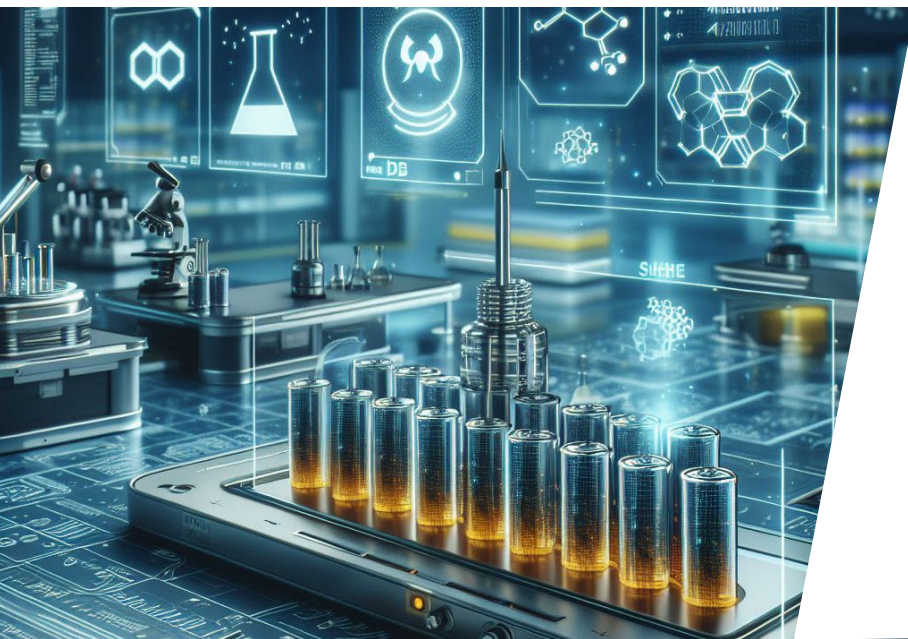




Innovating the batteries of the future

Prof. Dr. Corsin Battaglia

Empa – Swiss Federal Laboratories for Materials Science and Technology

ETHZ – Department of Information Technology and Electrical Engineering

EPFL – School of Engineering, Institute of Materials

NYU – Tandon School of Engineering, Chemical and Biomolecular Engineering

corsin.battaglia@empa.ch

CEO4Climate, ETH Zurich Energy Center

September 8 2025

Laboratory Materials for Energy Conversion



- Team of 30 researchers, postdocs, PhD students, and visiting students
- Brand new battery labs located at Empa campus in Dübendorf
- Affiliated with ETHZ D-ITET and EPFL STI IMX

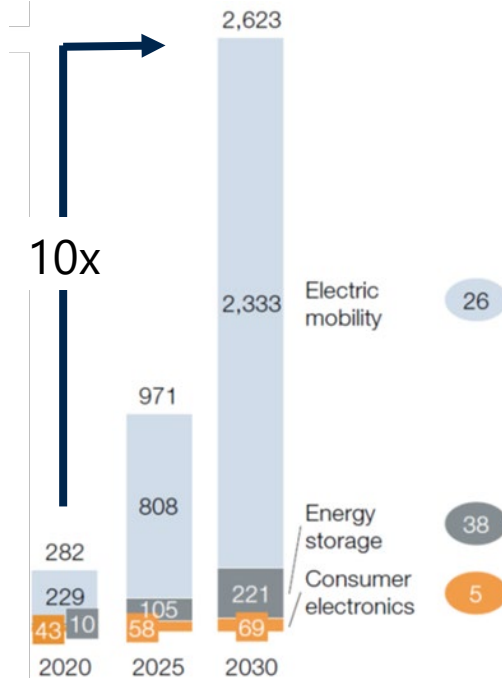


guided lab tour

Global battery demand

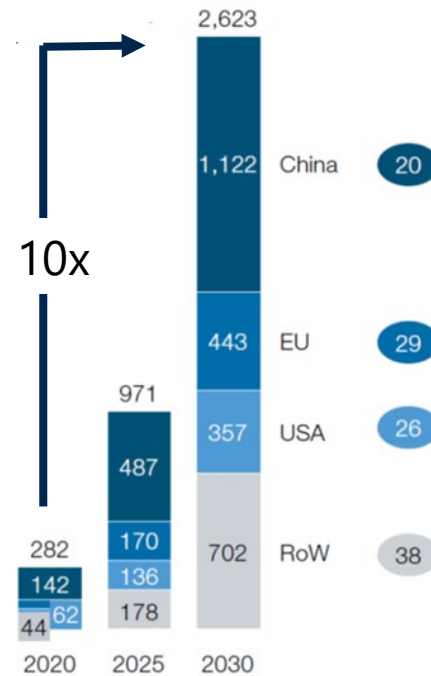
Global battery demand by application
GWh in 2030, base case

CAGR,
% p.a.

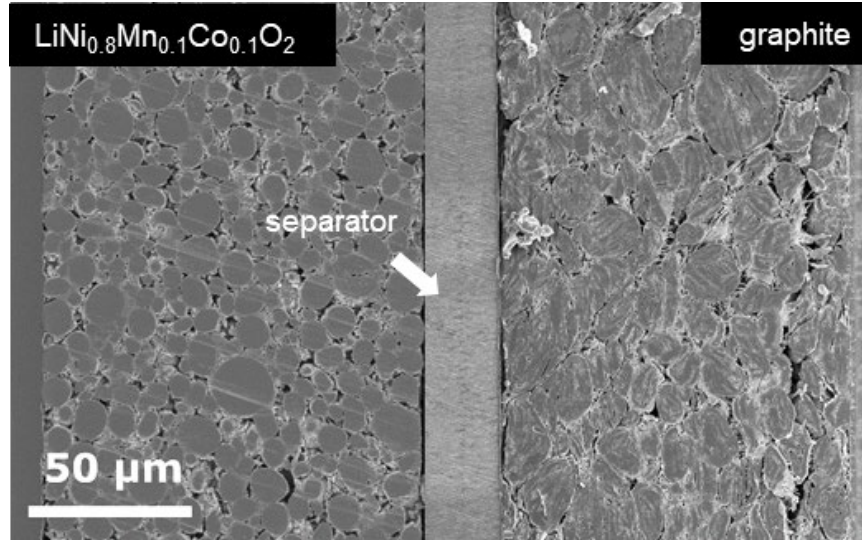


Global battery demand by region
GWh in 2030, base case

CAGR,
% p.a.

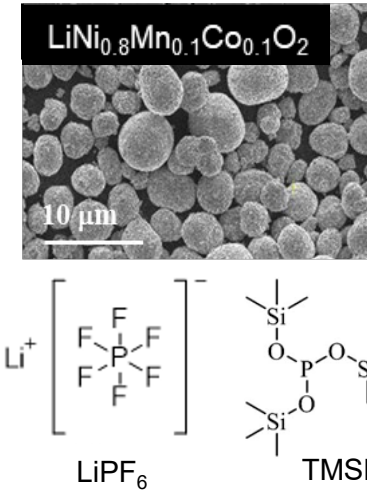
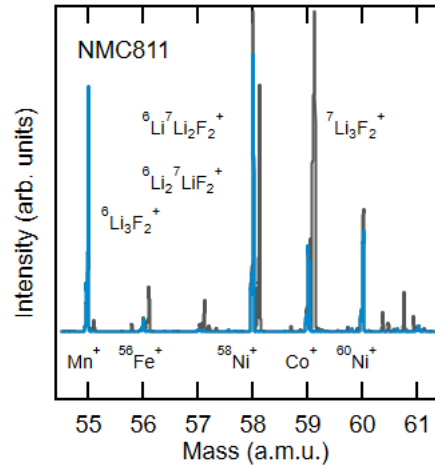
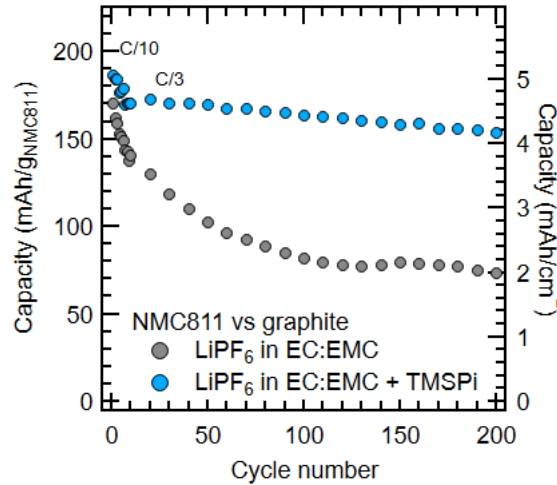


State-of-the-art lithium-ion batteries



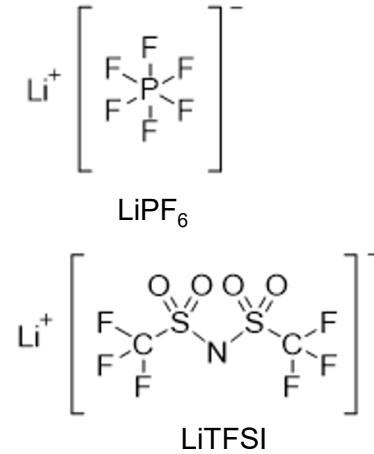
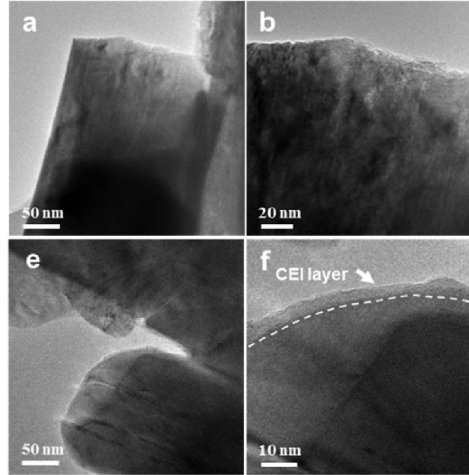
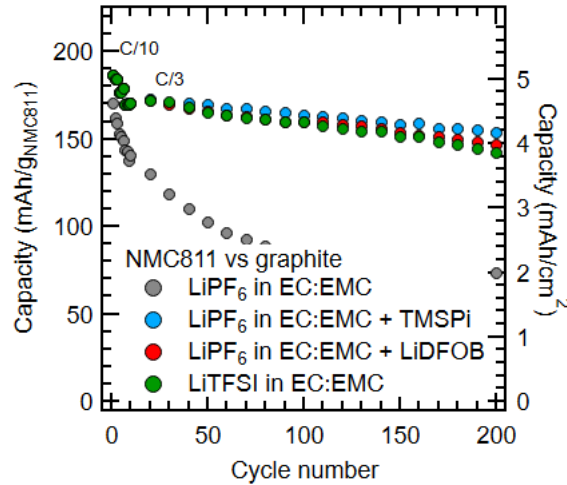
- Enable the electrification of the mobility sector
- Enable the integration of renewables into the electric grid

Understanding electrode/electrolyte interfaces



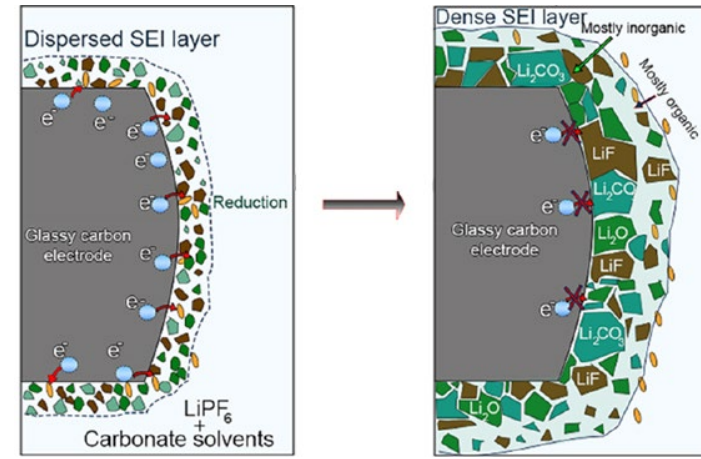
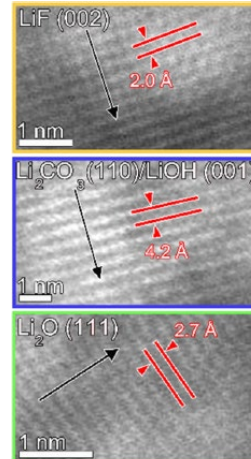
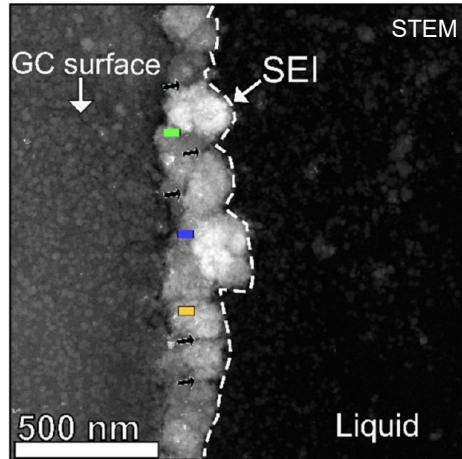
- Passivate reactive interfaces using sacrificial electrolyte additives
- Prevent lithium fluoride precipitation

Understanding electrode/electrolyte interfaces



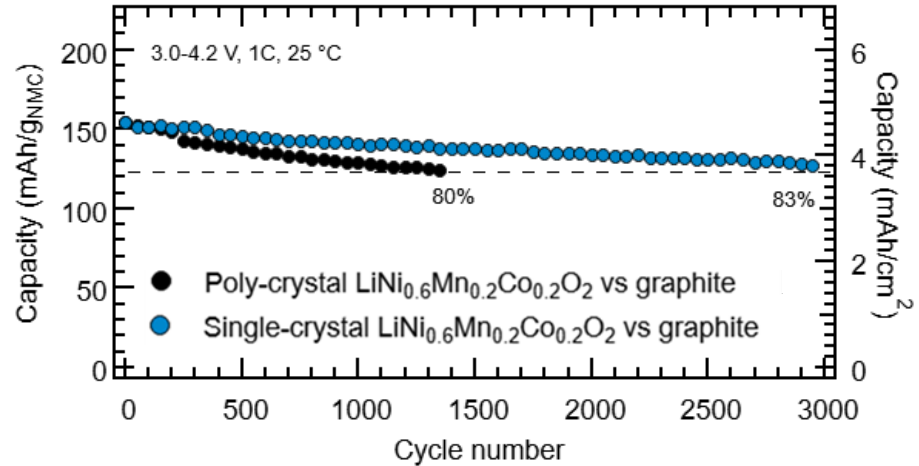
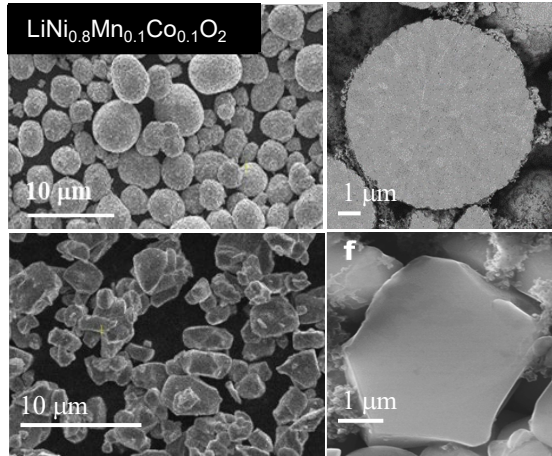
- Protect electrodes applying passivating coatings
- Use alternative electrolyte salt to prevent fluorine ion formation

Understanding electrode/electrolyte interfaces



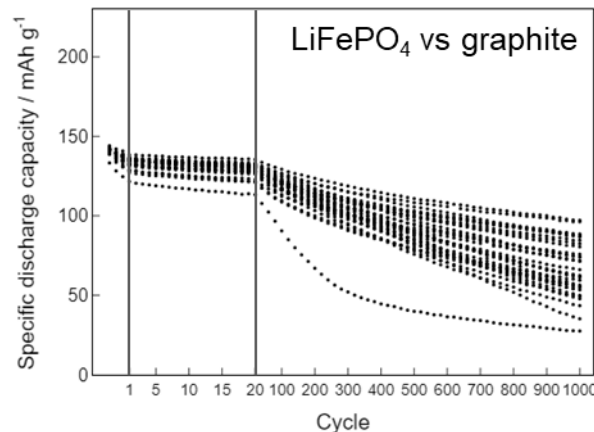
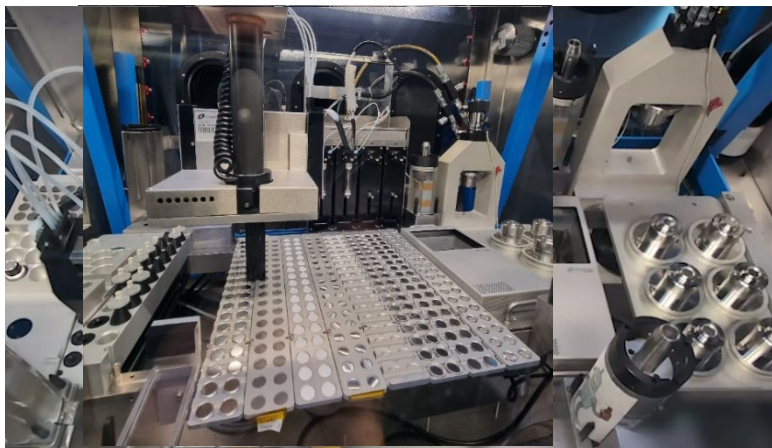
- Operando transmission electron microscopy in electrochemical cell
- Observation of solid electrolyte interphase formation in real time

Understanding electrode/electrolyte interfaces



- Excellent cycling stability with single-crystal cathode materials
- ~1 million miles battery

Accelerating battery research



collaboration w/
Chemspeed Technologies



collaboration w/
Prof. N. Marzari EPFL
Dr. G. Pizzi PSI



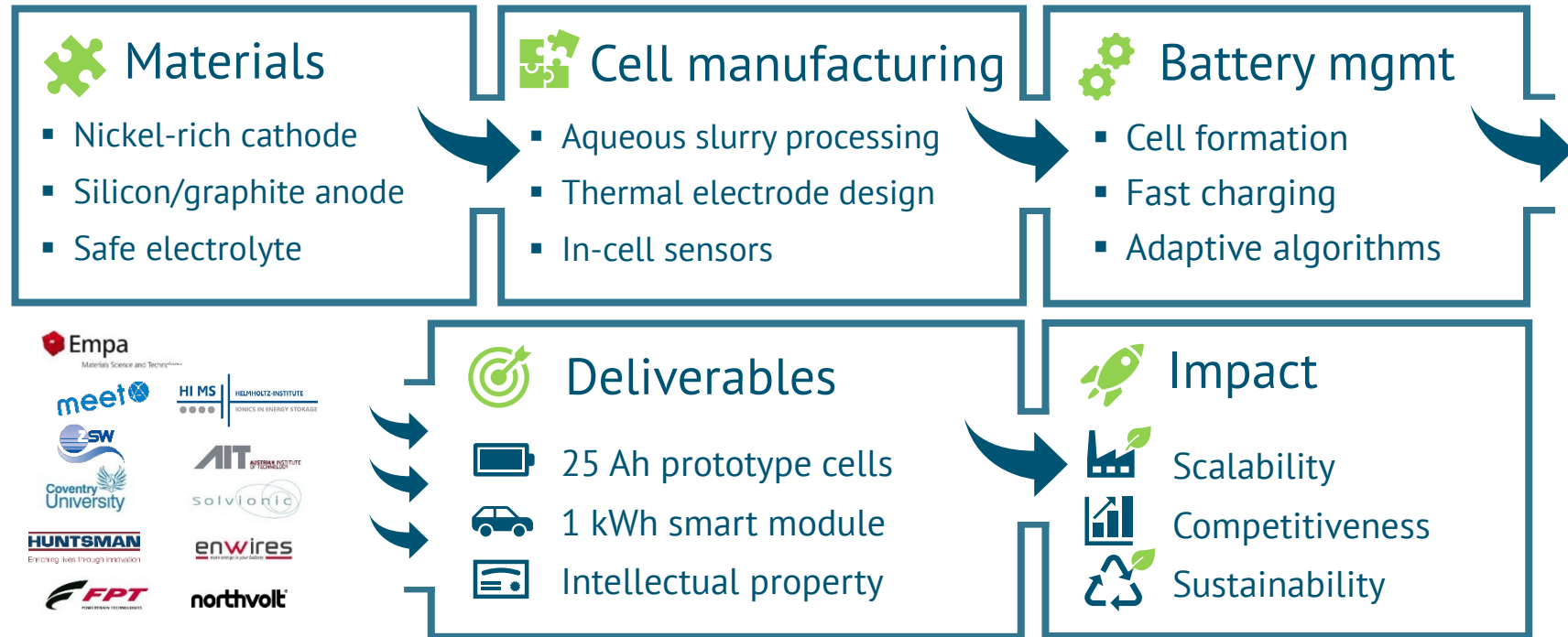
collaboration w/
ETH openBIS team

- Towards autonomous battery materials discovery
- Robotic platform for automated electrolyte formulation, cell assembly, and cell cycling
- Automated digital workflow and data management infrastructure



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957189

SeNSE innovation chain at a glance



€ 10.3 m EUR 02/20 - 01/24



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875548.



Website

www.sense-battery.eu



Twitter

@H2020SeNSE



Email

info@sense-battery.eu

SeNSE innovation chain at a glance

Materials

- Nickel-rich cathode
- Silicon/graphite anode
- Safe electrolyte



In addition to \$ 10 billion equity funding and subsidies, Sweden's Northvolt raises \$ 5 billion green loan to expand battery factories.

January 16 2024



Deliverables



25 Ah prototype cells



1 kWh smart module



Intellectual property



Impact



Scalability



Competitiveness



Sustainability

€ 10.3 m EUR 02/20 - 01/24



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875548.



Website



Twitter



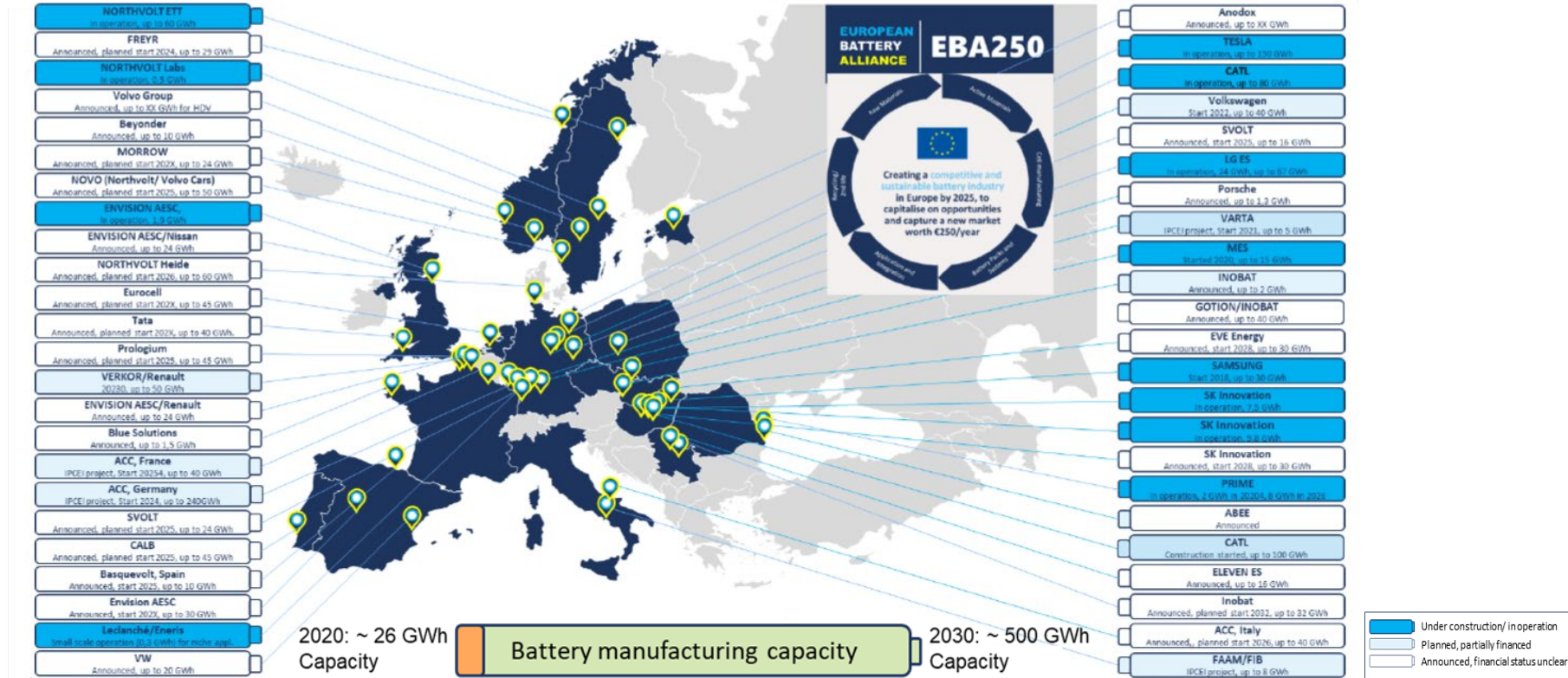
Email

www.sense-battery.eu

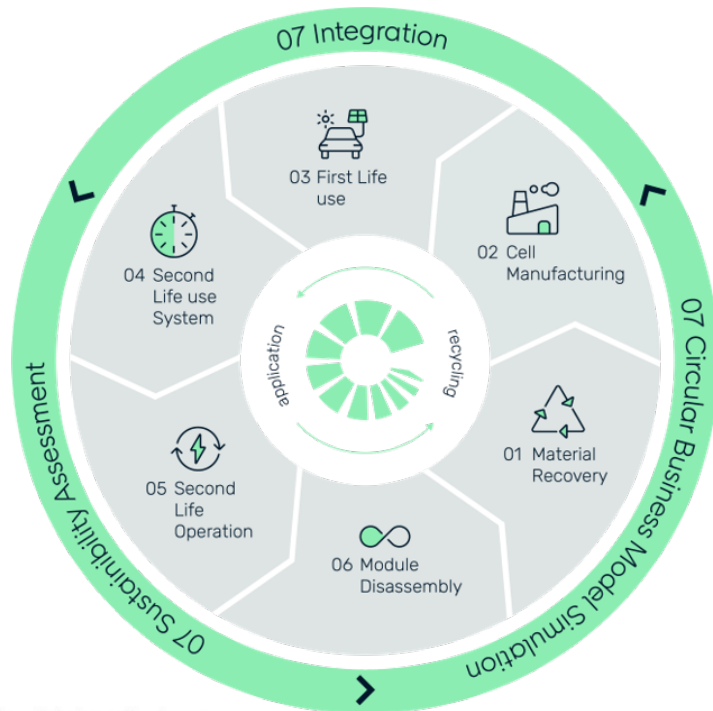
[@H2020SeNSE](https://twitter.com/H2020SeNSE)

info@sense-battery.eu

Battery gigafactories in Europe



adapted from European Battery Alliance



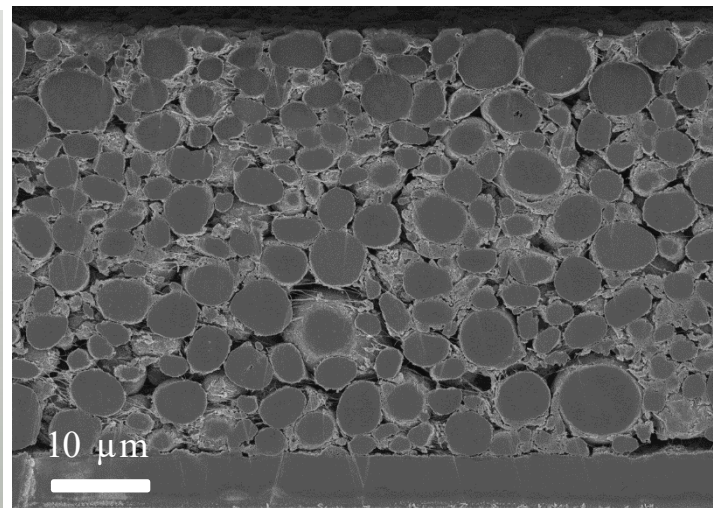
€ 7.5 m CHF 01/22 - 12/25

Establish a Swiss circular economy model for automotive lithium-ion batteries to reduce their ecological footprint.

Innosuisse - Swiss Innovation Agency

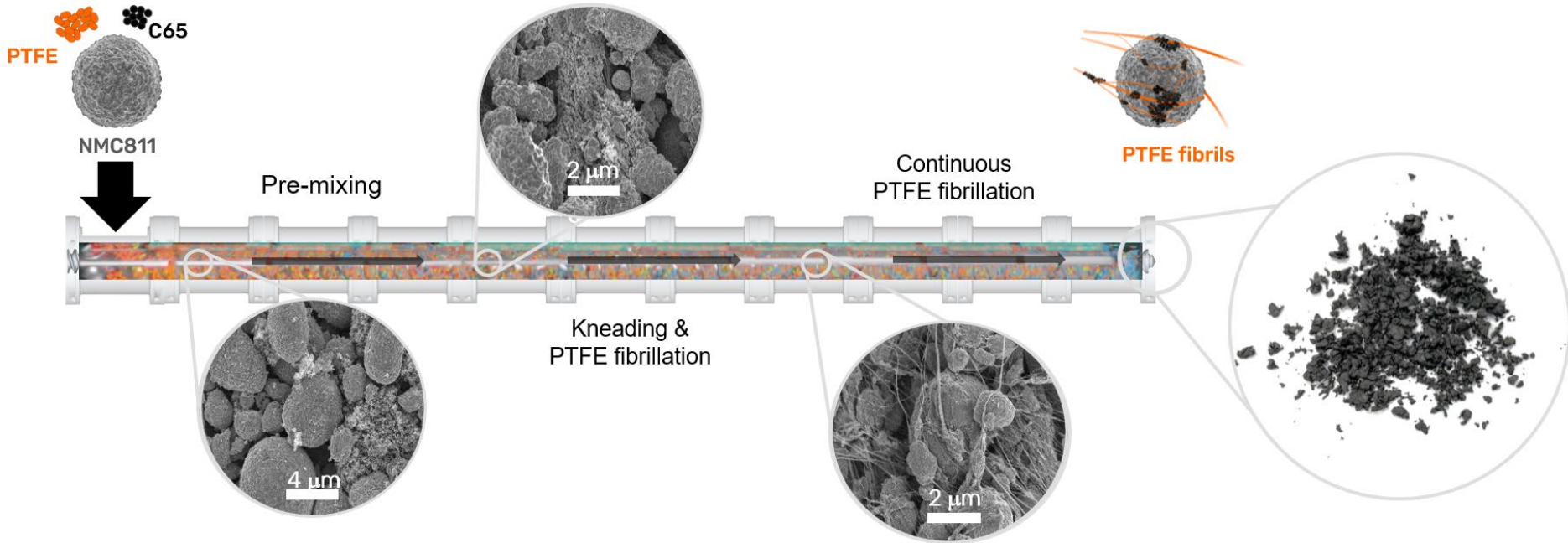
 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Sustainable battery manufacturing



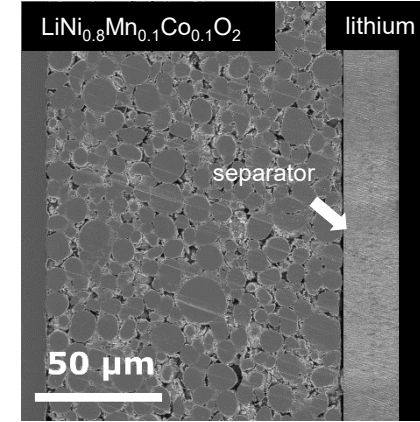
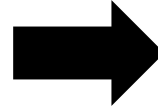
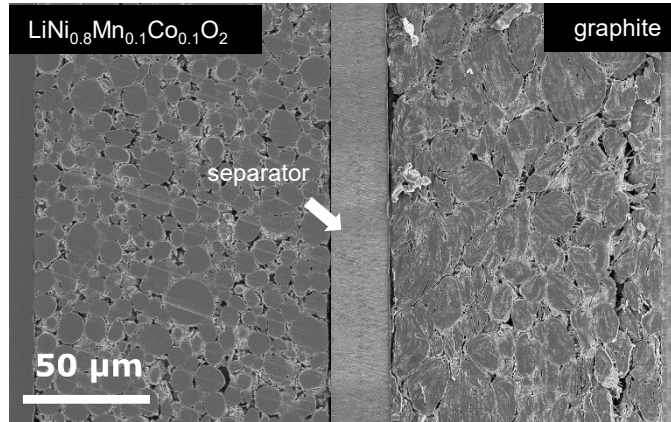
- Solvent-free mixing, calendaring, lamination
- Eliminates need for toxic solvents and the drying step

Sustainable battery manufacturing



- Already scaled to 150 kg/h corresponding to 1 GWh/y
- Reduces CO₂ footprint of cell manufacturing by 20%

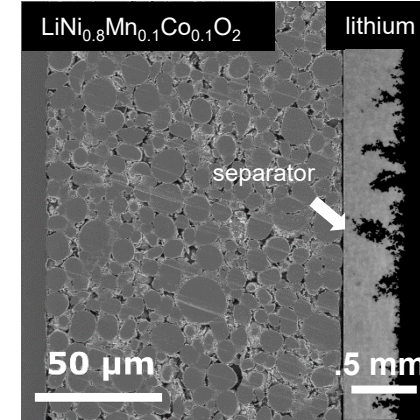
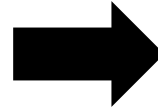
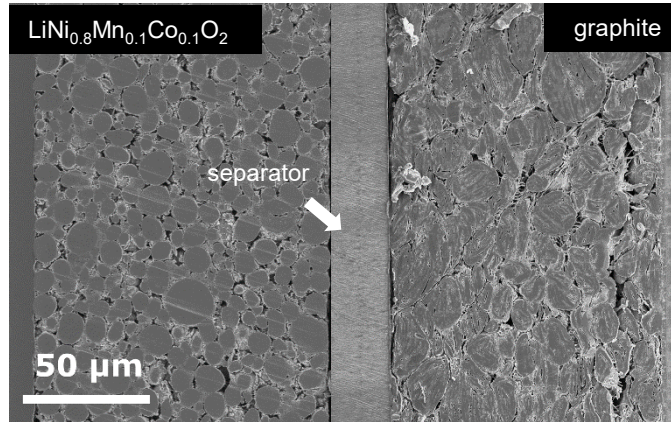
The next big thing?



- 750 Wh/l with 3000 deep cycles
- Sustainability and cost

- 1200 Wh/l with 3000 deep cycles
- Challenge fast charging

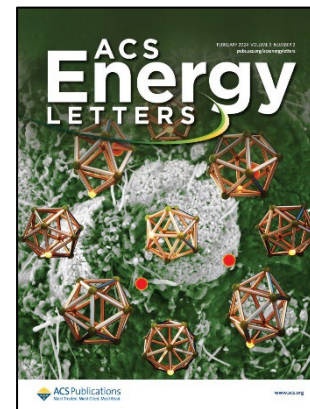
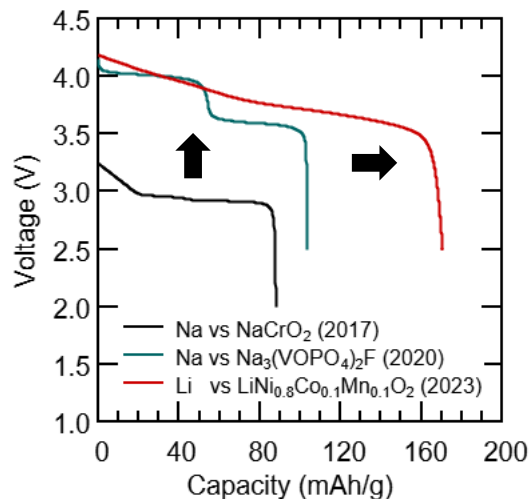
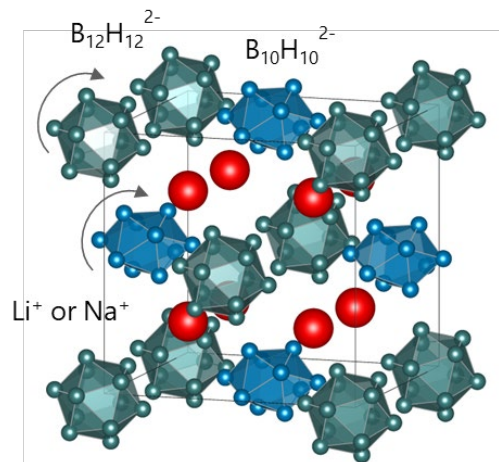
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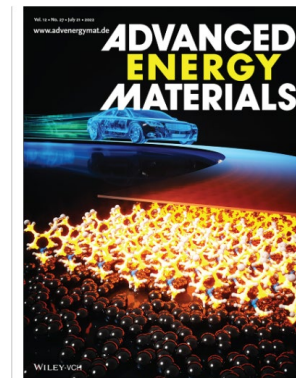
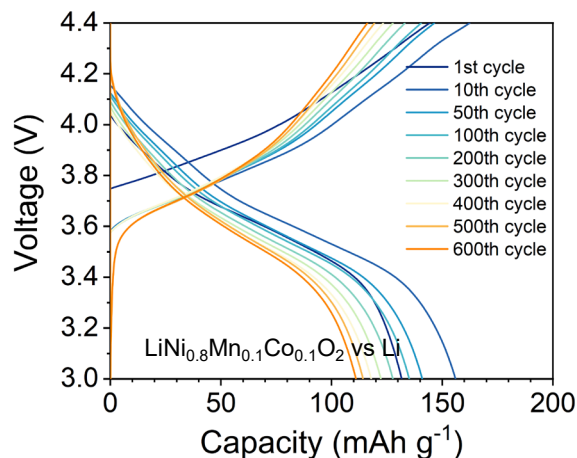
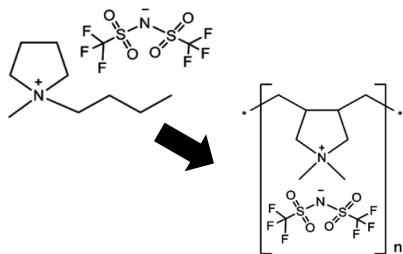
Solid-state batteries



Braun et al. ACS Energy Lett. 2024, 9, 707

- Solid electrolyte based on hydroborate salts
- 70% capacity retention after 1000 cycles
- Built-in interface passivation functionality
- Patented infiltration process

Solid-state batteries



Fu et al. Adv. Energy Mater. 2022, 2200412

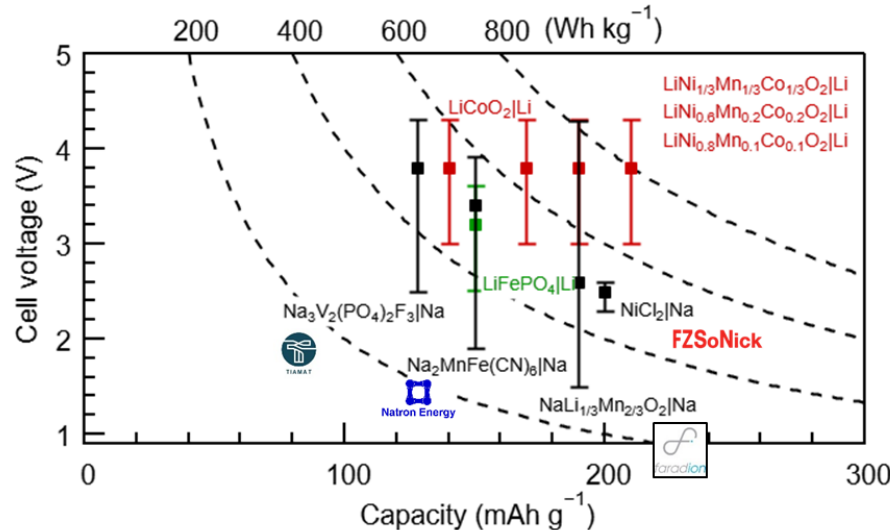
- Solid electrolyte based on polymerized ionic liquids
- Enables solid-state lithium metal batteries with $>1000 \text{ Wh/l}$
- 72% capacity retention after 600 cycles

collaboration w/
Solvionic



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875557

Lithium-ion vs sodium-ion batteries



- How to eliminate lithium, cobalt, and nickel?
- Sodium-ion batteries are a viable option for electric vehicles and enter mass production



SWISS BATTERY ASSOCIATION

Annual Conference

The 6th iBAT Annual Conference will be held on **October 29, 2025** at **Dätwyler** in **Altdorf**.
A unique opportunity to network with the Swiss stakeholders along the battery value chain.

Opening & Welcome

Prof. Dr. Corsin Battaglia, iBAT President

Urban Camenzind, Volkswirtschaftsdirektor Kanton Uri

Volker Cwielong, CEO Dätwyler

Keynote Talk

Dr. Adrian Spillmann, Bühler Group and Upcell Alliance – Current status of the European battery industry and the role of Bühler as an equipment supplier

Challenges for Electrified Public and Heavy-Duty Transport

Markus Erdmann, Designwerk – Heavy truck and utility vehicles

Johannes Wilhelmer, Stadler – Battery train and locomotives

Nicolas Amacker, Hess – New eBus generation

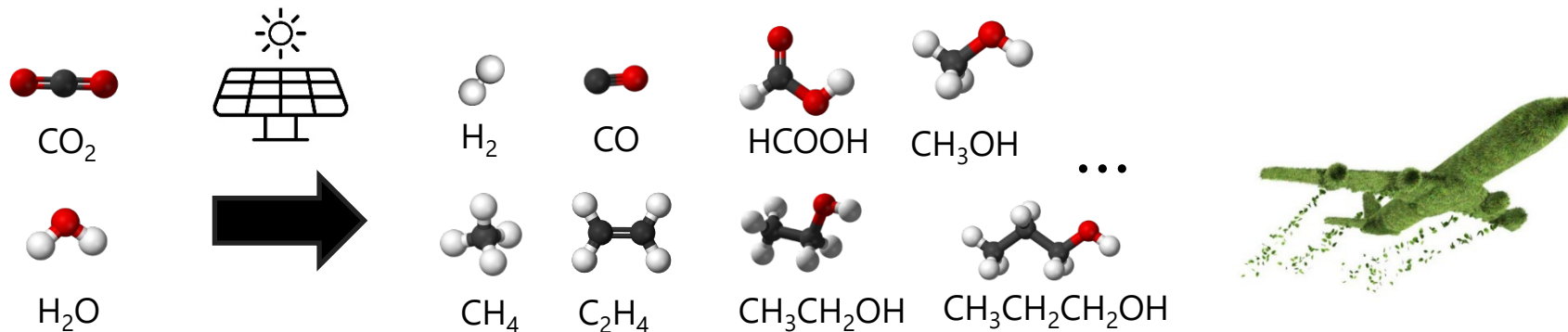
Safety of Lithium-Ion Batteries

Dr. Olivier Caumont, Blue Solutions – Solid-state battery safety considerations

Prof. Dr. Olivier Délémont and Stéphane Jacot-Guillarmod, Université de Lausanne – Lithium batteries in fire investigation

Andreas Achermann, SUVA – Battery safety on construction sites in enclosed spaces and during tunneling work

Electrochemical CO₂ reduction



- Sustainable non-fossil platform chemicals
- Enable synthetic fuels and feedstocks for plastics industry
- Understand and control catalyst selectivity

From science to market

iBATT

ALISTORE

upcell

BATTERY
2030

BEPA
Batteries European
Partnership Association

Synthetic fuels
for long distance
and long time scale

Green
batteries
(GenX)

Solid-state
batteries
(Gen4)

Li-ion
batteries
(Gen3b)

Empa
Materials Science and Technology

TRL

SNSF, SFOE, InnoSuisse
ETH Board, Horizon Europe,
Metrohm and Göhner Foundation

Contact
corsin.battaglia@empa.ch We have open PhD and postdoc positions!

