Press Release

The problem: Sustainable manufacturing of Gen. 4b solid-state batteries (SSBs) with minimised amount of critical raw materials (Co and Li), and with superior performance and safety is a major challenge in today's battery research. Lithium-ion battery (LiB) cells with conventional active materials are reaching their limits in terms of energy densities. Also, safety issues arise with the utilisation of liquid organic electrolyte which are becoming even more critical with the introduction of advanced materials made to increase cell voltage and fast charging rates. Hence, there is an urgent need for the development of innovative scalable manufacturing technologies based on new solid-state electrolytes (SSEs) that can be also combined with metallic lithium at the anode, leading to significantly enhanced energy density.

The project: The SOLiD project aims to create a sustainable and cost-efficient pilot scale manufacturing process for a high energy density, safe and easily recyclable solid-state Li-metal battery (LMB).

The objectives: The main goals are to develop:

- Roll-to-roll (R2R) dry extrusion coating process for cathode-polymer electrolyte composites, consisting of nickel manganese cobalt oxide (NMC) with high nickel content as the active material, carbon nanotubes (CNTs) or redox polymers as the conductive additive/binder, and polymer electrolyte, which can function also as a binder (binder solid-state polymer electrolyte, BSPE).
- R2R pulsed laser deposition (PLD) process for an ultra-thin Li metal anode, combined with an inline process to deposit an inorganic solid electrolyte barrier layer on top of it.
- R2R slot-die coating process for a curable polycarbonate polymer electrolyte (separator solid-state polymer electrolyte, SSPE), which is mechanically and electrochemically stable.
- Optimized interfaces for each material and layer, deposited by scalable methods, allowing improved performance and stability, and easy recycling.
- Digital quality control and inline characterisation tools for feedback control, combined with artificial intelligence and a digital twin for possible feedforward control, to go towards zero-defect and cost-efficient manufacturing.
- Technology assessment based on life-cycle thinking approach in respect to all three sustainability dimensions.
- Tools/methods for stakeholder engagement respecting inclusive research.

The technology: Project partners will use roll-to-roll (R2R) dry extrusion coating for blending cathode active material, solid polymer electrolyte (SPE), and conducting additives. R2R slot-die-coated primers on the cathode current collector will enhance adhesion, performance, and corrosion resistance of the cell. The SPE layer will be coated using R2R machinery, with a slot-die that is optimized using fluid simulation (CFD). For the Li metal anode, we will utilize cost-efficient R2R pulsed laser deposition, which enables minimizing the Li thickness down to 5 µm. The Li metal production will be combined with an inline process for interfacial engineering to ensure compatibility with the other layers and stability. The process development will be supported by digitalization methods to go towards zero-defect and cost-efficient manufacturing. The protective layers enable the use of NMC811, which reduces the amount of Co into minimum without compromising the lifetime, and PLD process helps to minimize the Li thickness. Dry coating eliminates the use of toxic solvents and energy-consuming drying steps, and the digital quality control will reduce the amount of waste. The thickness of each layer will be minimized to reach energy density above 900 Wh/l. Cost will be reduced by cost-effective production methods, the process control (digitalisation) and by maximizing the yield. Safety and long cycle life are guaranteed by the SPE and the protective interlayers. Supported by the life-cycle thinking and stakeholder engagement, the SOLiD project will enable the design for a sustainable SSB factory of the future.

The consortium:

The SOLiD consortium consists of 14 partners from 9 different countries, throughout the battery manufacturing value chain, being experts in material development, manufacturing of the battery layers in pilot scale, R2R integration, manufacturing the Gen. 2b industrial reference cells, developing scalable methods to produce interfacial barriers or functional layers, pouch cell assembly, safety testing, life cycle analysis, dissemination, communication and exploitation.

Project data:

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Twitter account	https://twitter.com/SOLiDProjectEU
Cordis page	https://cordis.europa.eu/project/id/101069505

Consortium:

1 (Coord.)	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	Finland
2	PULSEDEON OY	Finland
3	AVESTA BATTERY & ENERGY ENGINEERING	Belgium
4	RTD TALOS LIMITED	Cyprus
5	AALTO KORKEAKOULUSAATIO SR	Finland
6	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	France
6.1 (Aff.)	UNIVERSITE GRENOBLE ALPES	France
7	SPECIFIC POLYMERS	France
8	OCSIAL EUROPE SARL	Luxemburg
9	ARMOR BATTERY FILMS	France
10	COATEMA COATING MACHINERY GMBH	Germany
11	UNIVERZITA TOMASE BATI VE ZLINE	Czech Republic
12	CENTRO RICERCHE FIAT SCPA	Italy
13	CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPEMENT	Switzerland
14	BERNER FACHHOCHSCHULE	Switzerland

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