EUROPEAN COMMISSION

HORIZON 2020 PROGRAMME - TOPIC H2020-LC-BAT-2019
Strongly improved, highly performant and safe all solid-state batteries for electric vehicles.

GRANT AGREEMENT No. 875189

SAFELiMOVE – Deliverable Report

D7.2 – Post-mortem report

Deliverable No.	SAFELiMOVE D7.2	
Related WP	WP7	
Deliverable Title	Post-mortem report	
Deliverable Date	2023-12-31	
Deliverable Type	REPORT	
Dissemination level	Confidential – member only (CO)	
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Status	Final	2023-12-21

Disclaimer/ Acknowledgment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875189. The information and views set out in this publication does not necessarily reflect the official opinion of the European Commission. Neither the European Union institutions and bodies nor any person acting on their behalf, may be held responsible for the use which may be made of the information contained therein.

Publishable summary

The post-mortem analysis in the SAFELiMOVE project, under T7.3, focuses on cells received from WP7 partners. This study aims to understand aging causes and mechanisms in SAFELiMOVE cells and identifying challenges from their design. The unique design of Solid-State batteries in this project introduces challenges in the post-mortem study, ranging from handling of cell materials, coin cell building, and interface study. Using a comprehensive approach, combining non-invasive and invasive methods, this study categorizes cells into aged monolayer cells, 1 Ah Gen-1 cells (aged and pristine), and 1 Ah Gen-2 cells (aged and pristine). Each cell category presents distinct challenges in terms of handling and investigating them via post-mortem analysis methods. This study investigates recognized aging mechanisms in Lithium-ion batteries, focusing on aspects like the loss of electrical contact between different cell layers, dead or trapped Li-metal, degradation of cathode and separator materials, and chemical reactions at interfaces.

In the study of these aging mechanisms, diverse analytical methods were employed to examine various properties and aging phenomena in aged cells, comparing them to pristine cells of the same generation. Ultrasound imaging provided insights to the extent of degradation within the cells before they are opened, proving particularly beneficial for comparing degradation levels across cells of the same and different generations. ICP-OES was utilized to explore the presence of trapped Lithium within the separator or cathode layer. SEM-EDS and FIB-SEM were employed to investigate interfaces as well as particle quality before and after aging. XRD measurements on the cathode were conducted to assess bulk-level deterioration, complemented by Raman spectroscopy on NMC particles from aged cells. Lastly, the electrical performance of monolayer-level-2-pouch-cells and the evolution of their resistance were correlated with physical features and properties of the cells. These analyses provide valuable insights for modeling the aging and thermal behavior of the cells, contributing to the broader objectives of the SAFELiMOVE project and advancing our understanding of Solid-State battery technology.