Dependence of safety of Li-ion cells on their main aging mechanism and first insights into safety of Na-ion cells

Thomas Waldmann[1,2,3]

1) Zentrum für Sonnenenergie- und Wasserstoff-Forschung (ZSW), Helmholtzstrasse 8, D-89081 Ulm
2) Helmholtz Institute Ulm (HIU), Helmholtzstrasse 11, D-89081 Ulm
3) Ulm University, 89069 Ulm, Germany

Li-ion batteries are used for energy storage in many different applications, such as electric cars and stationary energy storage. Besides the established Li-ion technology, recently also Na-ion cells emerged on the market. Besides a long cycle life, safety of all batteries is essential. In this keynote talk, an overview on experimental results from ZSW's labs from the last 15 years on commercial Li-ion and recently investigated Na-ion cells will be presented.

Main aging mechanism in Li-ion cells are often SEI growth and deposition of metallic lithium ('Li plating') as can be distinguished by Arrhenius plots and Tear-down analysis. Accelerating rate calorimetry (ARC) tests of Li-ion cells with/without Li plating can show significant differences in the thermal runway due to exothermic reactions of lithium metal with electrolyte at elevated temperatures.[1–3] Additional other types of safety tests (nail penetration, overcharge, overdischarge) with cells with/without Li plating, including cells from an automotive application show that the question of safety is more complex than expected,[4–6] as the hazard level depends not only on the cell type (can be different for cells with same cathode chemistry) but also on the main aging mechanism (not only on the state-of-health) and on the type of safety test, and the regarded parameter.

In analogy to Li-ion cells where Li plating can happen, commercial Na-ion cells can also show Na metal plating.[7,8] First ARC results of commercial Na-ion cells with and without Na plating are presented, showing a decreased safety level for temperatures above the melting point of sodium metal.

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