterize the venting jet/flame emitted by the battery cell.

**Future directions:**

* The collaboration carried out to prepare the workshop initiated a small community. The objective is to maintain this link organizing periodic meetings.
* Cylindric cells currently proposed for the reference experiment are a good starting point for the comparison for the moment also if it can evolve in the future to pouch cells. The internal geometry of the cell is of high interest for 3D simulation and general understanding. X-ray measurements could be performed soon at Argonne National lab.
* Gas composition analysis (online and offline) is of high interest and a key to understanding phenomena inside the battery cell. More measurement will be performed including also direct sampling or in-situ measurement for venting and runaway gas emissions.
* New experiments on the reference test case will be performed soon performed by another contributing lab. The new experiments will enable to corroborate the database and clarify differences observed in the results discussed during the workshop.
* Direct measurements aiming at inside the cell (internal battery cell temperature and pressure) have a fundamental added value and should be deployed also for the reference experiment.