Talking Prevention with Diot-Siaci

Lithium-ion - when batteries fuel the fire

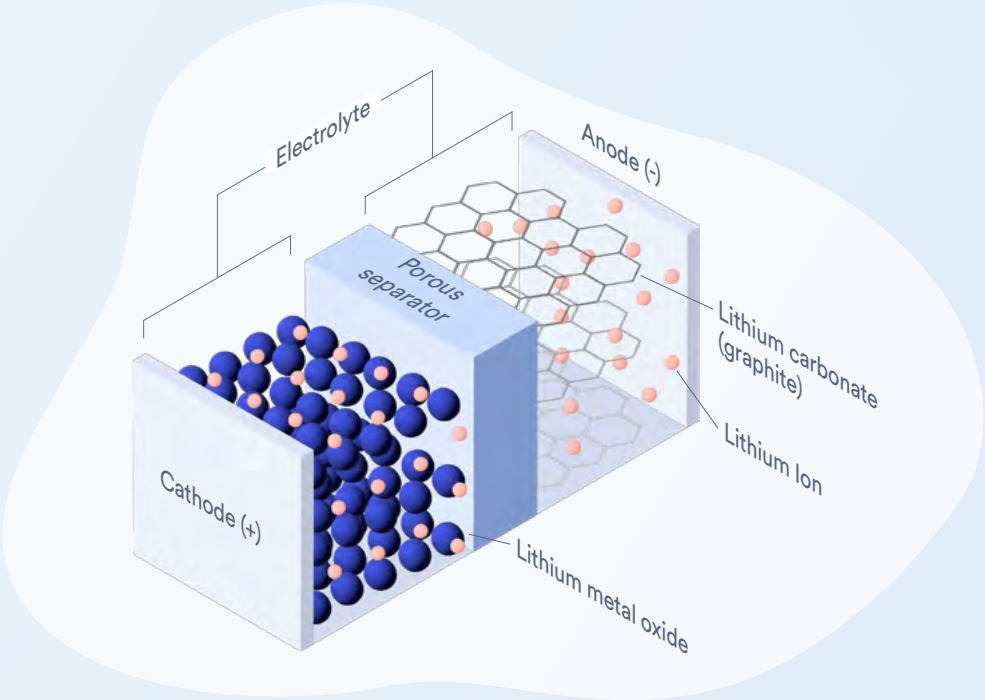
To meet the challenge of decarbonizing our societies, the world's major economies have opted for an all-electric future. This raises the question of storage, as energy is not often consumed at the point of production, nor immediately: mobility, telecommunications, etc.

Although the principle of the battery has been around for a long time, it is the quest to improve various performances to best suit our uses that has led lithium-ion (or Li-ion) batteries to replace all other technology (lead-acid, Ni-Cd, Ni-Mh...): longer life, better resistance to climatic conditions, rapid charging, no, or almost no, maintenance... but above all, for the same amount of stored energy, Li-ion batteries are 3 times lighter and 2 times smaller than other types. On the flip side, they can cause fires that are difficult to control.

Battery composition

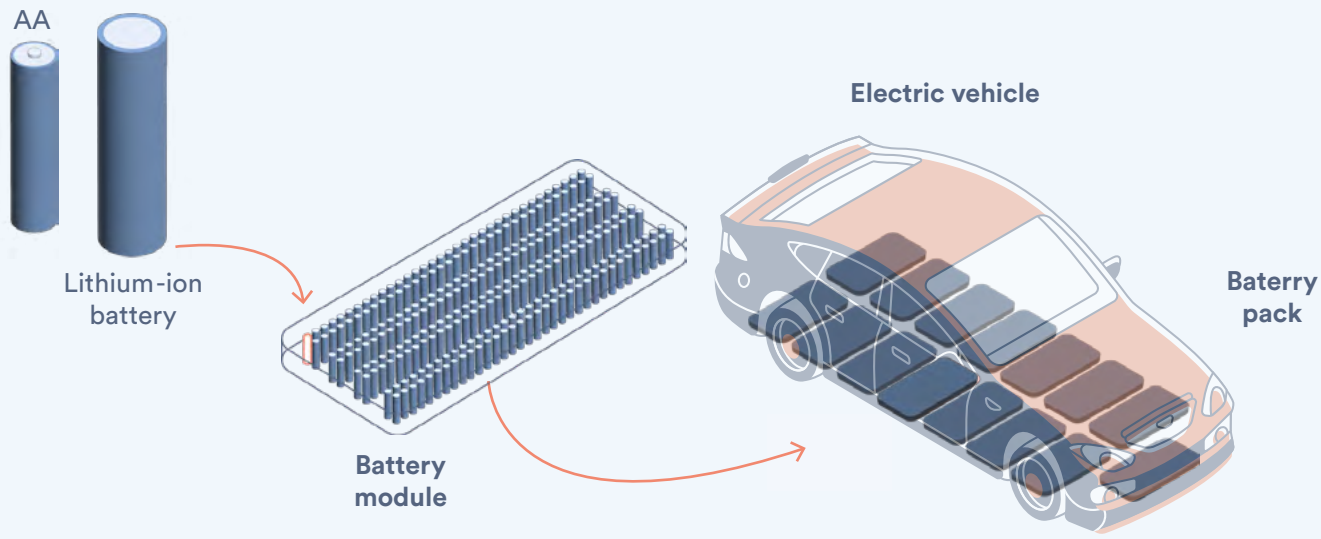
Contrary to popular belief, the difficulties encountered with Li-ion battery fires are not due to the very high reactivity of elemental lithium, for the simple reason that they don't contain any (unlike Li-metal or LMP technology). Lithium is of course present but in its ionic form and it is the displacement of these ions that generates the current by creating a flow of electrons. The components are immersed in an electrolyte (gel/liquid) that enables this transfer of electrons. This electrolyte is usually flammable.

Components of a lithium-ion battery



Source: https://parlonssciences.ca/ressources-pedagogiques/les-stim-en-contexte/comment-fonctionne-une-batterie-lithium-ion

Depending on the power required by the devices to be run off them, what is commonly known as a battery is made up of cells (telephone) which are connected together to form modules (wireless vacuum cleaner), which in turn form packs (vehicle).

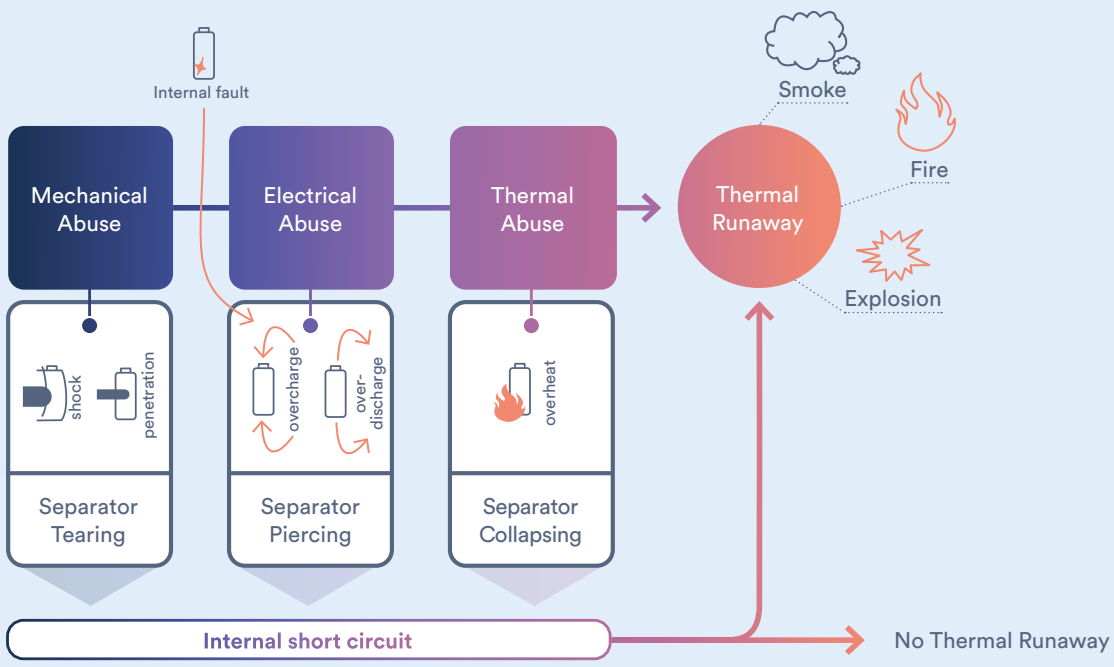


Source: U.S. National Transportation Safety Board

Batterry fires

Several phenomenons could lead to a battery fire:

- mechanical abuse caused by a shock or a penetration of the battery,
- electrical abuse caused by a internal fault, over charge or discharge,
- thermal abuse due to the overheat of the battery because of its use and/or the external temperature.



Source: "Thermal Runaway Mechanism of Lithium Ion Battery for Electric Vehicles: A Review" X. Feng, et al Tsinghua University - Beijing

Due to its particular chemistry, the reaction can be very violent: this is known as **thermal runaway**. A chain reaction can then develop between the cells, modules and battery packs, causing them to ignite one after the other.

A burning battery can only be extinguished by cooling with water, ideally by immersion. This is only possible when the batteries are accessible, i.e. when they are being stored and before their integration into the final device. In particular, there are sprinkler protection schemes that are approved for certain very specific configurations.

Without this cooling action, the battery will burn completely and the fire will spread all the more easily as heat radiation is high, the electrolyte creates a spill fire, and there is significant projection of incandescent particles. This is what happens when batteries are no longer accessible or are difficult to access because they are integrated into the device, as in the case of electric vehicles where they are hermetically sealed by design.

Note: for LMP technology batteries, there are currently no extinguishing solutions available; only recommended environmental protection measures to prevent the spread of fire.

Risk management

This is why insurance companies class this concentrated form of energy as a major risk, not because of the technology, which is reliable, but because, once ignited, the fire is difficult to control. Quite all occupancies are affected by this risk in one form or another: battery manufacturing (gigafactories), battery storage and transportation (logistics), energy storage (BESS in photovoltaic installations), module assembly (automotive), reconditioning/recycling, or simply the use of these batteries in handling equipment.

We must therefore be particularly vigilant, especially when it comes to prevention:

- fire compartmentation of battery storage and charging areas, or sufficient separative distance between them and the rest of the occupancy,
- adaptation of existing sprinkler protection systems, with the resulting constraints on operations,
- quarantine procedures for used or damaged batteries,
- upgraded training of personnel in the use and transportation of batteries, as well as the initial firefighting drills in case of fire,
- deployment of systems to monitor and manage batteries (Battery Management Systems and Energy Management Systems) for active battery applications.

The Diot-Siaci prevention team

1 integrated team dedicated to placement and customer service,
7 engineers with over 20 years' experience and a wide range of profiles.

Our approach:

analyze the risks,
implement prevention and protection initiatives,
promote business resilience.

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- Environmental risks
- Marine
- Nuclear
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- Benchmarking
- Training
- Prevention portal
- Project management tools
- Technical intelligence

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