Improving the safety of lithium-ion batteries in electric vehicles

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Researchers from the Universitat Politècnica de València (UPV), belonging to the CMT-Motores Térmicos research institute, are working on different national and international projects to improve the safety of

lithium-ion batteries, the most currently used in electric vehicles.

As pointed out by Antonio García, researcher at CMT-Motores Térmicos, the future of the automotive sector depends, to a large extent, although not exclusively, on the massive use of lithium-ion electric batteries, although there are currently some problems that may affect your safety. One of them is its thermal stability.

"Lithium ion batteries under certain conditions are not safe. There is a phenomenon known as thermal runaway, which can end up causing the battery to catch fire, with the consequent risk to the occupants of the vehicle. The thermal energy released during this process is around 5.4 times the electrical energy contained in the battery, so extreme precautions must be taken. Thermal instability of batteries can occur under high demand conditions, for example during fast charging. If this is not managed well, it can go into thermal runaway and start a fire. As a note, a German city has already prohibited the parking of electric cars in underground garages," explains García.

To reduce these risks, the UPV's CMT-Motores Térmicos team is currently working in two European and two other national projects whose objective is to better understand all the problems associated to the thermal runaway of lithium-ion batteries, both current and those that will reach the future market in the next 15 years.

"We are applying our more than 40 years of work focused on combustion engines to understand this phenomenon that affects lithium-ion batteries. We want to know even the smallest detail of the combustion process in batteries to help make them as safe as possible. And we already have our first results," says Javier Monsalve.

One of them is the development of an experimental installation, in collaboration with AVL Ibérica, to be able to visualize how the

combustion process of a battery develops. Along with the analysis of the gases emitted, it will be possible to carry out a physical-chemical characterization of the process under different conditions such as different state of charge states, composition of the environment, etc., which will allow the development of chemical kinetic mechanisms associated to the process.

In addition, the UPV team is working on the DETEBAT-VE project, financed by the Generalitat Valenciana, focused on reorienting companies that currently provide services to Ford Almussafes towards electrification.

"The objective of the project is to create a high-energy content battery pack demonstrator that allows the development and validation of the essential technologies to increase its driving range, safety and sustainability. From the CMT we work on the aspects of safety, thermal control and development of the battery energy management system," Monsalve says.

NASA interest

The work carried out from the laboratories of this team at the UPV's CMT-Motores Térmicos has aroused the interest of large multinationals in the automotive sector, as well as the US space agency, NASA.

"The Agency has a department dedicated entirely to the study of these batteries, which are also key for the aeronautical sector. Last December we presented the conclusions of our most recent work in this sector at the NASA Aerospace Battery Workshop, which was very well received," says García.

On the future of the automotive

With these projects, the CMT-Motores Térmicos team contributes all its knowledge for a future of the sector in which, Antonio García points out, "there will not be a single winning technology because the future is eclectic."

"We have a global problem that is CO_2 and, without the integration of hybrid electric vehicles (HEV), plug-in hybrids (PHEV), 100% electric vehicles (BEV), Fuel Cells, e-fuels, H_2... it will be impossible to reach the objectives of reduction of emissions set for 2050. We are working on this integration and, in this specific case, on helping to guarantee the maximum safety of lithium-ion batteries, which are key today and even more so in the not-so-long-term future," concludes Antonio Garcia.

More information: Antonio García, Javier Monsalve-Serrano, Rafael Lago Sari, Santiago Martinez-Boggio, Influence of environmental conditions in the battery thermal runaway process of different chemistries: Thermodynamic and optical assessment, *International Journal of Heat and Mass Transfer* (2022). DOI: 10.1016/j.ijheatmasstransfer.2021.122381

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