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D6.1 – Large pouch cell prototype cell design & assembly definitions

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Publishable summary

All solid-state battery technology involves development of new cell design and processing methodology to achieve low cell impedance and optimal electrochemical performance along the battery life cycle. The report focuses on the development of the 10 Ah large pouch cell in a pre-industrial prototype format to be then tested by partners for TRL6 demonstration at the end of the project. This SAFELIMOVE large pouch cell has been optimized for prototype manufacturing, involving new processing protocols of handling, stacking, assembly and connection welding of multiple thin electrodes.

With all the feedback from processing and assembly know-how on 1st generation of small-scale 1 Ah pouch cell developed by CIDETEC, SAFT has designed the final 10 Ah prototype pouch cell and the related assembly process flow chart following the specifications and Level 2 materials and cell components provided:

1. Very thin lithium metal foil (LiM) provided by Hydro-Quebec.
2. High voltage cathode provided by CIDETEC with lithium nickel manganese cobalt oxide ($LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$, NMC) from Umicore.
3. Solid electrolyte membrane upscaled by SAFT with polymers provided by CICe, inorganic filler $Li_{1+x}Al_xTi_{2-x}(PO_4)_3$ (LATP) provided by SCHOTT.

This new cell design required multiple processability tests achieved with SAFELIMOVE materials samples at different maturity levels, allowing us to define the right process parameters. Tab welding was investigated, especially for bonding to very thin LiM anodes. Good electrolytic contact between all electrodes and solid electrolyte layers requires a specific smoothing operation. The cell pressure holding has been set to ensure intimate contact with the different components despite the thickness variation due to lithium transport across cycles.

As a result, this report confirms the feasibility of this large multilayer pouch cell design with its related prototyping assembly flowchart, using new specifically designed tools. Detailed definitions of each component and assembly conditions have been set. Innovative solutions have been developed for handling and stacking sticky membranes with anodes, and the tab connection by welding with multiple LiM layers. These large pouch cells will be used for electrical performances, life and safety tests and will be integrated into a 24V battery module demonstrator.

However, due to the material properties of the solid electrolyte membrane (stickiness and mandatory cross-linking step) the usage of Roll-to-Roll coater and automatic assembly line was a big challenge to scale-up the manufacturing. To mitigate this risk, tools to help manual handling have been developed and manufactured, the number of layers in the stack has been reduced and the subsequent capacity of the cell decreased from 10 Ah to 5-3 Ah (theoretical capacity).

Appendix A- Acknowledgement

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

#	Partner	Partner Full Name
1	CICe	CENTRO DE INVESTIGACION COOPERATIVA DE ENERGIAS ALTERNATIVAS FUNDACION, CIC ENERGIGUNE FUNDAZIOA
2	SCHOTT	SCHOTT AG
3	UMICORE	UMICORE
4	HYDRO-QUEBEC	HYDRO-QUEBEC
5	SAFT	SAFT
6	RENAULT SAS	RENAULT SAS
7	TME	TOYOTA MOTOR EUROPE NV
8	IKERLAN	IKERLAN S. COOP
9	CEA	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
10	CIDETEC	FUNDACION CIDETEC
11	TUB	TECHNISCHE UNIVERSITAT BERLIN
12	RWTH AACHEN	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN
13	ABEE	AVESTA BATTERY & ENERGY ENGINEERING
14	LCE Srl	LIFE CYCLE ENGINEERING SRL
15	UNIRESEARCH BV	UNIRESEARCH BV