ADVAGEN

DELIVERABLE REPORT

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Participant responsible:	TUBS
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Nature of the Deliverable		
R	Document, report (excluding the periodic and final reports)	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	

Dissemination Level		
PU	Public, fully open	
SEN	Sensitive	X

Quality procedure			
Date	Version	Reviewers	Comments
07/12/2023	1	Julia AMICI (POLITO)	Minor corrections
18 /12/2023	2	Takwa BENISSA (ABEE)	Overall review
09/01/2024	3	Neel SANGHVI (ABEE)	General review
18/01/2024	3	Rahmandhika Firdauzha Hary HERNANDHA (ABEE)	Technical review, minor corrections, propose for additional contents
29/01/2024	4	Jessica GERSTENBERG (TUBS), Arianna PESCE (CICE)	General edit and finalise the format
30/01/2024	4	Rahmandhika Firdauzha Hary HERNANDHA (ABEE)	Overall finalisation and submission

Project summary

This report is part of the deliverables from the project "ADVAGEN" (Development of ADVAnced next GENeration Solid-State batteries for Electromobility Applications), which has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No. 101069743.

To date, the battery market is dominated by lithium-ion (Li-ion) chemistries, as the energy density has more than doubled and their costs have dropped by a factor of at least 10. However, conventional Li-ion batteries (LIB) are reaching their performance limits in terms of energy density and facing safety issues, is required the development and production of new battery generations, such as Solid-State Batteries (SSBs), to create a new industry value chain in Europe towards their commercialization. Consequently, high-energy-density EU-made SSBs will ensure the supply of, among others, the automotive sector. To do so, the development and deployment of new manufacturing technologies, enabling the large-scale production of SSBs, is crucial. Indeed, among the overarching themes to develop and produce sustainable batteries in the future, the BATTERY 2030+ roadmap4 considers manufacturability as a cross-cutting key area. Innovative and scalable manufacturing techniques to produce SSBs will accelerate cost reduction, energy savings, and enhanced safety. ADVAGEN will develop a new lithium metal (LiM) battery cell technology based on a safe, reliable, and high-performing hybrid solid-state electrolyte (LLZO-LPS based), gaining a competitive advantage over the worldwide (mainly Asian) competition. This will sustainably strengthen the EU as a technological and manufacturing leader in batteries as specified in the ERTRAC electrification roadmap and SET-Plan Action Point-7. ADVAGEN consortium contains key EU actors in the battery sector, from industrial materials producers (CPT, ABEE), battery manufacturer (ABEE) to R&D centers (IKE, CEA, IREC, TUB, CICe, POLITO, INEGI, UL, FEV) and the automotive industry (TME), covering the complete knowledge and value chain. By developing high-performance, affordable and safe batteries, ADVAGEN aims to re-establish European competitiveness in battery cell production.

Objective and Executive summary

Oxide and sulfide components for the preparation of hybrid electrolyte preparation is selected. Different types of sulfide electrolytes are prepared and evaluated with regard to their lithium-ion conductivity and efficiency. Argyrodite-type sulfide electrolyte is chosen due to its high ionic conductivity as well as the processing via mechanochemical synthesis. The oxide component LLZO is analyzed and an Nb-doped LLZO is used because of the higher conductivity of the hybrid electrolyte.

Hybrid sulfide-oxide samples are prepared in different ratios by dry and wet processing, and structural, morphological, and electrochemical characterization is used to select the best-performing parameters. Dry hybrid electrolyte pellets show an improved lithium-ion conductivity with 10-20 wt.-% LLZO and cycling more than 1000 h against lithium. Transferring the process from a dry to a solution-based, scalable process reduces the lithium-ion conductivity as well as the density of the hybrid electrolyte. The quality of the wet film is optimized by adapting the binder system and the dispersion process.

List of partners

N°	Name	Short name	Country
	AVESTA BATTERY & ENERGY ENGINEERING	ABEE	BE
	INEGI - INSTITUTO DE CIENCIA E INOVACAO EM ENGENHARIA MECANICA E ENGENHARIA INDUSTRIAL	INEGI	PT
	POLITECNICO DI TORINO	POLITO	IT
	FEV EUROPE GMBH	FEV	DE
	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVE	CEA	FR
	TECHNISCHE UNIVERSITAET BRAUNSCHWEIG	TUBS	DE
	CENTRO DE INVESTIGACION COOPERATIVA DE ENERGIAS ALTERNATIVAS FUNDACION, CIC ENERGIGUNE FUNDAZIOA	CICE	ES
	FUNDACIO INSTITUT DE RECERCA DE L'ENERGIA DE CATALUNYA	IREC-CERCA	ES
	TOYOTA MOTOR EUROPE NV	TME	BE
	UNIVERZA V LJUBLJANI	UL	SI
	EUROQUALITY SARL	EQY	FR
	TECHCONCEPTS BV	TC	NL
	CERAMIC POWDER TECHNOLOGY AS	CERPOTECH	NO
	IKERLAN S. COOP	IKERLAN	ES