



HYDRA

Hydra Project Overview



This project has received funding from the European Union's Horizon 2020 innovation programme under grant agreement number: 875527



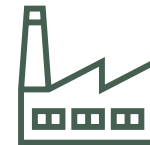
Like the mythical beast, HYDRA will take a multi-headed approach to develop the next-generation of high-energy and low-cost Li-ion batteries.



**Hybrid
Materials**



**Model-Based
Design**



**Advanced
Manufacturing**



Sustainability



HYDRA will develop Generation 3b Li-ion batteries

- **Energy density: > 750 Wh L⁻¹**
- **Cost: < 90 € kWh⁻¹**
- **Max. Charging rate: 5C**
- **Max. Discharging Rate: 15C**
- **Cycle Life: 2000 deep cycles**
- **TRL 6 – Prototype tested in intended environment close to expected performance.**

Objective 1

Develop new **Co-free hybrid electrode materials & architectures**

Objective 2

Improve **environmental impact and ecological sustainability** of batteries

Objective 3

Enhance **manufacturing processes** for production of new materials

Objective 4

Ensure **fast commercial implementation** of project results





Hybrid Co-free electrode materials

Co-Free Cathode



Co-free cathode materials like LNMO & LFP help achieve stable & energy-dense cells.

High-voltage electrolytes stabilize the cathode interface and avoid excess SEI formation at Si anode interface.

Stable Si-C blends increase the capacity of the electrode & energy density of the cell.

Hybridized electrode materials and novel architectures help cell designers:

- **Balance the needs for energy & power**
- **Stabilize electrodes for long lifetime**
- **Create sustainable and affordable batteries**

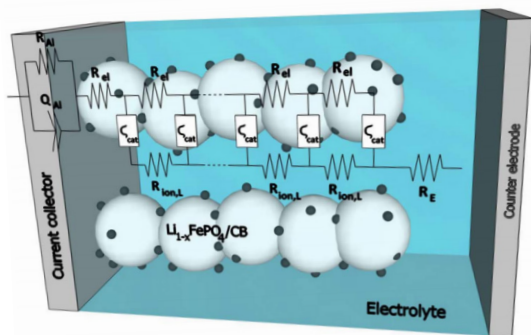




Model-based battery design

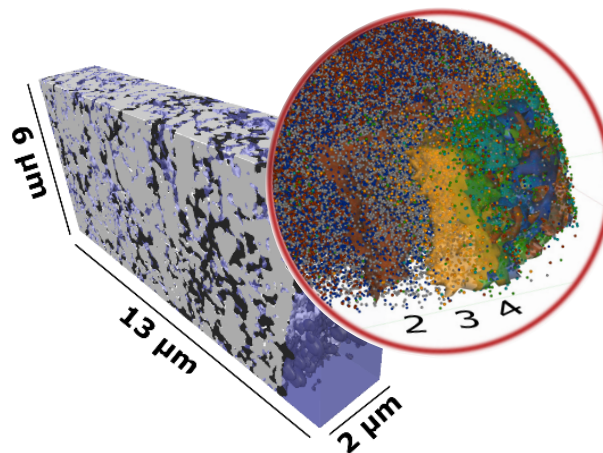
HYDRA will apply recent advances in model-based battery design to develop tools that help developers **understand material performance, optimize cell performance, and predict lifetime in real operation.**

Advanced EIS models for porous electrodes



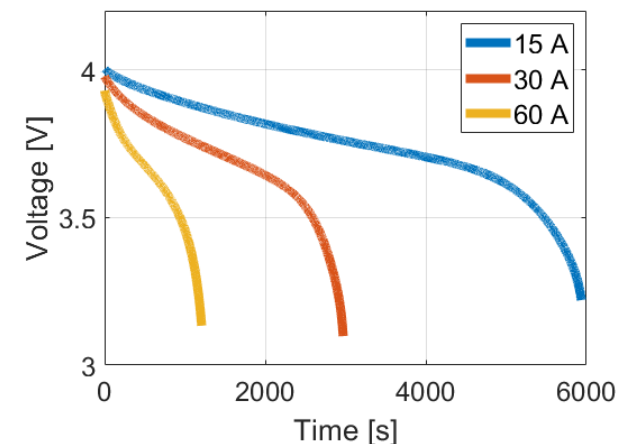
R. Scipioni et al, *Electrochimica Acta* 284 (2018) 454-468

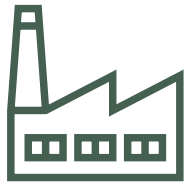
Sophisticated Material Characterization



R. Scipioni et al, *Applied Materials Today* 20 (2020) 100748

Theory-Based Continuum Modelling

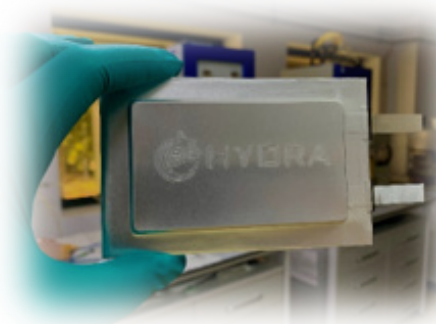




Advanced Manufacturing

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HYDRA has strong industry commitment across the value chain. The project will demonstrate pilot scale production, achieve TRL 6, and target a cost $< 90 \text{ € kWh}^{-1}$



Electrode
Materials

Electrolyte

Cells

Packs





Sustainability

Ecological and economic sustainability are important aspects of HYDRA, which will pursue a **CRM reduction of > 85%**

- **CRM reduction will help the European battery industry** keep up the momentum currently driving large-scale low cost electrification
- **Aqueous processing of cathodes** will reduce the need for organic solvents, saving cost and energy during the manufacturing process



Hybrid power-energy electrodes for next generation lithium-ion batteries (HYDRA)

Topic: Gen 3b Li-ion Batteries

Duration: 4 years (48 + 4 Months)

Budget: 9.4 million Euro

Coordinator: SINTEF

Partners: CEA, Corvus, DLR, Elkem, FAAM, ICSI, JM, POLITO, Solvionic, UCL, Uppsala University





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