Karlsruhe Institute of Technology

Safety First – Enhanced Safety for Lithium-Ion Batteries

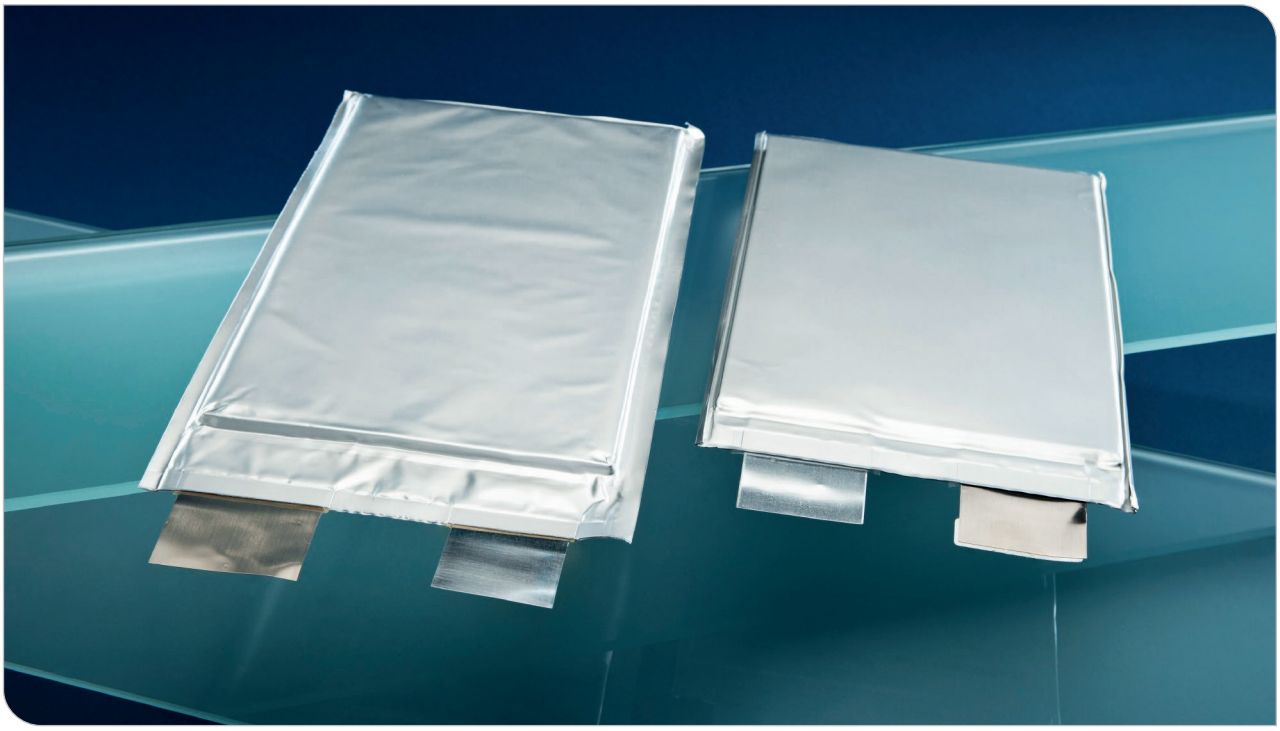
Lithium-ion batteries can be very efficient, reliable and safe energy storage systems. Indeed, for their use in electric vehicles they have to pass strict safety tests and their functionality is tested over tens of thousands of kilometres. This is however completely different for stationary PV home storage systems with Li-ion batteries, for which the current standards and regulations do not yet cover all safety-related cases. Therefore a CE label and listed standards do not at the moment automatically result in a safe product.

Currently, there are products of very different quality and safety standards on the market:

- Insecure systems with partially insecure Li-ion cells and/or insufficient safety mechanisms that would need to be withdrawn from the market immediately, if similarly high safety regulations were applied as those for established products e.g. of the automotive industry.
- Systems of average quality that mostly operate well and in which defects or damage are only expected in a few cases.
- Excellent systems that are developed, tested and produced according to more strict criteria than currently required. These systems are built with high quality cells and have multiple safeguards.

What do the listed standards and labels in product fact sheets mean for the safety of Li-ion based home storage systems?

CE means that a product meets all applicable community standards and that the obliged assessment procedures (e.g. hazard analysis, risk assessment) have been carried out. At the moment, these standards do not cover all possible cases



of failure of Li-ion batteries and the hazard analysis often lacks detailed knowledge of the Li-ion electrochemistry. Additionally, for packages consisting of battery and inverters one should ensure that the CE label covers the whole package.

UN38.3 contains criteria and electrical, mechanical and thermal tests for the safe transport of Li-ion batteries. The tests are in part very sophisticated and reveal a certain robustness and basic safety of the system.

DIN EN 62427:2006 (Secondary cells and batteries for solar photovoltaic energy systems - general requirements and methods of test) contains e.g. capacity and cycle life tests, but few aspects concerning safety.

DIN EN 62620 (Draft, Large format secondary lithium cells and batteries for use in industrial applications) Performance tests and measuring methods for Li-ion cells and batteries, no safety tests.

DIN EN 50272 is related to electrical engineering (e.g. isolation, separation) and battery safety issues (e.g. transportation, installation site, charging, protective measures). Although the focus is on lead-acid and NiCd batteries, many aspects can be applied to Li-ion batteries.

How can you find a system that is as safe as possible?

Since the existing tests are not completely exhaustive, test seals can be trusted only to a certain extent. Please ask for confirmation that the tests for the listed standards and labels in the product catalogue were actually performed and passed.

You can ask for additional tests and risk analyses – for example:

- How safe is the system in the case of failure of single safety features (e.g. switch or battery management system) and are the failures reported?
- Is it certain that the Li-ion cells in the battery have never become warmer than the specified maximum temperature?
- Does the system turn off permanently if the Li-ion cells are irreversibly damaged and have thus become less safe (e.g. by deep discharge, overheating)?
- Does the manufacturer of the cells in the battery also supply the automotive industry with cells?
- Have additional safety standards been taken into account? The new DIN EN 62619 (as of April 2014 still in draft) addresses some deficiencies. Also, some tests and specifications from automotive standards increase the safety and reliability.

Does increased safety result in increased performance and cycle life?

Li-ion cells with a higher intrinsic safety usually have less material impurities and are better processed – both aspects lead to a higher cycle stability and cycle life. Battery manufacturers seeking a consistently high quality of the entire system are both careful in cell selection as well as in selection of other components (e.g. control, safety components). This results in safe products with long-lasting components and high availability. Although quality and safety come at a price, products that age too fast or even fail are definitely too expensive.

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