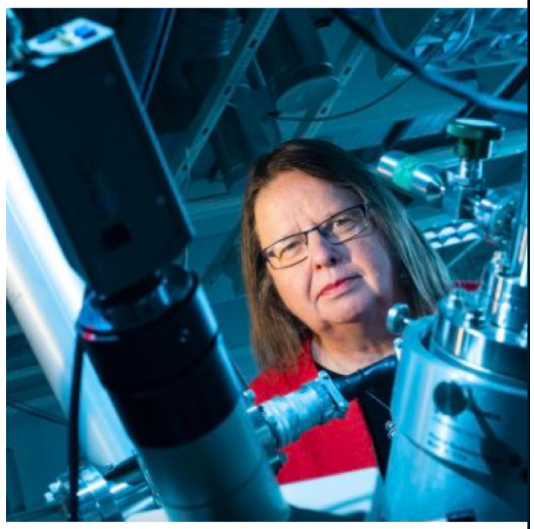
LENS LEAGUE OF ADVANCED EUROPEAN NEUTRON SOURCES

The Game Changer for Energy Storage: BATTERY 2030+



Kristina Edström: Project Coordinator, BATTERY 2030+; Prof. of Inorganic Chemistry, Uppsala University

brightness²

BrightnESS² is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 823867

BATTERY 2030+

At the heart of a green and connected society

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

A Large-Scale Research Initiative on Future Battery Technologies

Director: Prof. Kristina Edström, Uppsala University, Sweden

Kristina.edstrom@kemi.uu.se

Deputy director: Dr. Simon Perraud, CEA, France

BATTERY 2030+

WHY EUROPE SHOULD ACT NOW?

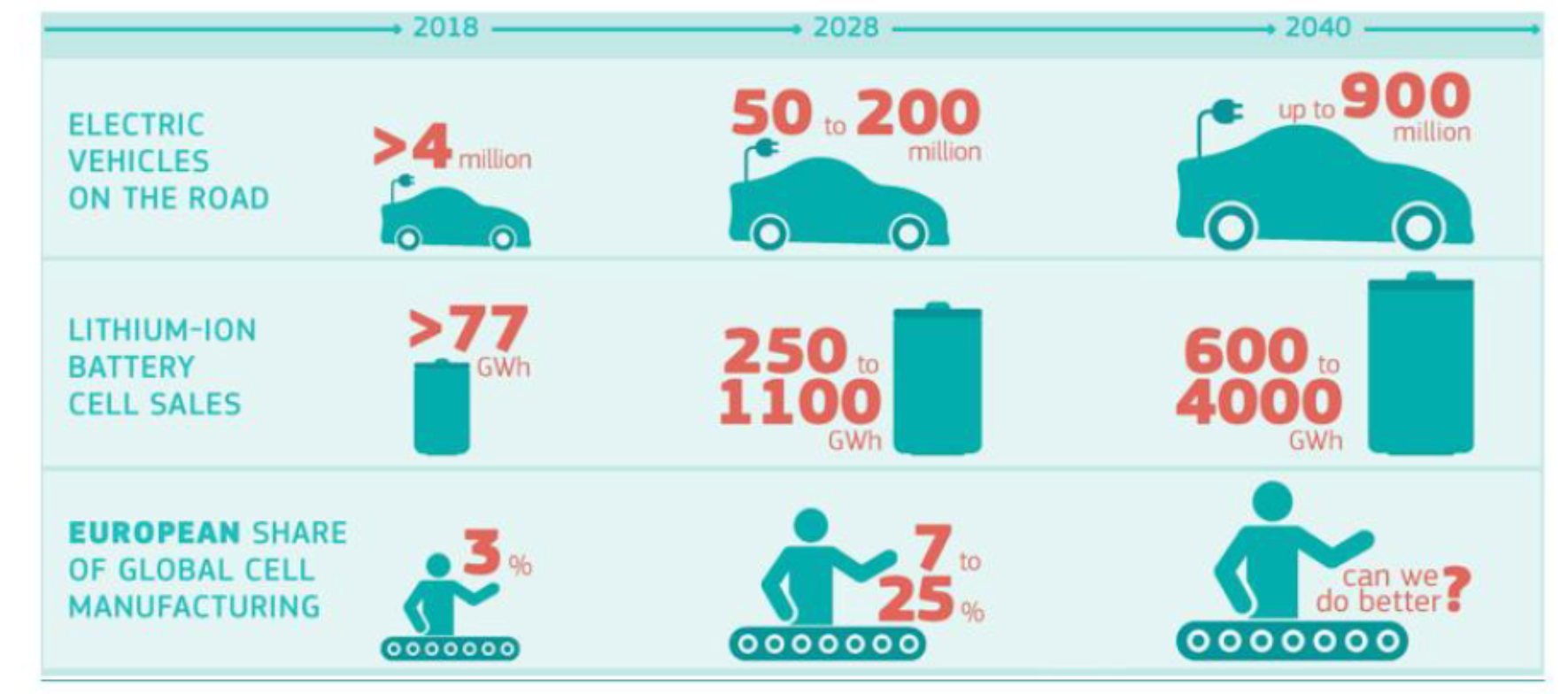
European Green Deal by 2050

Fossil-free society 2050

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

BATTERY 2030+

KEY TECHNOLOGY FOR A CLIMATE NEUTRAL EUROPE



Global supply and demand of Li-ion batteries and the European share inmanufacturing. Source: JRC April 2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

BATTERY 2030+

WHAT IS BATTERY 2030+?

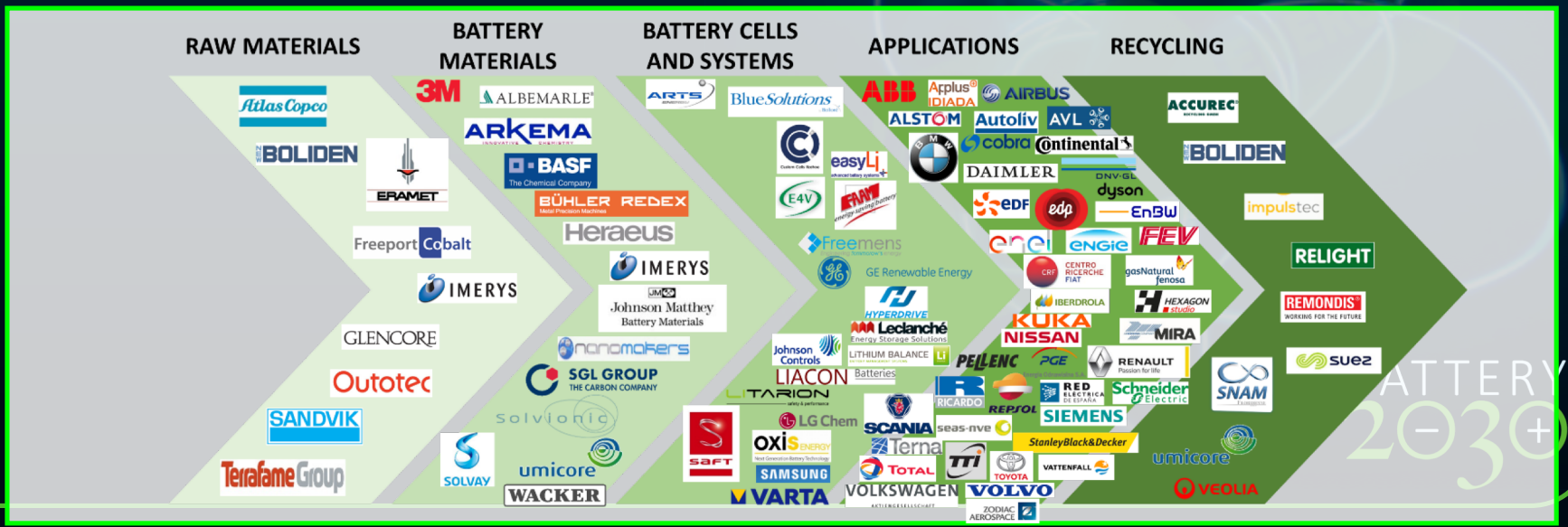
Core group

UPPSALA UNIVERSITET · cidetec · WWU MÜNSTER · JÜLICH FORSCHUNGSZENTRUM · POLITECNICO DI TORINO · NATIONAL INSTITUTE OF CHEMISTRY · VUB VRIJE UNIVERSITEIT BRUSSEL · cea · DTU · SINTEF · cnrs · Fraunhofer · KIT Karlsruher Institut für Technologie · EMIRI · RECHARGE · EASE · absiskey

Supporting organizations

ALISTORE European research institute · EERA European Energy Research Alliance · eit InnoEnergy · eit RawMaterials · earpa · EUROBAT · EGVI European Green Vehicles Initiative · Tyndall National Institute · CLEPA · KLiB Kompetenznetzwerk Lithium Ionen Batterien · PolStorEn · ENERGIE RS2E Réseau sur le stockage électrochimique de l'énergie · Swedish Electromobility Centre · CIC energiGUNE energy cooperative research centre · eucar · ENEA · imec

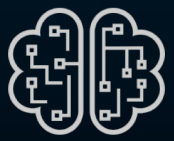
Industry (90+ companies belonging to the core or supporting organizations)



A LARGE-SCALE & LONG-TERM RESEARCH INITIATIVE

- Inventing the batteries of the future
- Providing breakthrough technologies to the European battery industry across the full value chain
- Enabling long-term European leadership in both existing markets (road transport, stationary energy storage) and future emerging applications (robotics, aerospace, medical devices, internet of things, …)

Ultrahigh performances



Smart functionalities

Environmental sustainability

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

BATTERY 2030+

WHAT BATTERIES?

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

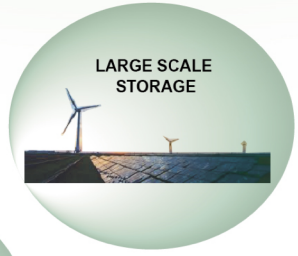
Understand interfaces to prolong battery life

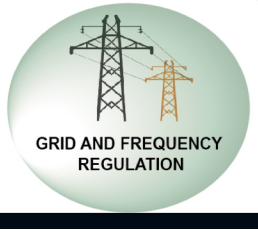
Recyclability of new batteries

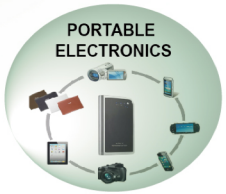
Smart battery functionalities to increase safety and mitigate ageing phenomena

Upscalability and manufacturability of new concepts

Accelerate the discovery of materials to enhance battery performances







Innovation

Society Acceptance

System integration

Raw materials

Cost regulations

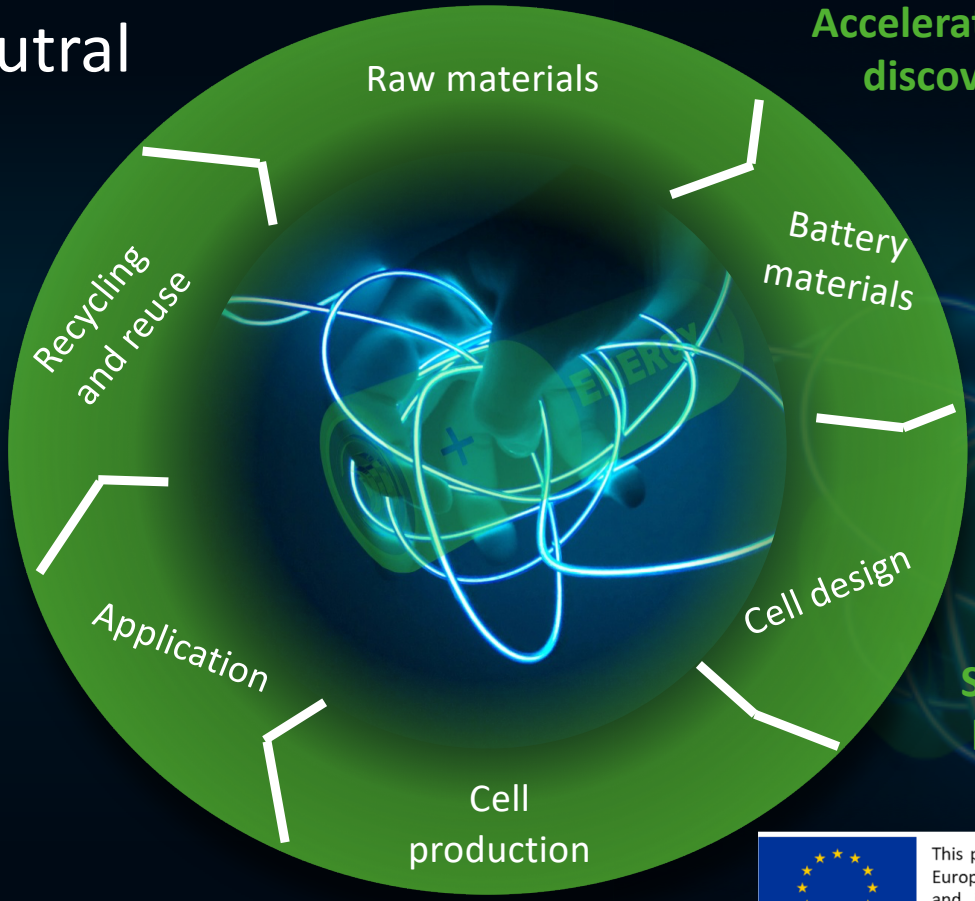
Education

Environment

BATTERY 2030+

NOVEL CONCEPTS ALONG THE FULL VALUE CHAIN

Chemistry neutral approach



Accelerated materials discovery (MAP)

Energy & power densities approaching theoretical limits

Establish the computational "**Battery Interface Genome**":

Smart sensing and **self-healing** functionalities

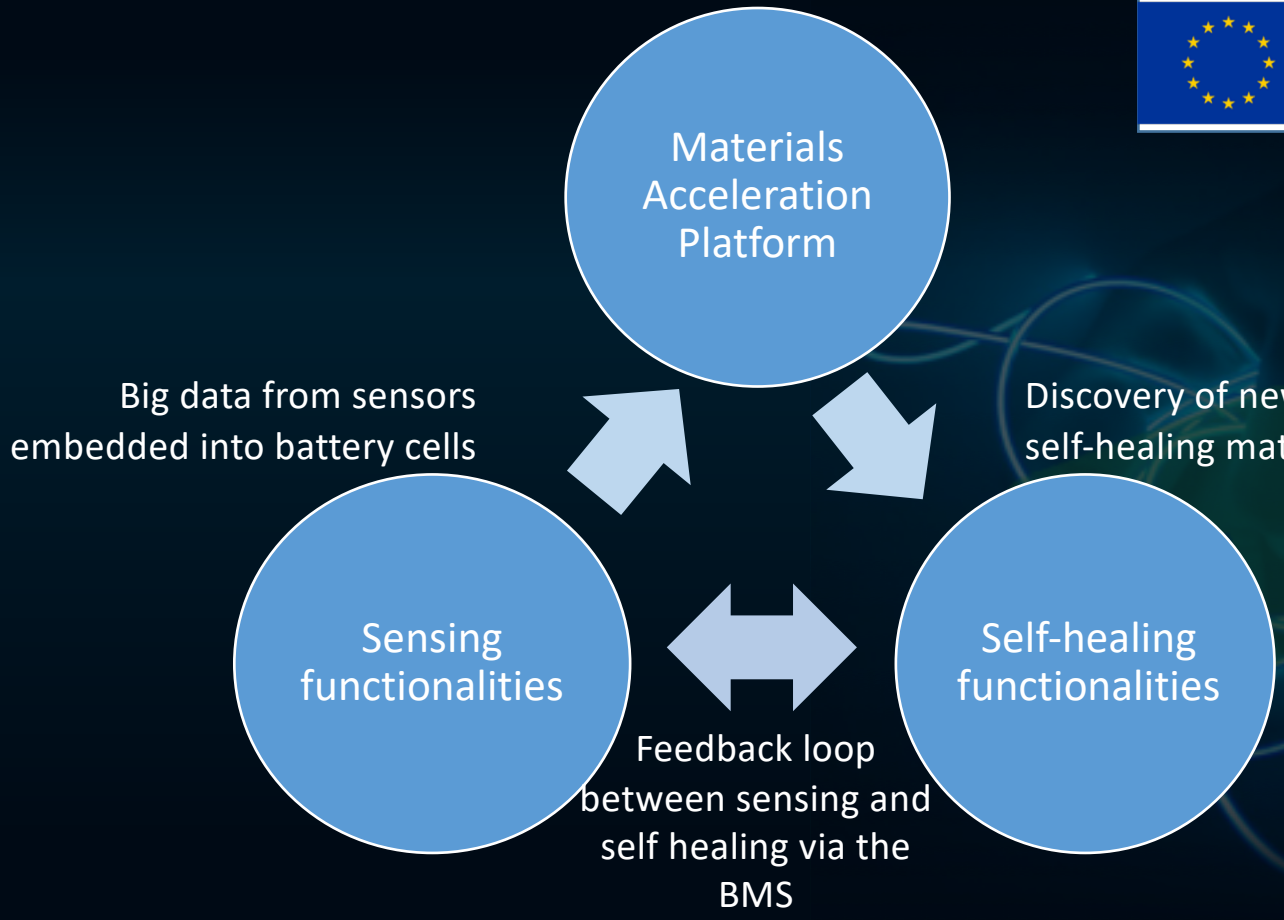
Manufacturability and **recyclability** are cross-cutting topics for battery technologies to be developed

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

BATTERY 2030+

TOWARDS AN INTEGRATED APPROACH FOR THE BATTERIES OF THE FUTURE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.



BATTERY 2030+

TO ACCELERATE MATERIALS DISCOVERY

We combine modelling tools and high-throughtput techniques to discover the best battery materials and how they behave in a battery cell

We collaboration and utilization of large scale facilities in Europe: Neutron Scattering Facilities and Synchrotron Facilities as well as high throughput computing (Euro HPC)

Synthesis

Electrochemical performance

Structural changes and PDF-studies

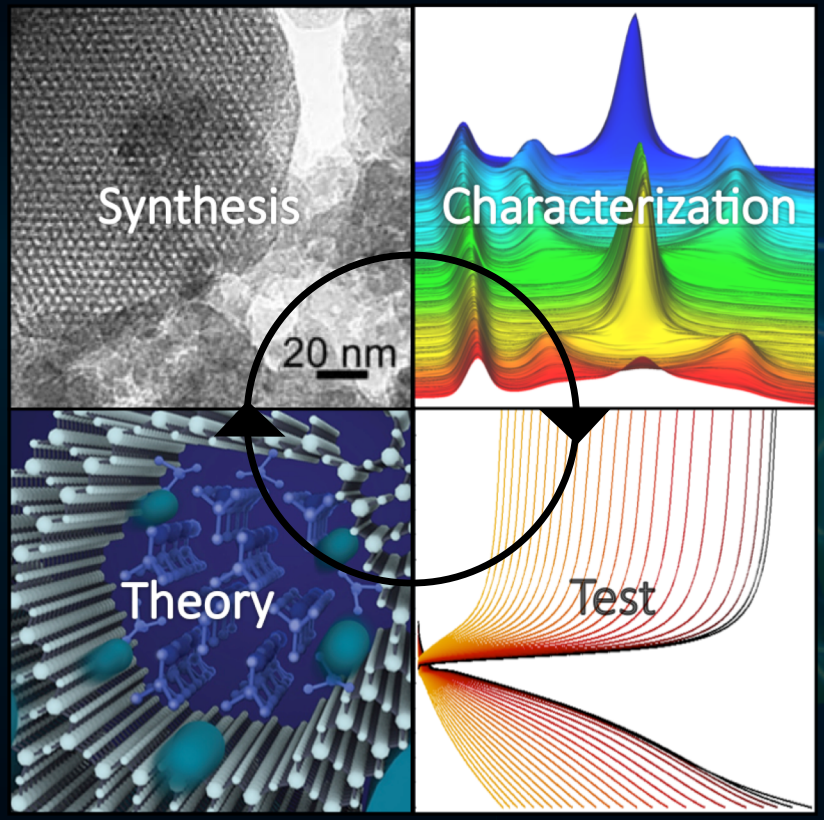
Imaging and tomography

Interfacial reactions in batteries

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

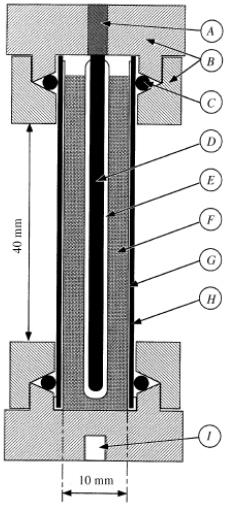
BATTERY 2030+

A CIRCULAR DESIGN LOOP

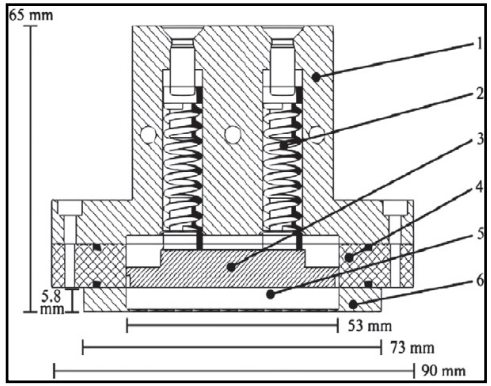


BATTERY 2030+

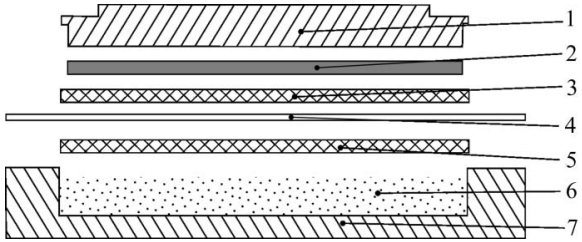
EXAMPLES OF NEUTRON DIFFRACTION CELLS

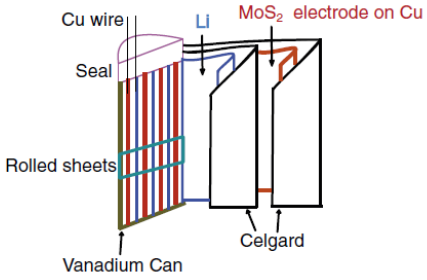


Ö. Bergström et al., J. Appl. Cryst. 1998

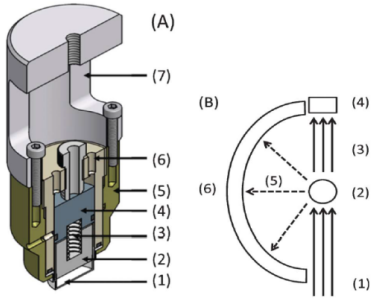


F. Rosciano et al., *J. Appl. Cryst.* 41 (2008) 690-694.





N. Sharma et al. / Solid State Ionics 199–200 (2011) 37–43



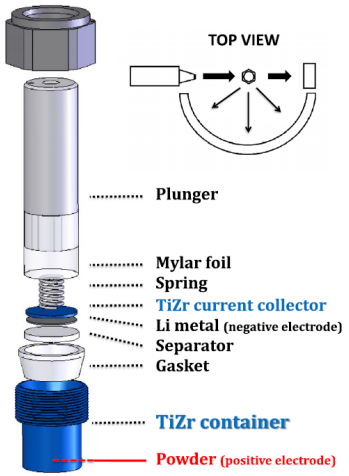


Figure 1. Description of the electrochemical cell designed for in-situ or *operando* neutron diffraction.

M. Bianchini et al., J. Electrochem. Soc. 2013

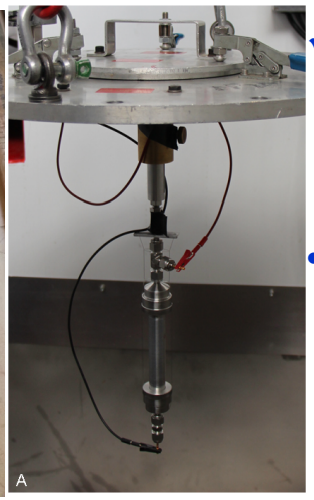
BATTERY 2030+

STRONG DEVELOPMENT THE LAST YEARS

Work performed at ISIS, Rutherford Appleton Lab

Coin-type Cell Design:

- ✓ 350-400 mg active feasible, to ~1-5 mg of other components
- ✓ Cheaper! Only ~50-100 µl of deuterated electrolyte
- Smaller d-space range accessed



Wound Cell Design:

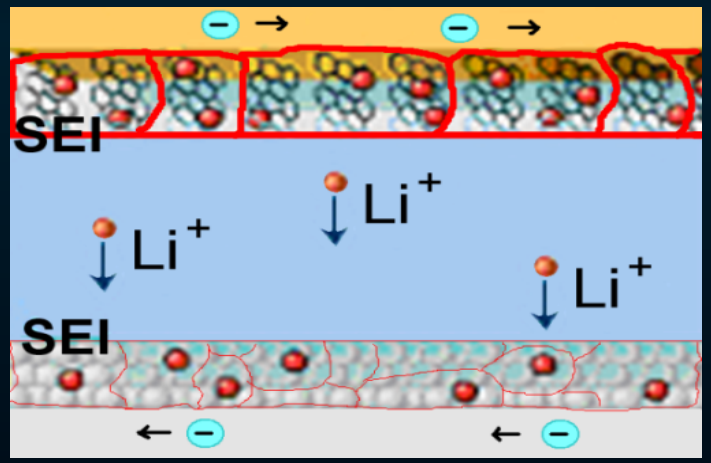
- ✓ Can utilise all detector banks on POLARIS (larger d-range).
- Larger cell (up to 4 g), other components also increased (~10 ml deuterated electrolyte)

BATTERY 2030+

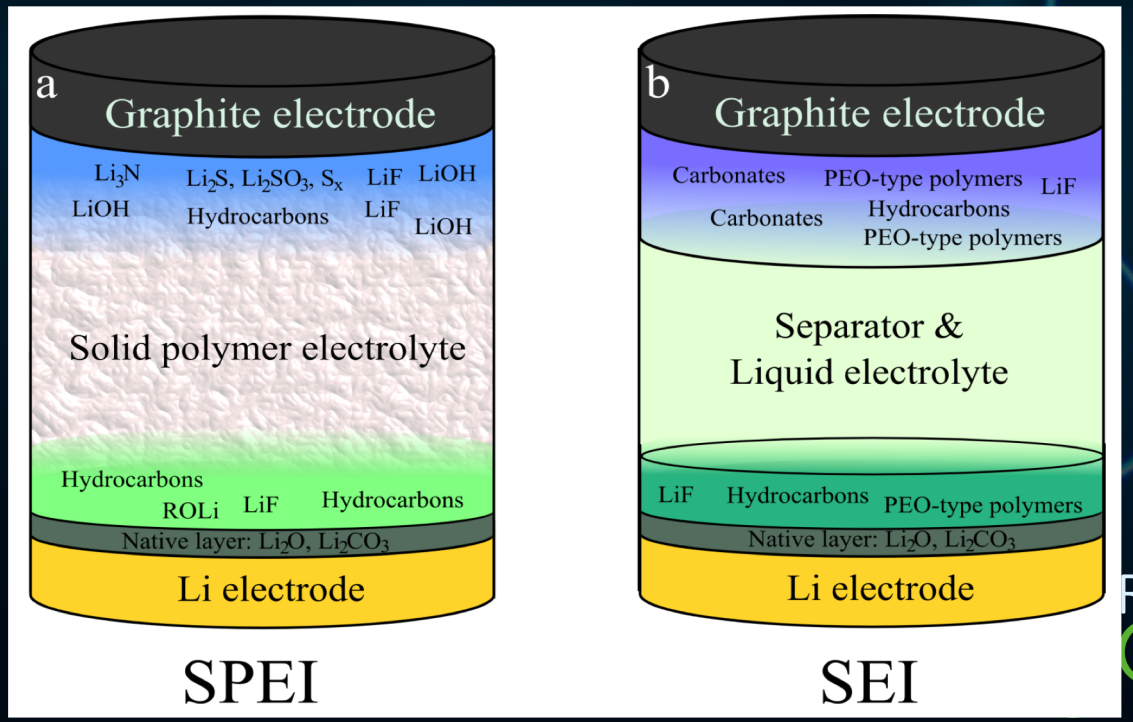
TO UNDERSTAND SMART FUNCTIONALITIES

Interface characterisation

How are interfaces formed? How do they evolve as a result of battery cycling? How can they be stabilized to increase the safety of the battery?



From my own work



ACTIONS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

Starting soon:

1) Materials Acceleration Platform/Interface Genome — 20 M Euro for one project
2) Sensors — 10 M Euro for 2-4 M Euro projects
3) Self-healing — 10 M Euro for 2-4 M Euro projects
4) CSA — 2 M Euro for three year CSA
5) **M-ERA NET 5M Euro from the commission and at least 10 M Euro from member states**

Competences in materials, characterisation, modeling at different length-scales, sensors, AI, machine learning, polymer chemistry, recyling, BMS, how to adapt batteries in an application, etc…

BATTERY 2030+

BATTERY 2030+

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

We create a BATTERY 2030+ research roadmap for a large-scale and long-term initiative

We support Europe to reach the sustainability goals

We develop European research excellence to the benefit of European battery industry, along the full battery value chain

We suggest new R&I actions

BATTERY 2030+

ACKNOWLEDGEMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 854472.

http://battery2030.eu

Twitter: 2030battery

Linkedin: batteryinitiative

BATTERY 2030+