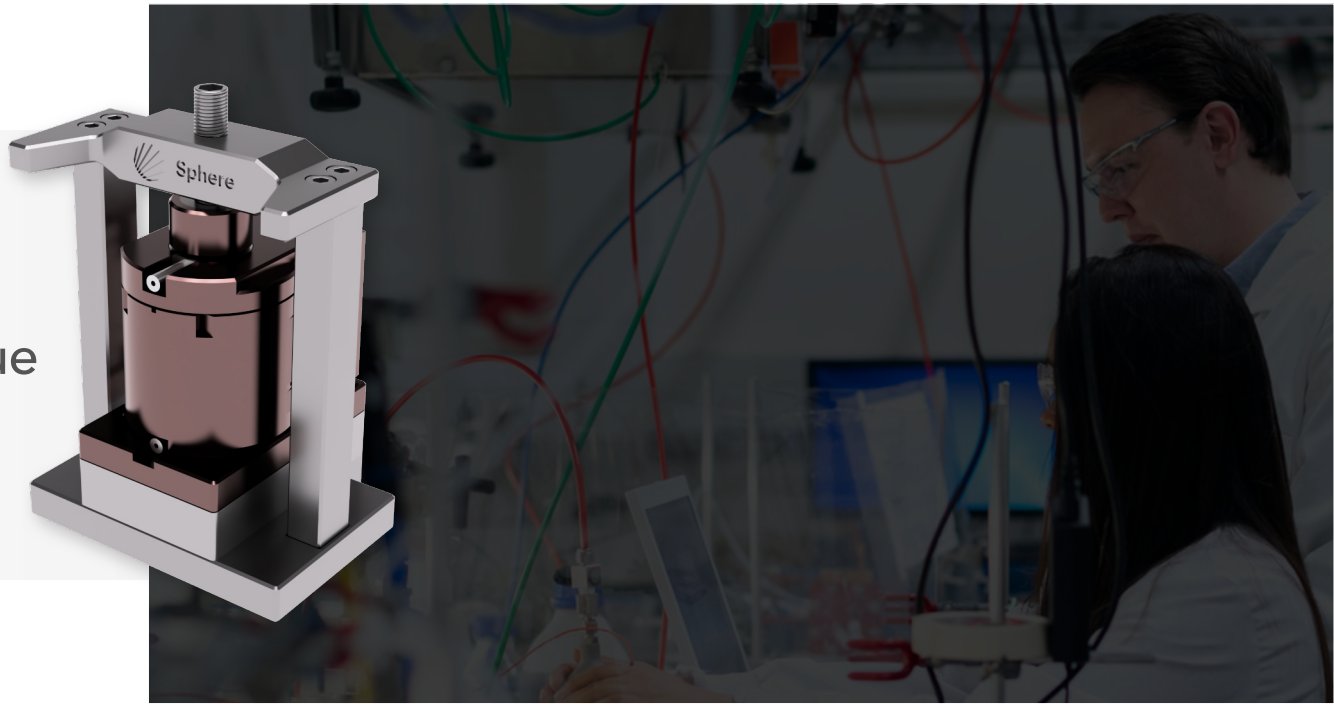
Sphere Energy

2021 Product Catalogue



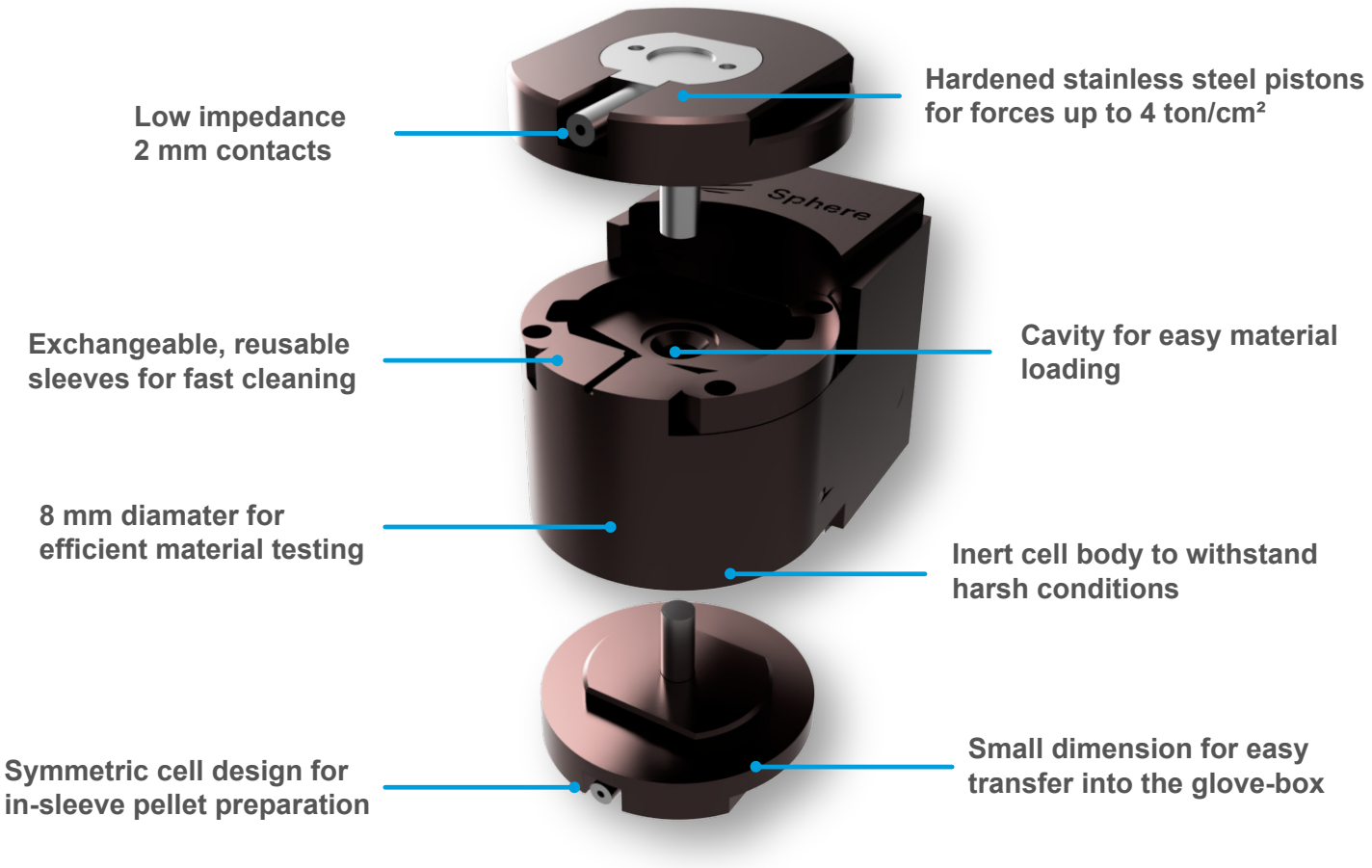
Advancing energy storage by accelerating your research

Efficient energy storage and conversion is key to a sustainable future.

At Sphere, our mission is to support academic and industrial R&D with the best test equipment and accelerate access to greener energy for everyone.

The ASC Family

The ASC Test-Cell for All-Solid-State Batteries



With the ASC-family, we created a set of battery test-cells that enable users to perfrom the most accurate and reproducible experiments, day after day.

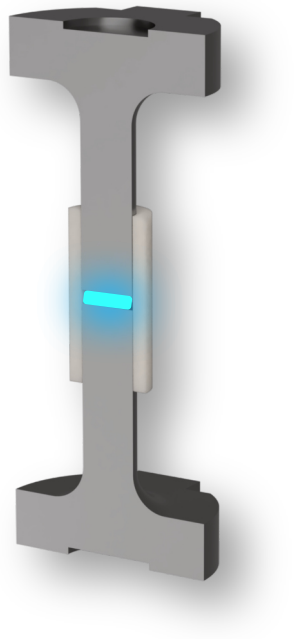
Powerful features to accomodate all of your testing needs

Access to all the parameters you need

We designed the **ASC-T, ASC-A**, **ASC-AD** and **ASC-Gas** to accompany the user from the material stack preparation, pellet densification from powders to high performance cycling under elevated temperatures or dynamic pressure balancing.

Pellets created exactly where they are measured

Battery materials, often powders, are loaded into an insulating sleeve (PEI or Al_2O_3) and compressed between two stainless steel pistons - where force is applied via a pressure frame and controlled via a pressure sensor. It was important for us to have the pellet created exactly where it is measured to eliminate the risk of damaging the pellet when removing it from the die.



No cross-contamination or short-circuiting

To address the challenges of cross-contamination and short-circiuting, we made the ASC symmetric, allowing the user assemble the material stack layer by layer from both openings of the cell (top or bottom).

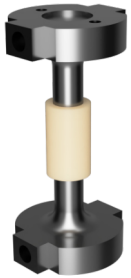
High-temperature resistant

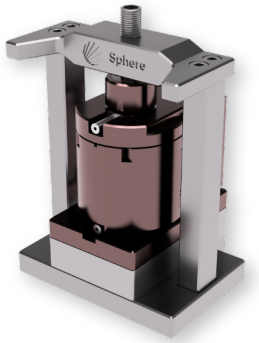
With the Al_2O_3 sleeve, sintering of the materials in an oven at temperatures up to to 1200°C is no problem. Both, the PEI and Al_2O_3 sleeves are exchangeable and easy to clean, giving the user the freedom to choose when its time to change.

Live pressure monitoring

When the sample is ready for electrochemical testing, the stacking pressure can be live monitored and logged via the control box to understand potential expansion and contraction of your materials.

The ASC-T | For high precision analysis of solid-state battery materials





ASC-T cell, fully assembled in the pressure frame

With the ASC-T, we created a test-cell to control the two most important performance parameters for electrochemical investigation of all-solid-state-battery materials - the mechanical pressure and the temperature applied to the material stack.

The ASC-T cell fits in the pressure frame, to accurately control the stacking ressure during pellet formation but also during electrochemical cycling, to better understand potential expansion and contraction of materials. The stacking pressure can be monitored live and logged via our control box.

The built-in heating element, pointing directly at the insulating sleeve and the material stack, assures efficient and fast heating up to 200 °C - essential to find optimal conditions for each material.

To optimally identify the reactions at the anode/cathode, we equipped the ASC-T with an optional, metal based (Cu, Al, Ni, Stainless steel) 3rd electrode. This reference electrode can be simply inserted into the electrolyte material, during the in-sleeve pellet preparation.

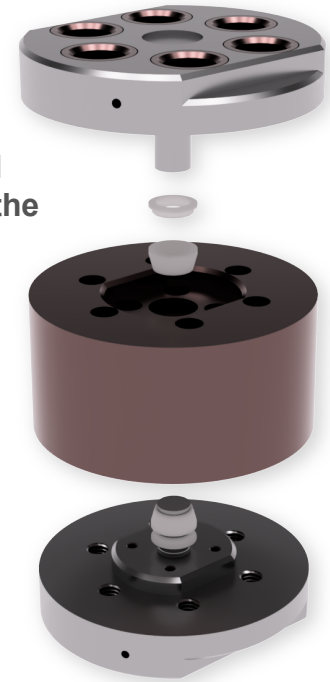
Technical details:

- 8 mm interior diameter
- Max. stacking pressure up to 4 tons/cm²
- Pressure resolution of approx. 200 g/cm²
- The applied pressure is monitored by an analogical output (0-10 V)
- Heating up to 200° C
- Metallic reference electrode (Cu, Al, Ni, Stainless steel)

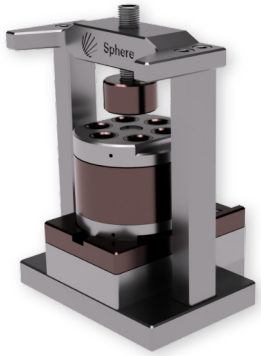
The ASC-A | For material screening outside the glovebox

For the ASC-Airtight, we kept the design as simple as possible for easy assembly and fast screening of materials. With the ASC-A, you have all you need for the inital electrochemical analysis of air-sensitive materials outside the glove-box.

The ASC-A is hermetically sealed and mechanical pressure can be applied on your material stack via the torque screw system or, for more accuracy and live monitoring, via the pressure frame.



Fully assembled

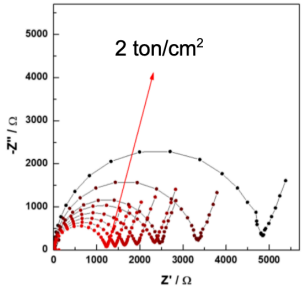


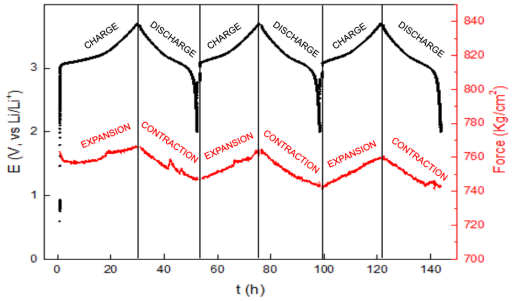
In the ASC pressure frame

Unassembled

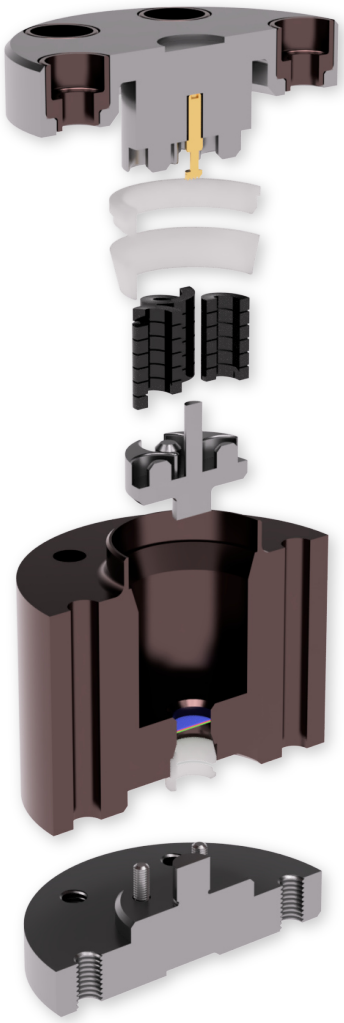
Technical details:

- 8 mm interior diameter.
- Max. stacking pressure up to 4 tons/cm²
- Hermetically sealed by ferrules.
- PEI exchnagable interior sleeves
- Temperature resistant up to 120°C





The ASC-AD | For dynamic pressure compensation



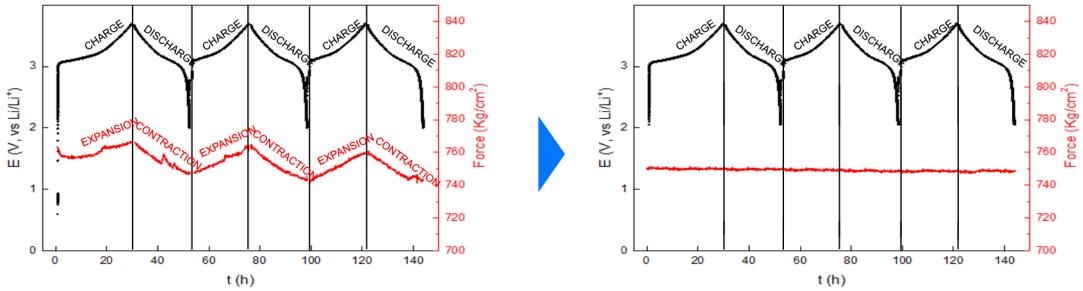
The ASC-Airtight Dynamic offers an active pressure balancing system for high performance during long-term cycling.

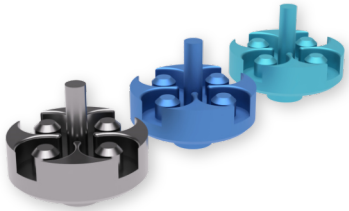
The four-spring design ensures that the initially set stacking pressure is kept constant and any expansion or contraction of the tested materials is balanced.

This ensures optimal conditions for long-term electrochemical cycling.

Technical details:

- 8 mm interior diameter
- Max. stacking pressure up to 2 tons/cm²
- Active Pressure balancing
- Hermetically sealed by ferrules
- PEI/Al_2O_3 exchangable interior sleeves
- Temperature resistant up to 120°C





ASC-AD cross section

ASC-AD fully assembled

Various pistons for pressure adjustment.

The ASC-Gas | For in-situ analysis of gases released by battery materials

The ASC-Gas is based on the ASC-A, however also features a gas in/outlet that can be easily connected to any mass spectrometer. This enables simple in-situ analysis of gases released by the battery materials.

Compared to vertical gas collection via perforated current collectors, we designed the ASC-Gas for diagonal gas flow. This allows the user to ASC-Gas to maintain a high and consistent mechanical stacking pressure on the material stack via two solid, hardened steel pistons.

Technical details:

- 8 mm interior diameter.
- Max. stacking pressure up to 4 tons/cm²
- Hermetically sealed by ferrules
- PEI/Al_2O_3 exchnagable interior sleeves
- Temperature resistant up to 120°C
- Gas inlet and outlet
- Diagonal gas flow to maintain stacking pressure

The ASC-Set | Everything in the package

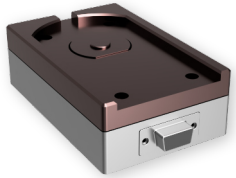
1x ASC- T
Advanced analysis

1x ASC-A
Screening

1x ASC-AD
Long-term cycling

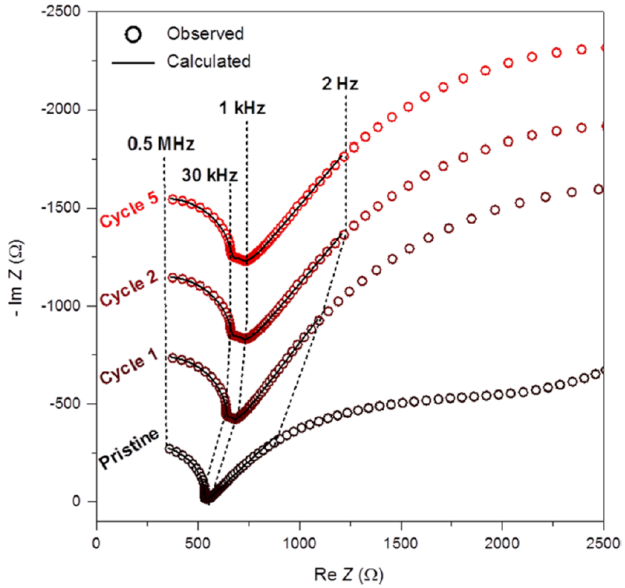
1 x Pressure frame
High mechanical stability
and compact design

1 x Control Box
Temperature control &
pressure monitoring

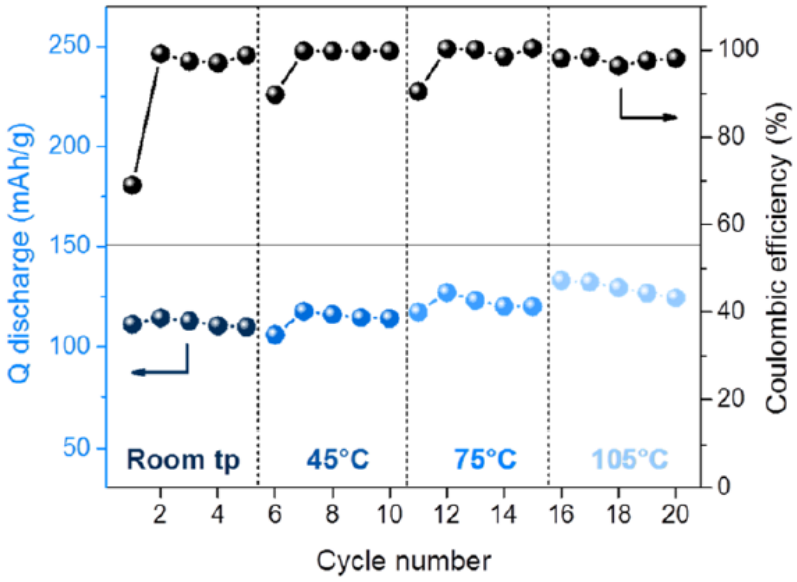


1 x Sensor box:
From 0 to 4 ton/cm²

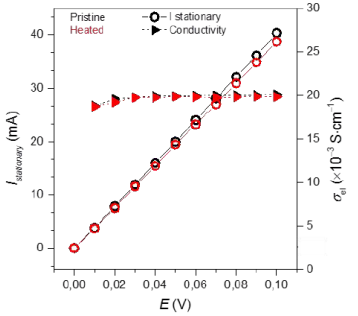
Impedance measurements during cycling



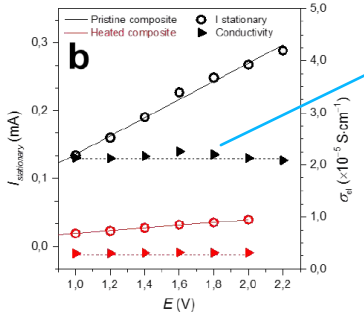
Electrochemical performance of SSB at different temperatures



LPS Based



LTFS Based



Ionic conductivity measurements under thermal treatment

Li-Rich Layered Sulfide as Cathode Active Materials in All-Solid-State Li–Metal Batteries
F. Marchini et al.
ACS Applied Materials & Interfaces 2020

The ASC-family overview

	ASC-T (Set)	ASC-A (Set)	ASC-AD (Set)	ASC-Gas
Adjustable elctrode distance	✓	✓	-	✓
Temperature control	✓	-	-	-
Pressure control & monitoring	✓	✓	-	✓
3rd electrode	✓	-	-	-
Hermetically sealed	-	✓	✓	✓
Dynamic pressure balancing	-	-	✓	-
Gas sampling	-	-	-	✓

Please contact us for a quote
info@sphere-energy.eu

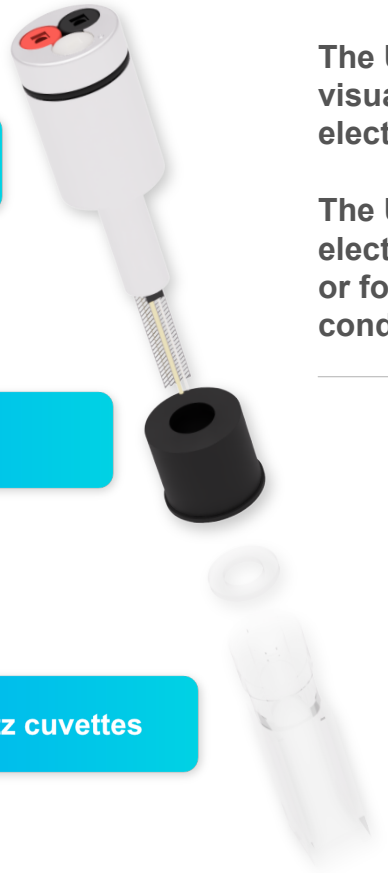
The UVC

The UVC | In-operando UV-vis setup

Large variety of electrode materials

Hermetic Sealing

High-quality Hellma quartz cuvettes



The UVC was designed to mimic a battery environment and visualize reactions happening in the electrolyte and at the electrode surface.

The UVC couples in-operando UV-Vis spectroscopy with your electrochemistry and enables screening for dissolving materials or forming degradation products in real time and under hermetic conditions.

Monitoring of the electrolytes

The UVS Set | Everything in the package

1x UVC cell top

1x UVC holder

1x set of electrodes (SS, Au, Ag, Pt, GC)

1x Hellma UV-cuvette

Application examples:

Synthesis and Electrochemical Activity of Some Na(Li)-Rich Ruthenium Oxides with the Feasibility to Stabilize Ru^{6+}. M. Otoyama et al. Advanced Energy Materials 1803674 2019

Assessment of the Electrochemical Stability of Carbonate-Based Electrolytes in Na-Ion Batteries. G. Yan et al. Journal of The Electrochemical Society 165 (7) 2018

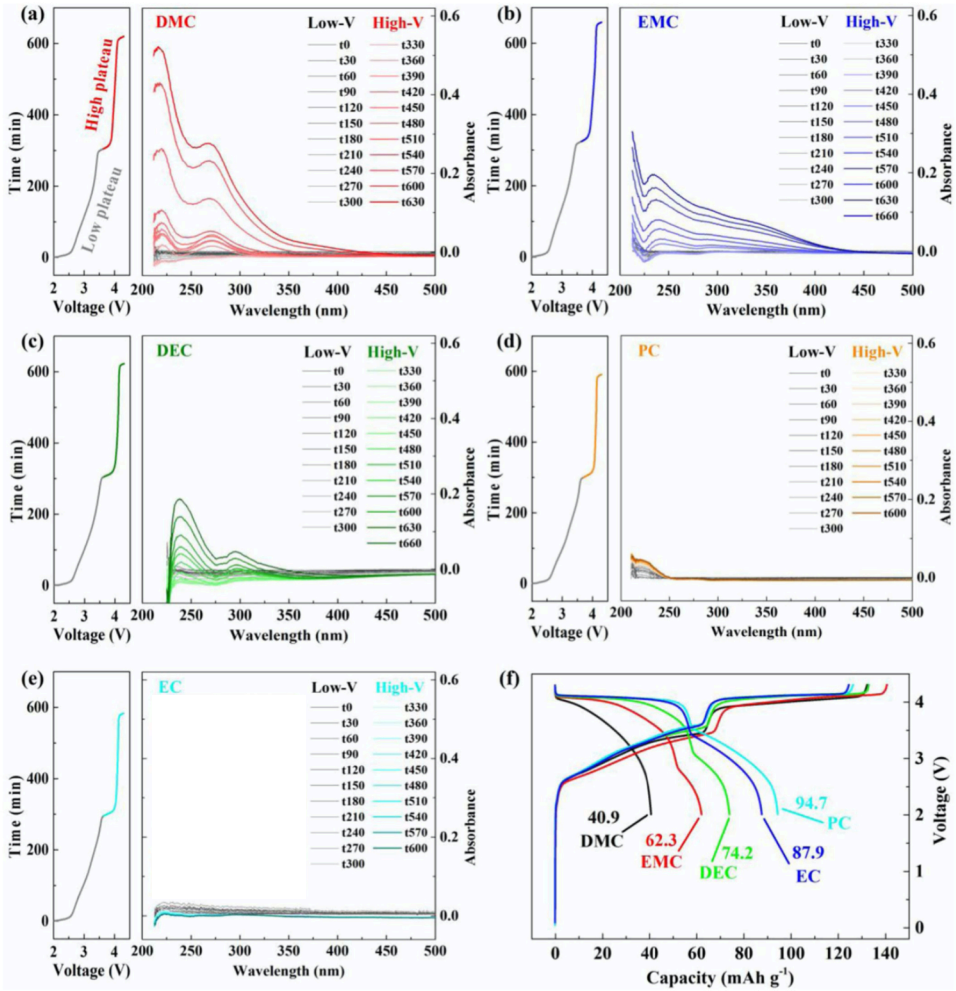
Competition between metal dissolution and gas release in Li-rich $Li_3Ru_yIr_{1-y}O_4$ model compounds showing anionic redox. Q. Jacquet et al. Chemistry of Materials 30 (21) 2018

Technical details:

Electrodes:
- Stainless Steel mesh
- Gold wire (99.999%)
- Platinum wire (99.9%)
- Silver wire (99.9%)
- Glassy carbon rod

Hellma quartz cuvette:
- UV-light - 10 mm pathlength
- Chamber volume: 3500 µL
- Spectral range: 200 to 2500 nm

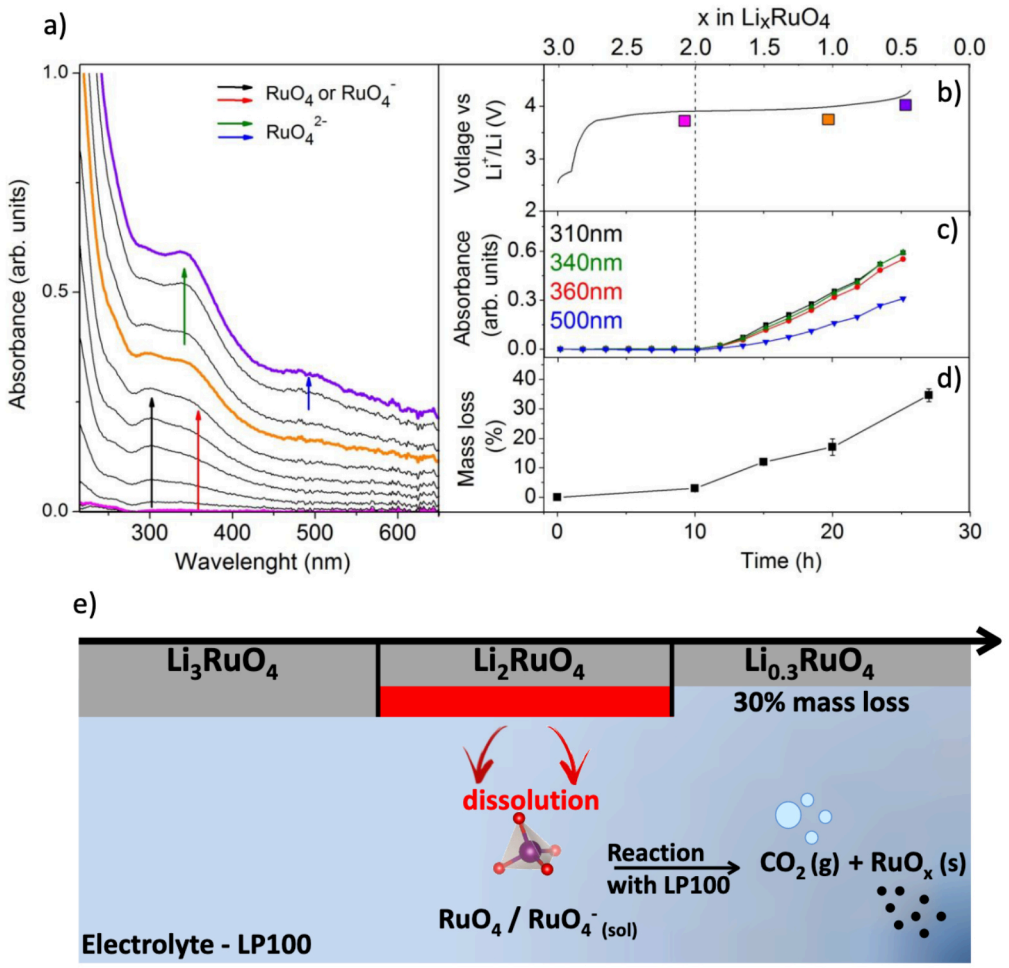
Live monitoring of electrolyte degradation



Assessment of the Electrochemical Stability of Carbonate-Based Electrolytes in Na-Ion Batteries.

G. Yan et al. Journal of The Electrochemical Society 165 (7) 2018

Direct correlation to voltage range & Visualizing of soluble species



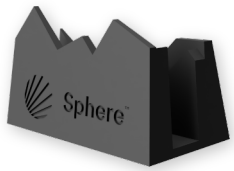
Competition between metal dissolution and gas release in Li-rich $Li_3Ru_yIr_{1-y}O_4$ model compounds showing anionic redox.

Q. Jacquet et al. Chemistry of Materials 30 (21) 2018

The FLC

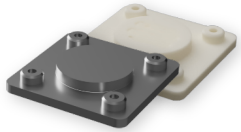
The FLC | Flow cell for electrochemistry

The FLC-Set:



1x Holder

1x Standard Cell body



2x Extra tops

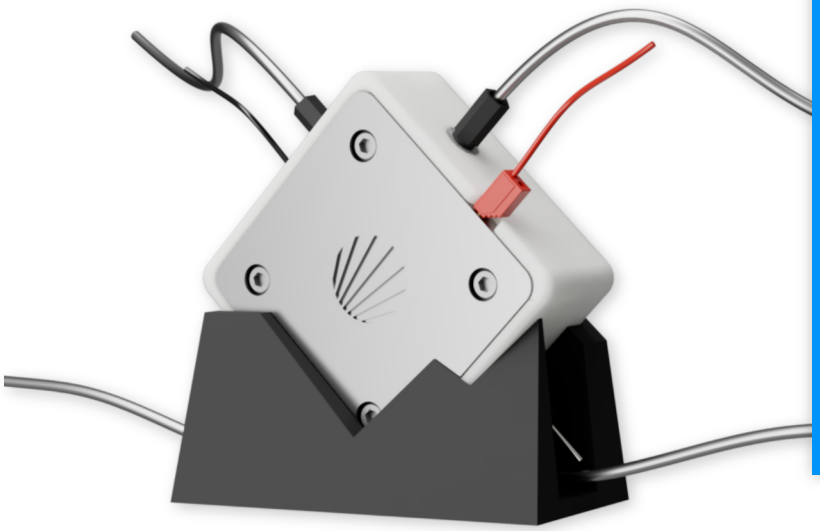
2x Metallic substrates

- Defined active area
- Minimal inter-electrode distance
- Intuitive sample switching
- Reference electrode per compartment
- Optimized electrolyte flow

The FLC is designed to simplify electrochemical measurements with flowing electrolyte. The cell is composed of two compartments separated by a membrane. Each compartment has an independant electrolyte-flow channel and its own reference electrode.

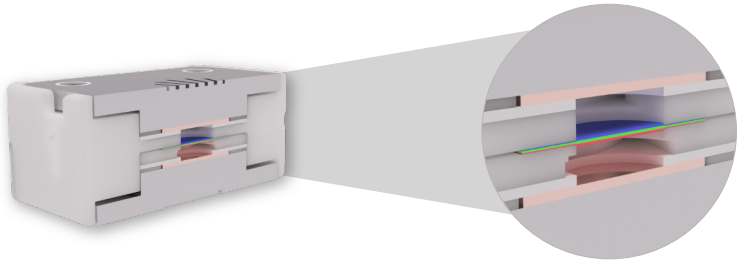
The FLC is made to test redox-flow systems, catalyst materials, ion conducting membranes, corrosion, photochemical or gas-interface reactions.

The symmetrical design is made for maximum versatility: exchanging the top and/or bottom parts will allow the user to switch between a total of six possible configurations.



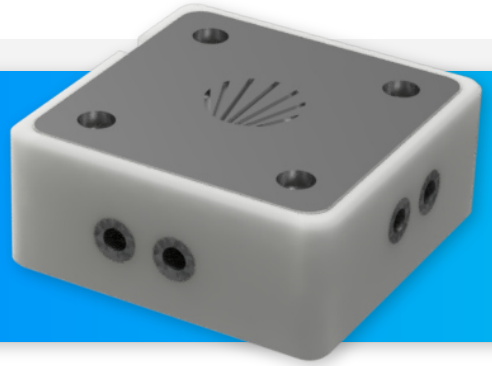
Technical details:

- PTFE body and gaskets for tightness
- Low cell volume (1.2 ml)
- Electrolyte flow up to 150 ml/min
- Holder keeps cell in upright position to improve flow and gas evacuation
- 4-screw assembly with a simple hexagonal key (included in the set)
- Compatible with multiple membrane shapes (between 15 mm- 30 mm diameter)
- Compatible with zero-gap experiments (illustration below)

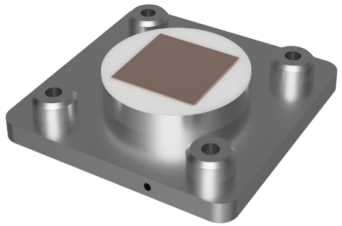


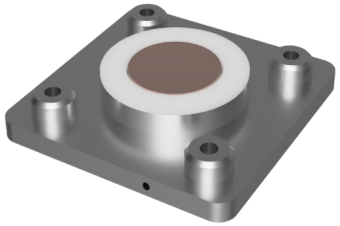
FLC in a zero-gap configuration

FLC STANDARD | Flow cell for plane metallic substrates

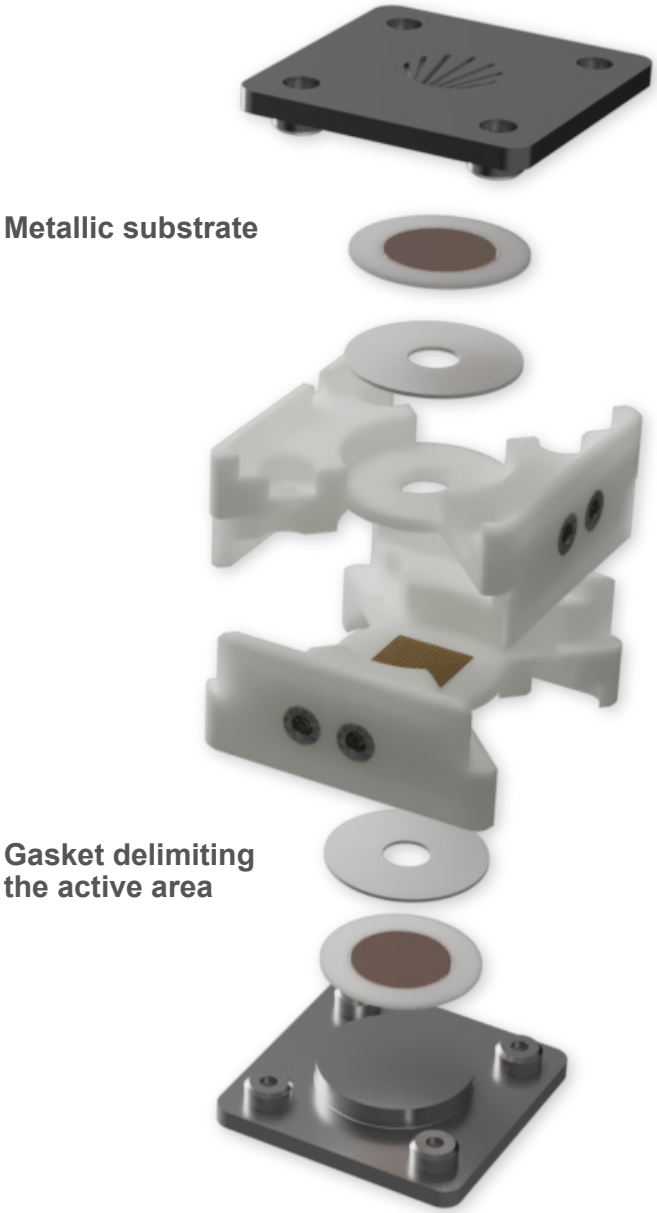


The FLC - Standard comes with an interchangeable set of metallic copper substrates (Cu 99.99%), on which the active materials can be deposited or electrodeposited.



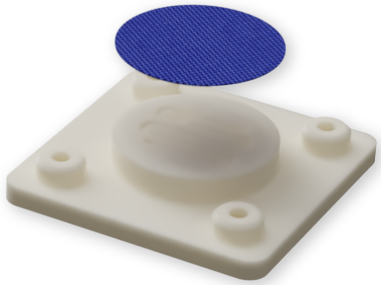


Square geometry: 25 x 25 mm - thickness 1mm	**Circular geometry:** diameter 25 mm - thickness 1mm



FLC-Gas | Flow cell for porous substrates

The FLC - Gas is made to host a gas diffusion layer (GDL) electrode. This substrate can be loaded with different type of materials (e.g. catalyst materials deposited by drop cast), offering improved electrolyte accessibility while allowing gas injection through the electrode.

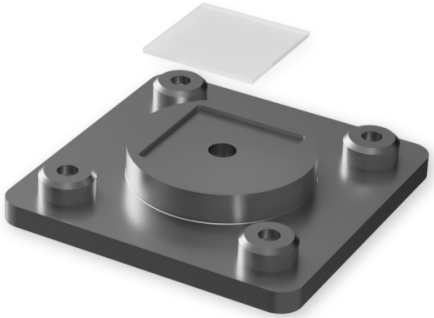


The gas-flow entering the back of the porous substrate optimizes the triple interface between

The FLC-Gas can host commercial available GDLs cutted at around 40 mm diameter to maximise contact with the gas injection

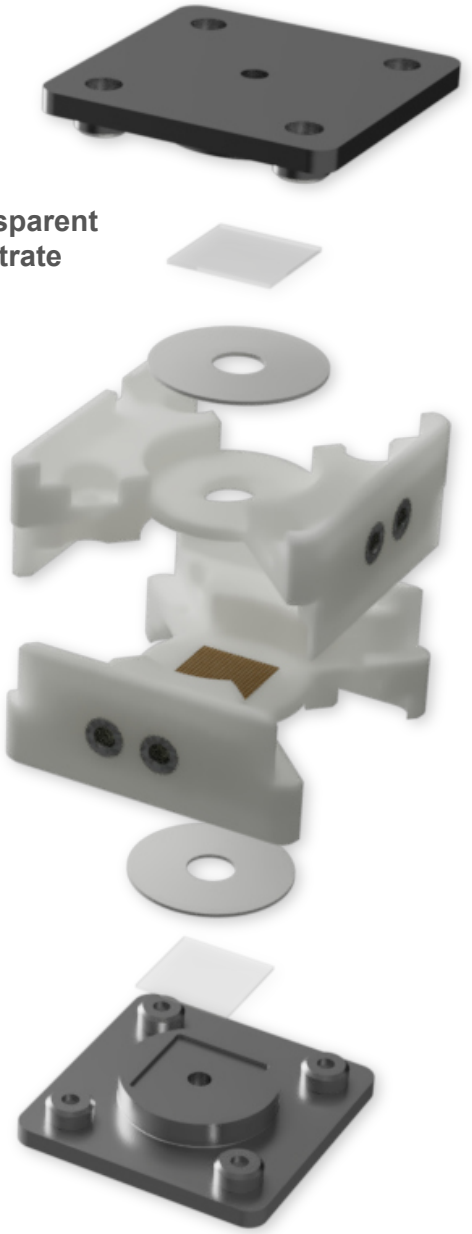
FLC-Light | Flow cell for photoelectrochemical substrates

The FLC - Light is compatible with commercially available transparent substrates and external light sources. The sample can be excited by an external light source via a 6mm aperture.



The cell is compatible with ITO and FTO substrates of 25 x 25 mm and 1.1 mm of thickness. The transparents substrates are fixed into the sample holder.

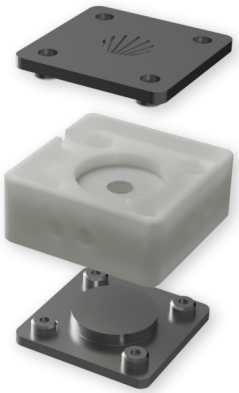
The electrical contact is assured by a conductive copper plate



The FLC configurations overview

Standard setup

Metallic vs. Metallic substrate

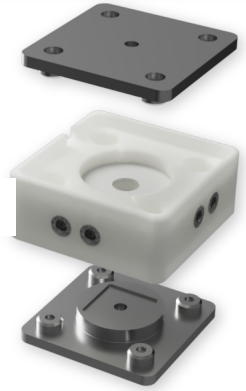


Gas setup

Gas vs. Gas substrate

Light setup

Light vs. Light substrate

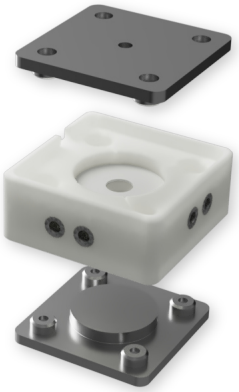


Gas vs. Standard setup

Gas vs. Metallic substrate

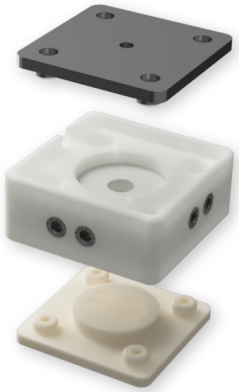
Light vs. Standard setup

Light vs. Metallic substrate

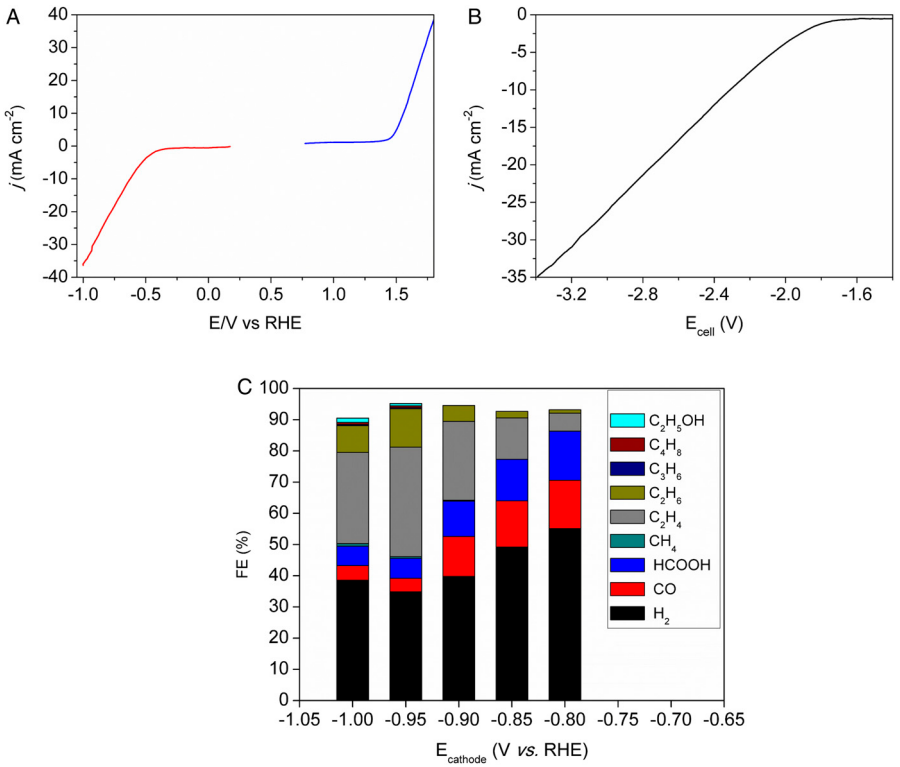


Light vs. Gas setup

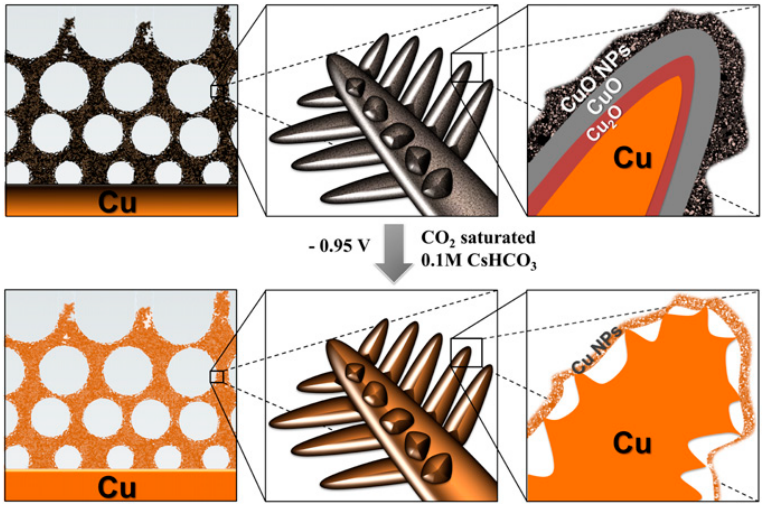
Light vs. Gas substrate



Electrochemical reduction of CO2 into hydrocarbons



Catalyst based on hierarchical Cu structure



Low-cost high-efficiency system for solar-driven conversion of CO2 to hydrocarbons
T. Huan, et al.
PNAS May 14, 2019

At Sphere Energy we design, manufacture and commercialize high performance instruments and tools to accelerate energy research.

All our cells are designed, assembled and tested in France. With mechanical parts manufactured from highly precise CNC machines in Germany. The electrical components used in our cells are selected first by their quality second by their location (>70% of the electrical components we use are manufactured within Europe).

For more information on products, consulting, or testing services, please visit us at www.sphere-energy.eu

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