

# Products 2016

Instrumentation for  
battery research





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# About PAT series

The science of battery testing has reached the next level with the introduction of the PAT series. This new generation of battery test cells features a unique single-use concept to raise the standard of

Li-ion battery research. The PAT series comprises two types of battery test cells, and two docking stations.

Worldwide  
patented



PAT-Cell-Press



PAT-Cell

PAT-Core



The **PAT-Core** is the heart of the PAT series. It can be used in both the PAT-Cell and the PAT-Cell-Press test cell.\*



PAT-Single-Stand



PAT-Tray

\* For customers using the older ECC-Std, ECC-Ref or ECC-Combi the „ECC to PAT upgrade kit“ is available to make these cells working with the PAT-Core.

## PAT-Core

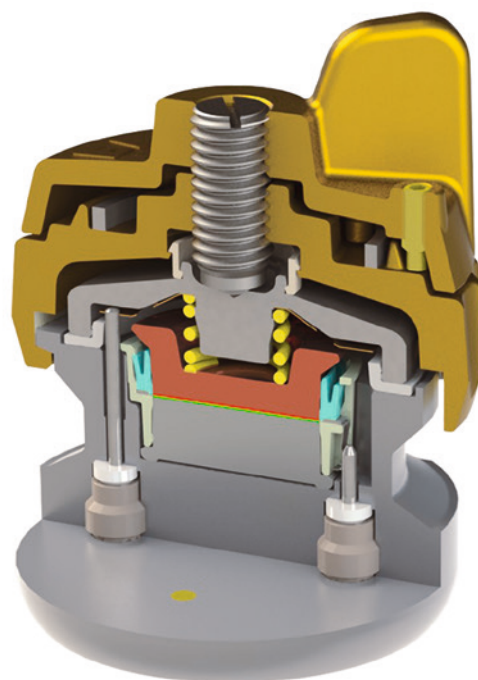
**The PAT-Core is the heart of the PAT series.  
It comprises three components.**

The first part of the PAT-Core is an insulation sleeve, which is made of polypropylene and equipped with a built-in ring-shaped Li-reference electrode and a 260  $\mu\text{m}$  thick glass fiber separator. The insulation sleeve is pre-assembled under protective atmosphere at the EL-CELL<sup>®</sup> factory to ensure consistent quality for reproducible battery tests.

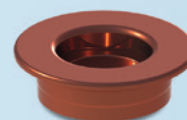
Versions without reference electrode or with customized separator are available on request. Upper and lower plunger are made of copper, aluminum or stainless steel as a current collector. This enables battery researchers to work exclusively with battery-grade materials. Aluminum and copper plungers are single-use parts, while the stainless steel plungers can be reused.

### Features

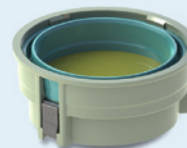
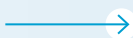
- Single-use concept in order to lower lead time of experiments
- With or without built-in lithium reference electrode (ring-shaped)
- With or without built-in glass fiber separator
- Thin technical separators (e.g. PP based) optionally available
- All battery grade construction materials: Al, Cu, PP
- Optionally reusable current collectors made of stainless steel (316L)
- Compatible with both the ECC \* and the PAT series



upper plunger (negative)  
available in stainless steel 316L (1.4404) , aluminum Al 99.5  
(EN-AW-1050) and copper Cu 99.9 (E-CU 58)



insulation sleeve with lithium metal ring and a 260  $\mu\text{m}$  glass fiber  
separator, both pre-installed;  
also available without reference ring (for 2-electrode tests)



lower plunger (positive)  
available in stainless steel 316L (1.4404) , aluminum Al 99.5  
(EN-AW-1050) and copper Cu 99.9 (E-CU 58)



\* For customers using the older ECC-Std, ECC-Ref or ECC-Combi the „ECC to PAT upgrade kit“ is available to make these cells working with the PAT-Core.

\*\* All pictures on this page are made from CAD drawings.

# PAT-Core configurations

## The new test cell core for characterizing battery and capacitor materials

The PAT-Core is available in different configurations for different test cases. The below tables give an overview of the most common applications only, LiB (Li-ion and Li-metal) and aprotic supercapacitors (EDLC). Several other solutions - other separator, reference and plunger materials - are available on request. We continuously expand the PAT-system to new chemistries.

### Insulation sleeves

	separator	field of application	order no.
<b>Insulation sleeve</b> with lithium metal ring reference	glass fiber	LiB	ECC1-00-0210-O (standard)
<b>Insulation sleeve</b> without ring reference	glass fiber	LiB and aprotic EDLC	ECC1-00-0210-P
<b>Insulation sleeve</b> with activated carbon ring reference	glass fiber	aprotic EDLC	ECC1-00-0210-S
<b>Plain insulation sleeve,</b> disassembled	without (for self-assembly with your own separator)	LiB and aprotic EDLC	ECC1-00-0210-F

### Upper plungers (negative)

	type of utilization (single-use vs. reusable)	stable potential range (vs. Li) in LiPF <sub>6</sub> based electrolytes	field of application	order no.
<b>copper</b> Cu 99.9 (E-CU 58)	single-use	0 to 3 V	LiB	ECC1-01-0026-A
<b>aluminum</b> Al 99.5 (EN-AW-1050)	single-use	1 to 5 V	aprotic EDLC, LiB with LTO as negative	ECC1-01-0026-B
<b>stainless steel</b> 316L (1.4404)	reusable	0 to 4.5 V	LiB and aprotic EDLC	ECC1-01-0026-C

### Lower plungers (positive)

	type of utilization (single-use vs. reusable)	stable potential range (vs. Li) in LiPF <sub>6</sub> based electrolytes	field of application	order no.
<b>copper</b> Cu 99.9 (E-CU 58)	single-use	0 to 3 V	LiB „half cell“: graphite vs Li metal	ECC1-01-0027-A
<b>aluminum</b> Al 99.5 (EN-AW-1050)	single-use	1 to 5 V	LiB and aprotic EDLC	ECC1-01-0027-B
<b>stainless steel</b> 316L (1.4404)	reusable	0 to 4.5 V	LiB and aprotic EDLC	ECC1-01-0027-C



# PAT-Cell

## High-throughput testing with PAT-Core

The PAT-Cell is the test cell for high-throughput testing of battery materials. The PAT-Cell has no sockets for direct cable connections. It must therefore be used with a docking station such as the PAT-Single-Stand or PAT-Tray. This enables parallel battery tests to generate more reliable test results with less effort and in a shorter period of time.

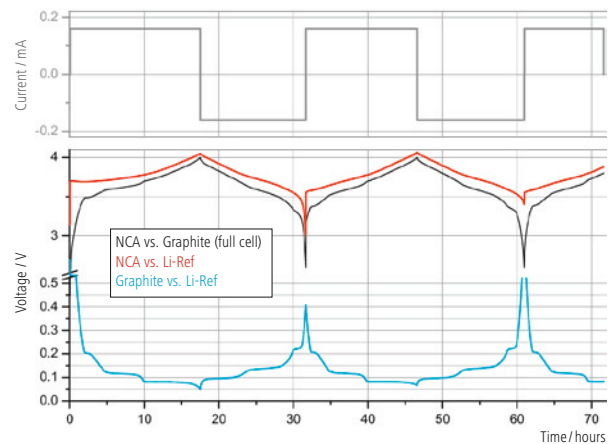
## Features

- Ability for conducting long-term half cell measurements with three electrodes over more than one thousand hours of battery operation
- Increase of testing productivity by single-use concept
- No need for cleaning or drying cell components
- Less mistakes that may result from corrosion or cross-contamination
- Saves space through PAT-Tray docking station
- Avoids wiring and saves time and effort in the lab
- Measurement of half cell impedance spectra of unmatched quality
- Fast assembly and dismantling lowers lead times of experiments
- Easy and reliable electrolyte filling upon assembly (defined electrolyte volume down to 0.05 cm<sup>3</sup>)
- Reliable LDPE sealing with double cutting rings
- Reproducible and homogeneous mechanical pressure on electrodes
- High precision 18 mm diameter sandwich geometry with a concentricity better than 0.1 mm (electrode and separator dimensions are compatible with test cells of the ECC series)

The PAT-Cell and the PAT-Tray are a solution for medium and large battery test laboratories with more than 10 test cells running in parallel. Moreover, the PAT-Cell increases the testing productivity through easy handling and it saves space in the lab.

The PAT-Cell is the ideal cell for high-throughput battery testing.

Monitoring of half cell voltages during the initial cycles of NCA vs. Graphite



# PAT-Cell-Press

## New pressure test cell for the PAT series

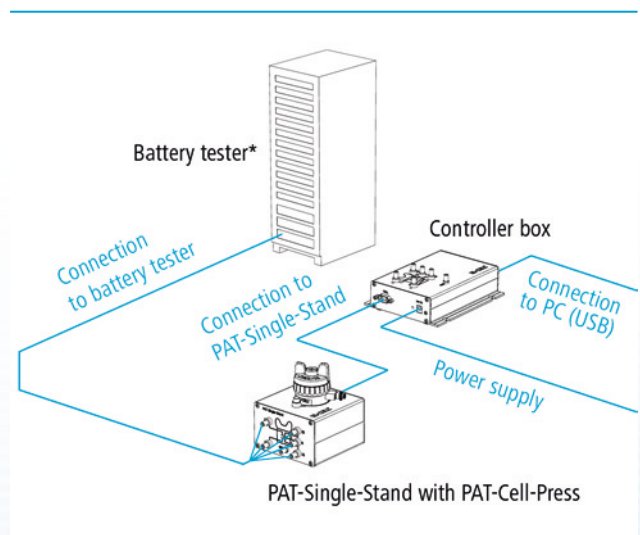
The PAT-Cell-Press is the newest addition to our PAT series. It is a pressure test cell for measuring gas evolution and drawing gas samples (option). Its advanced design includes a laser welded pressure sensor and glass-to-metal-seals. The number of non-permanent seals is reduced to its minimum: a single PE seal between cell lid and base and a ferrule when the cell is ordered with the optional gas sample port.

## Features

- PAT-Core design with or without reference electrode
- Laser welded pressure sensor, 0 to 3 bar abs.
- Glass-to-metal-seals
- Number of non-permanent seals reduced to its minimum
- Helium leak tested
- Integrated USB data logger for recording of pressure, temperature, cell current and half cell voltages
- Analog outputs for pressure and temperature (+ -10V) for seamless integration with other instruments
- Saves wiring effort

In order to ensure best testing results, every PAT-Cell-Press is intensively tested for helium leaks. An integrated USB data logger enables recording of all relevant signals. The PAT-Cell-Press is to be used with the PAT-Single-Stand which adds further benefits of the PAT series like less wiring effort and increased productivity.

The PAT-Cell-Press is the ideal, leakproof cell for pressure testing.



\* All available battery testers can be used with the PAT series



The image shows the PAT-Press, a package containing a controller box, a PAT-Cell-Press and a PAT-Single-Stand.

# PAT-Single-Stand

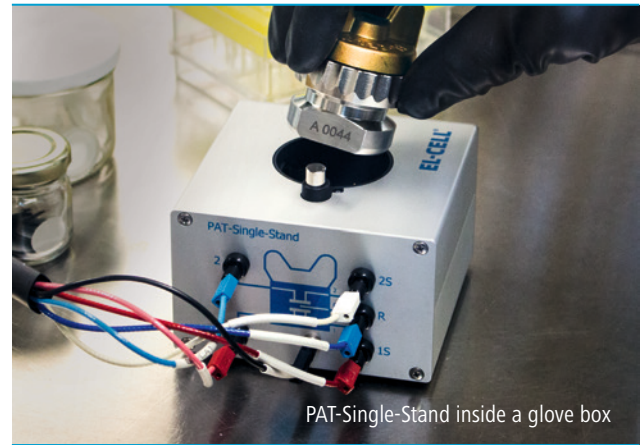
## PAT-Cell docking station for individual battery testing

The PAT-Single-Stand is a docking station connecting a single PAT-Cell to any potentiostat or battery tester. The connection is made via the banana sockets at the front or the Sub-D connector at the rear of the PAT-Single-Stand. The PAT-Single-Stand saves wiring effort, because it is not necessary to renew the connection between cell and potentiostat for every battery test.

The PAT-Cell is our most advanced test cell, ready for high-throughput testing with the PAT-Tray. If you want to perform individual battery tests with the PAT-Cell, the PAT-Single-Stand is the ideal entry docking station for you.

## Features

- Compatible with all of today's potentiostats and battery testers
- Can be placed on the bench top, inside a temperature chamber or inside a glove box
- Saves wiring effort
- Paves the way for high-throughput testing with the larger PAT-Tray



PAT-Single-Stand inside a glove box

## Technical Data

- 105 mm x 113 mm (width x depth)
- Height: 80/110 mm (without / with PAT-Cell)
- Weight: ca. 0.56/0.96 kg (without / with PAT-Cell)





# PAT-Tray

## High-throughput docking station

The PAT-Tray is the docking station for up to 16 PAT-Cells in 4 x 4 matrix. The PAT-Tray has a built-in data logger recording full and half cell voltages, cell current, tray temperature and time. The PAT-Tray can be connected permanently to a usual multi-channel potentiostat (like the Biologic MPG-2 or VMP300) or battery tester (like the Maccor 4000).

## Features

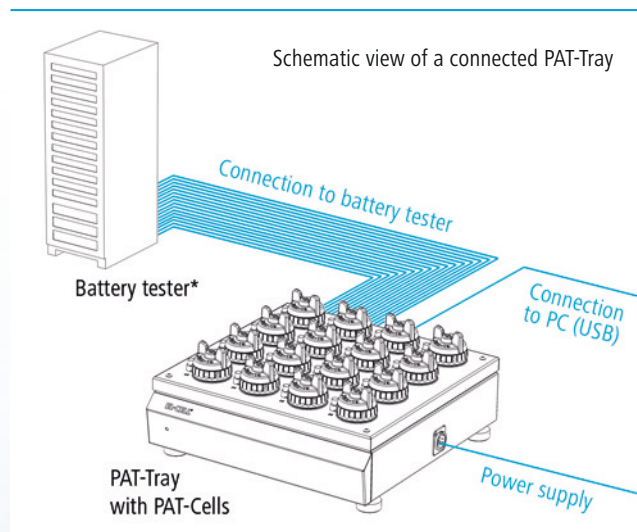
- 4x4 docking station for up to 16 PAT-Cells
- Integrated data logger for recording of cell data (current, full and half cell voltages) and tray temperature
- Compatible with most of today's multi-channel potentiostats and battery testers
- Can be placed on the bench or inside temperature chamber
- Saves wiring effort and space in the lab

## Technical Data

- 315 mm x 315 mm (width x depth)
- Height: 120 / 148 mm (without / with cells)
- Weight: ca. 6.9 kg (without cells)

This way, the PAT-Tray saves wiring effort, because it is not necessary to renew the connection of cell and potentiostat for every battery test. The PAT-Tray fits nicely into a usual climate chamber (for example Binder KB53), which saves space in the lab.

All these features make the PAT-Tray with the PAT-Cells the optimal solution for high-throughput battery testing.



\* All available battery testers can be used with the PAT series



# Why PAT?

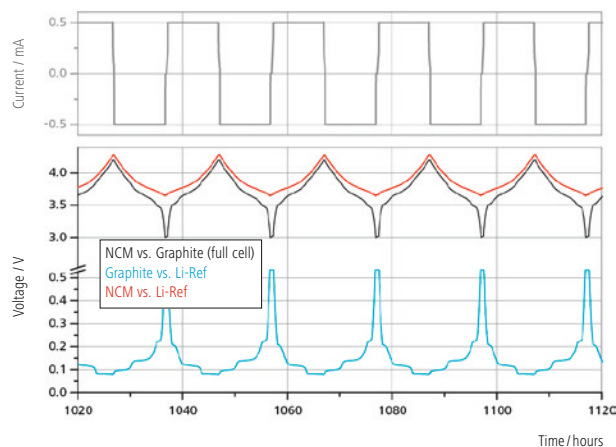
There is a variety of advantages for using the new PAT series.  
A detailed description of all the advantages will be given in the following.

## → Long-term tests

Ability for conducting long-term half cell measurements with three electrodes over more than 1000 hours of battery operations

The PAT-Core enables battery tests with a three-electrode setup of a duration of 1000 hours and more. The reason for this advantage is the new ring-shaped Li-reference electrode, which is far more time stable than point-type reference electrodes. This makes the PAT-Core the perfect test system for aging studies.

Detail view of a long-term cycling test of NCM vs. Graphite



## → Less cross-contamination

Reduction of mistakes, due to less cross-contamination and corrosion

The single-use concept of the PAT series helps to reduce cross-contamination between subsequent tests and corrosion issues. The PAT-Core consists of three single-use parts: insulation sleeve (PP), upper plunger (Cu as standard) and lower plunger (Al as standard). All these parts are assembled, packed and sealed under controlled atmosphere at the EL-CELL® factory. Moreover, it is not required to clean and dry the single-use parts, which avoids the risk of contamination with water and reduces effort in the lab.

Please note that upper and lower plungers are also available as reusable versions in stainless steel.

## → Easy electrolyte filling

Easy and reliable electrolyte filling during assembly (defined electrolyte volume down to 50  $\mu$ L)

The PAT-Cell can be filled easily with electrolyte during the assembly procedure. The user needs only an usual micro pipette for this purpose to drip a defined amount of electrolyte onto the separator, which is factory preinstalled in the insulation sleeve of the PAT-Core.

The amount of the electrolyte used is typically between 50 and 200  $\mu$ L, depending on the specific components used.

## → Less cleaning effort

### No need for cleaning or drying cell components

The single-use concept of the PAT series eliminates any cleaning effort. With this concept, the insulation sleeve and the plungers (current collectors) are disposed after the experiment. This means that it is no longer necessary to clean and dry cell components between battery tests.

This avoids work effort in the lab and eliminates the risk of cross-contamination between tests and water uptake from insufficiently dried cell components. In this way, the battery test procedure becomes more productive and more reproducible than ever before.

## → Tight test cells

### Reliable ultra-low leakage sealing with PE-Seal and double cutting rings

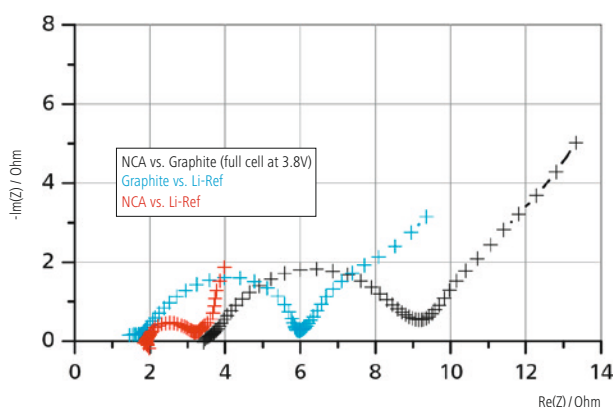
The PAT-Cell is completely airtight. This is ensured by the special PE-Seal clamped between the double cutting rings of the cell lid and cell body. This sealing concept guarantees ultra-low leakage and enables the operation of the PAT-Cell outside of the glovebox. Each single PAT-Cell is helium leak tested before delivery.

## → Half-cell impedance spectra

### Measure half-cell EIS spectra of unique quality

The results of half-cell impedance spectroscopy reach a new level with the new PAT-Cell. The ring-shaped Li-reference electrode allows half-cell impedance tests with minimal artifacts, due to the well-defined geometry of the insulation sleeve.

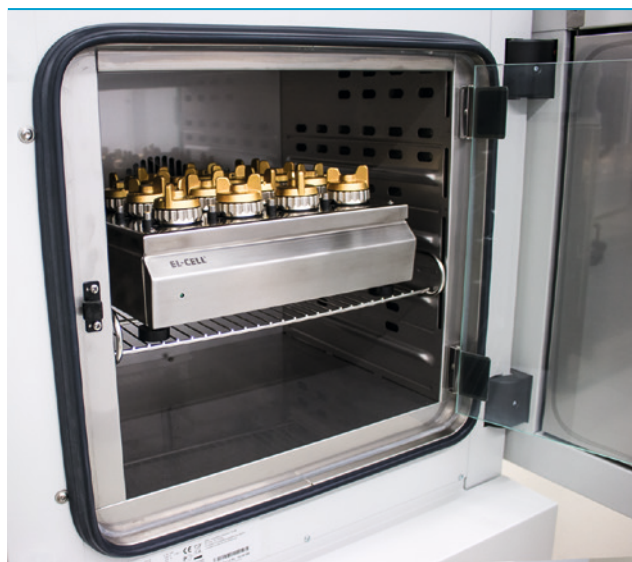
Full and half cell impedance spectra of NCA vs. Graphite at a full cell voltage of 3.8 V



## → Saving time and space

### Fast assembly and dismantling to accelerate experiments

The application of the new PAT series saves time and space in the laboratory. The single-use concept avoids cleaning and drying and so reduces labour effort. Moreover, the PAT-Tray can be left permanently connected to the multi-channel potentiostat. There is no need for connecting cables each time a new test is started. Finally, the PAT-Tray makes the most effective use of lab space and fits nicely into usual climate chambers.



## → Good reproducibility

### PAT series increases the reproducibility of battery test results.

In general, the PAT concept improves the reproducibility of battery tests by eliminating mistakes that may result from the cleaning and drying procedure required for reusable components. The easy handling eliminates assembly errors. Moreover, the ring-shaped Li-reference electrode enables stable long-term battery cycling tests and better half-cell impedance results. This altogether contributes to a better reproducibility of battery test results.

## → Battery grade materials

### PAT series enables battery tests with battery grade materials only.

With the new PAT series it is possible to use only battery grade materials in the test cells. In contrast to the ECC series, stainless steel and PEEK are no longer used as construction materials. With the new PAT-Core, Al and Cu are used as plunger materials and PP as material for the insulation sleeve – just as it is the case for most commercial Li-ion batteries. Moreover, the pre-installed ring-reference electrode enables the utilisation of thin technical separators. Hence, it is possible to work only with battery-grade materials when using the new PAT series.

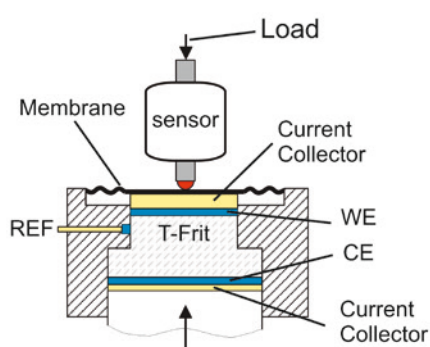
Please note that stainless steel is still available as additional plunger material.



# Electrochemical Dilatometer

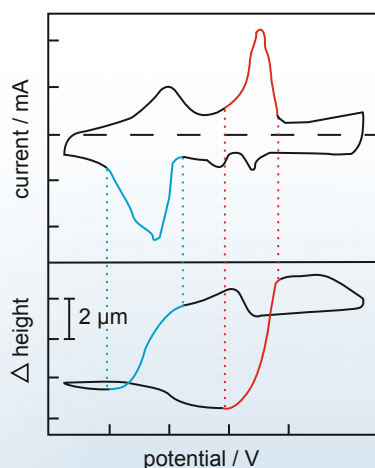
## Watch your electrodes breathing

Our new electrochemical dilatometer is available in two versions, the ECD-3 and the ECD-3-nano. The two instruments mainly differ in the resolution and drift stability of the displacement sensor system that is attached to the electrochemical cell. The electrochemical cell is identical for both versions.



## Working principle

The ECD-3 and ECD-3-nano electrochemical dilatometer measure the thickness change of a working electrode during the electrochemical cycle. The heart of the dilatometer is an electrochemical cell hermetically sealed against ambient atmosphere.



Current response and height change of layered ruthenium oxide HRO in 2 M  $\text{H}_2\text{SO}_4$  during slow scan voltammetry. Courtesy of Prof. Wataru Sugimoto, Shinshu University, Japan.

The working electrode WE and the counter electrode CE are separated by a stiff glass frit soaked with electrolyte. The upper WE is sealed by means of a flexible metal membrane, through which any charge-induced thickness change is transmitted towards the sensor/load unit attached on top. The fixation of the glass frit ensures that only the thickness change of the working electrode is being detected, without interference from the CE. Optionally, a reference electrode REF can be placed at the edge of the frit close to the working electrode.

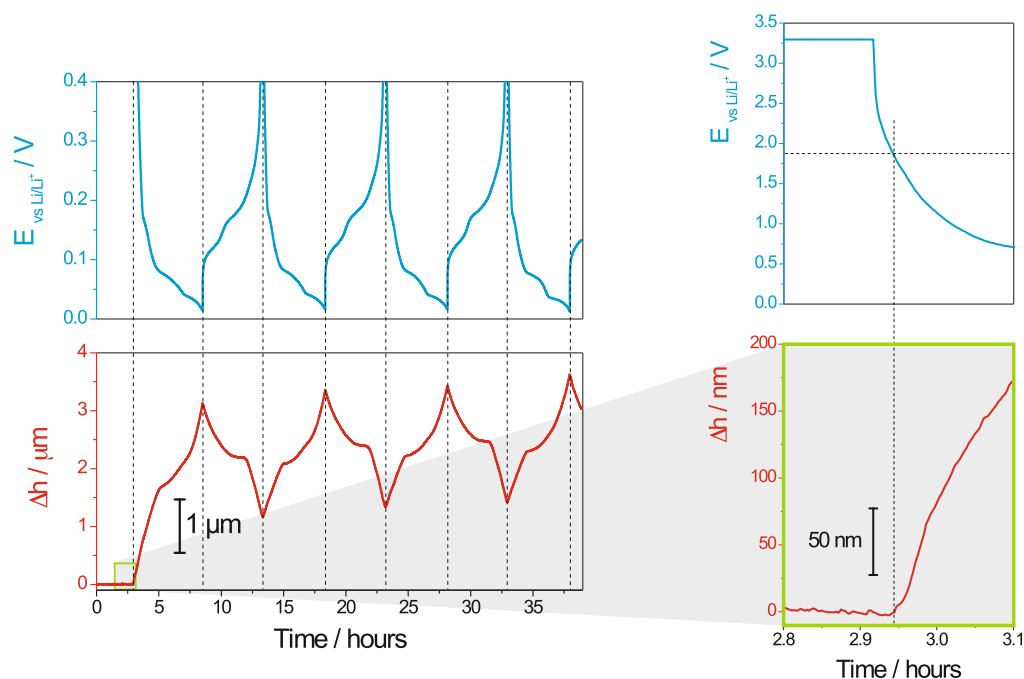
## Options

Various add-ons are available for special testing requirements, such as for using aqueous electrolytes, for using single grains or crystals instead of bound electrode films and for measuring the thickness change of the whole battery stack instead of the WE only.



ECD-3

ECD-3-nano



Expanding and shrinking of a graphite electrode during lithium insertion and extraction (figure left). The detailed view on the right shows the onset of expansion at 1.9V vs. Li/Li<sup>+</sup> (figure right).

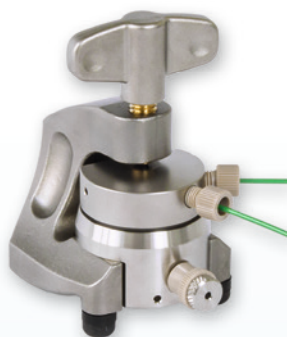
## Technical data

	ECD-3	ECD-3 nano
Displacement sensor system	LVDT	capacitive
Displacement range	500 μm	250 μm
Displacement resolution	≤ 50 nm	≤ 5 nm
Signal drift (sample-free)	≤ 100 nm / hour	≤ 20 nm / hour
Test specimen	Electrode films, optional single crystals / grains Diameter ≤ 10 mm, thickness ≤ 1 mm	
Load on test specimen	approx. 1 N	
Chemical compatibility	Aprotic organic electrolytes; optional aqueous electrolytes	
Cell electrolyte volume	approx. 0.5 ml	

# Special purpose test cells

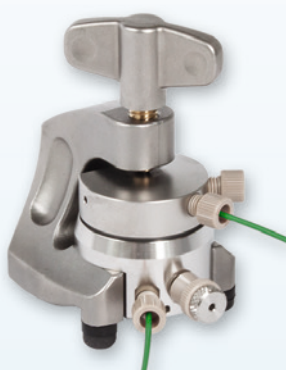
Here you can find test cells of the ECC series for different electrolytes and testing purposes. For some of them optional kits are available to upgrade or adapt the cell. Find more information on [www.el-cell.com](http://www.el-cell.com).

## → Gas analysis test cells



### ECC-Air

The ECC-Air is another member of the modular ECC-series dedicated to the electrochemical characterization of gas diffusion electrodes in aprotic electrolytes, e.g. for lithium-air batteries. Basically, the upper diffusion type electrode is contacted by and “breathes” through the perforated stainless steel current collector on top. Two ports in the cell lid serve to connect the inside cell volume to the external gas supply and outlet. The design includes a reference electrode.



### ECC-DEMS

This test cell is dedicated to the in-situ gas analysis in aprotic Li-air and conventional Li-ion systems. The cell features a current collector with a spiral-shaped flow-field that is to be constantly purged with a gentle stream of inert gas. The flow-field is located at the bottom of the cell base. The composition of the outgoing gas can be analyzed by e.g. mass spectrometry. The ECC-DEMS cell provides almost perfect plug-flow of the purge gas being essential for quantitative time-resolved analysis.



### ECC-Press-Air-DL

The ECC-Press-Air-DL test cell is dedicated to the characterization of gas diffusion electrodes in aprotic electrolytes, in particular for lithium-air batteries. The attached pressure sensor serves to monitor the inside pressure in either a flow-through or in a dead-end pressurized set-up. The ECC-Press-Air-DL combines all the features of the ECC-Press-DL and the ECC-Air test cells. The provided low-dead-volume sampling port/valve serves to draw gas samples from the cell’s headspace. The cell hardware can be used with or without a reference electrode. The ECC-Press-Air-DL comes with a controller box for easy interfacing with an external potentiostat.

## → Optical test cells



### ECC-Opto-Std

The ECC-Opto-Std test cell is dedicated to the inspection of electrodes by optical methods such as light microscopy or Raman spectroscopy working in the reflection mode. A special kit is available for XRD.

Basically, the respective instrument looks through a transparent window onto the backside of the working electrode. For this purpose the working electrode is to be supported on a perforated current collector or a current collector having a single small hole in its center.



### ECC-Opto-SBS

With the ECC-Opto-SBS the electrode can be observed in-situ in the reflective mode – just as with the ECC-Opto-Std. The special thing about the ECC-Opto-SBS is the side-by-side (“face up”) arrangement of the electrodes which is in contrast to the conventional sandwich (“face to face”) arrangement of the ECC-Opto-Std.

## → Aqueous test cell



### ECC-Aqu

The ECC-Aqu electrochemical cell is dedicated to the characterization of aqueous battery and capacitor systems. The cell is equipped with a reference electrode assembly. Cell parts that come in contact with the electrolyte are made of fine gold and PEEK and can thus withstand all common aqueous electrolytes like sulphuric acid (up to 50% concentration) or potassium hydroxide. Other current collector materials such as platinum are also available.

## Customized test cells

Our main focus is on lithium-ion batteries, but we also design test cells for other battery technologies. We can also customize our devices and tools according to your individual purposes and develop solutions for specific experiments – Just ask.





# Accessories & Tools

EL-CELL® offers useful tools and accessories for enhancing the work experience with our test cells and to make your life as a battery researcher easier. Find more information on [www.el-cell.com](http://www.el-cell.com).



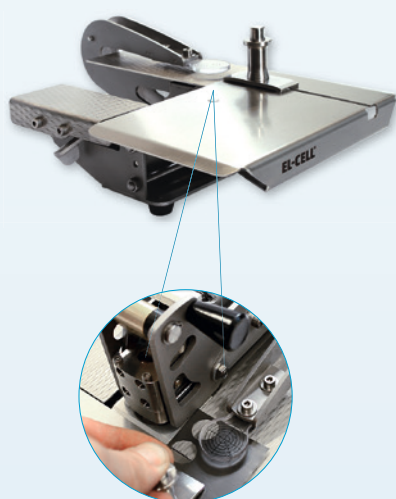
## EL-Cut

**High precision cutting pliers eliminate torn and chipped electrode edges.**

The proper cutting of the electrodes is often an neglected factor in battery testing. Torn and chipped electrode edges – although invisible to the bare eye – inevitably cause current inhomogeneity and are thus likely to affect experimental results. Especially life cycle and impedance results are prone to such artifacts. Electrodes being cut (fine blanked) by the EL-Cut are produced in tools with a few microns cutting clearance. The fine blanking process results in electrodes having clean cutting surfaces without torn or chipped edges and being almost perfectly flat.

## Features

- Perfectly cut electrodes
- Electrode thickness: max. 300 µm (for coatings on Al and Cu foil (may vary for other support materials))
- Any size (diameter) from 6 to 40 mm. Different shapes (e.g. squared) are available on request.



## ECC-StopRail

**Cross hairs reduce cutting waste after mounting to the EL-Cut.**

The ECC-StopRail is an optional tool for the EL-Cut cutting pliers. When attached to the pliers, the ECC-StopRail helps to conveniently target the cutting area and to make effective use of the electrode sheet.

## Features

- Easily attached to EL-Cut, no tools required
- Compatible to any EL-Cut diameter up to 22 mm



## ECC-RefLoad

**Tool for loading reference materials such as lithium metal into ECC-Opto-Std, ECC-Opto-SBS and ECC-Aqu test cells.**

The device is basically a small tube (cannula) with a knock-out pin inside. A tiny piece of lithium metal is first picked up by pressing the cannula onto a piece of lithium foil. The cannula is then inserted into the bore of the Ref sleeve, and the lithium inside the cannula is extruded into the Ref bore by pushing the knock-out pin.



## ECC-LiPunch

**Punching tool for lithium foil**

The ECC-LiPunch is the perfect tool for smoothly punching lithium discs for PAT and ECC series test cells. The punching knife can easily be removed for cleaning.

## Features

- For punching precise and flat lithium discs
- Standard size for EL-CELL® test cells: 18 mm diameter
- Other sizes available:  
6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 16.6, 17, 18, 19, 20 mm



# Services

In addition to our hardware we also offer a wide scope of services like hands-on seminars or performing electrochemical experiments in our own research laboratory.

## → Lithium battery application lab

No time or equipment available to run battery tests yourself? We can help you to solve your testing problems in our own laboratory e.g.:

- Manufacturing (slurry preparation, casting, drying, punching) of electrodes from clients' materials; formulation and characterization of electrolytes
- Cycle life and impedance tests on half and full cells (to some extent materials can be provided by us)
- Round Robin tests for validation and tuning up of client's test capabilities
- Testing of clients' materials with EL-CELL® test equipment

### Equipment

Our professional research laboratory provides the following equipment to run different electrochemical experiments. With this equipment we are able to operate at the highest standard of academia and industry:

- All kinds of battery test cells of EL-CELL® (standard and reference electrode test cells, optical test cells, dilatometer, gas and air test cells and many more)
- Tools and handling equipment for electrochemical experiments (e.g. cutting and punching tools)
- Equipment for the preparation of electrode slurries and for casting or drying of electrode films
- MBraun glove box system for test cell assembly
- Helium leak tester
- Temperature controlled test cabinets
- Different kinds of potentiostats and battery testers:
  - Maccor 4000 series cyclers
  - Biologic VSP multichannel impedance analyzer
  - Gamry Interface 1000
- All standard consumables such as lithium metal, LiPF<sub>6</sub> based electrolytes, anode and cathode materials

## → Hands-on seminars

EL-CELL® organizes seminars and trainings in its laboratory to impart knowledge about battery testing and to support researchers in effectively exerting our products.

### Learn more about:

- The latest devices and applications for battery testing
- How to run meaningful electrochemical tests by yourself (constant current cycling, voltammetry, impedance)
- The practical preparation and testing of Li-ion battery materials in the lab
- The pros and cons of different cell designs (EL-CELL® test cells, coin cells, pouch cells, Swagelok® cells)
- The benefits and limitations of 2- and 3-electrode test cells
- How to perform experiments with the latest in-situ test cells from EL-CELL® (dilatometer, gas analysis, Raman, X-ray and many more)
- Many other recent electrochemical research topics

### Facts:

- Duration: Two days (8 hours per day)
- Location: Tempowerkring 8 - 21079 Hamburg, Germany
- Pricing: Regular registration: 1,250 Euro (1,150 Euro\*)  
PhD-students\*\*: 625 Euro (575 Euro\*)

See website [www.el-cell.com](http://www.el-cell.com) for next dates.

\* Early bird (4 weeks before)

\*\* confirmation required

# What is the right test cell for you?

Test cells	Aprotic electrolytes LiPF <sub>6</sub> and R <sub>4</sub> NBF <sub>4</sub> <sup>2)</sup>	Aqueous electrolytes		Available current collectors
		alkaline	neutral + acid	
PAT-Cell	yes	no	no	Cu, Al, SS <sup>3)</sup>
PAT-Cell-Press	yes	no	no	Cu, Al, SS <sup>3)</sup>
ECC-Aqu	no	yes	yes	Au (Pt)
ECC-Air	yes	no	no	SS <sup>3)</sup>
ECC-Air-Ni	no	yes	no	Ni, SS <sup>3)</sup>
ECC-DEMS	yes	no	no	SS <sup>3)</sup>
ECC-Press-Air-DL	yes	no	no	SS <sup>3)</sup>
ECC-Press-Aqu-DL	no	yes	yes	Au (Pt)
ECC-Press-Air-Aqu-DL	no	yes <sup>1)</sup>	no	Au (Pt)
ECC-Opto-Std	yes	no	no	Cu, Al, SS <sup>3)</sup>
ECC-Opto-SBS	yes	no	no	SS <sup>3)</sup>
ECD-3-nano	yes	yes <sup>1)</sup>	yes <sup>1)</sup>	SS <sup>3)</sup> , Al, Cu, Au <sup>1)</sup>
ECD-3	yes	yes <sup>1)</sup>	yes <sup>1)</sup>	SS <sup>3)</sup> , Al, Cu, Au <sup>1)</sup>

<sup>1)</sup> with optional aqueous kit only

<sup>2)</sup> for organic super capacitors

<sup>3)</sup> SS = stainless steel 1.4404 (316L)

<sup>4)</sup> GC = glassy carbon



## Test cells

	Purpose / testing						
	2-electrode	3-electrode	optical	X-Ray	IR	dilatometry	gas analysis
<b>PAT-Cell</b>	yes	yes	no	no	no	no	no
<b>PAT-Cell-Press</b>	yes	yes	no	no	no	no	yes
<b>ECC-Aqu</b>	yes	yes	no	no	no	no	no
<b>ECC-Air</b>	yes	yes	no	no	no	no	yes
<b>ECC-Air-Ni</b>	yes	yes	no	no	no	no	yes
<b>ECC-DEMS</b>	yes	yes	no	no	no	no	yes
<b>ECC-Press-Air-DL</b>	yes	yes	no	no	no	no	yes
<b>ECC-Press-Aqu-DL</b>	yes	yes	no	no	no	no	yes
<b>ECC-Press-Air-Aqu-DL</b>	yes	yes	no	no	no	no	yes
<b>ECC-Opto-Std</b>	yes	yes	yes <sup>1)</sup>	yes <sup>3)</sup>	yes <sup>4)</sup>	no	no
<b>ECC-Opto-SBS</b>	yes	yes	yes <sup>2)</sup>	yes <sup>3)</sup>	yes <sup>4)</sup>	no	no
<b>ECD-3-nano</b>	yes	yes	no	no	no	yes	no
<b>ECD-3</b>	yes	yes	no	no	no	yes	no

<sup>1)</sup> with glass window, sapphire optional

<sup>2)</sup> with sapphire window (standard)

<sup>3)</sup> with optional beryllium window

<sup>4)</sup> with optional ZnSe or CaF<sub>2</sub> window

# What is the right tool for you?

Test cells	ECC-RefLoad (one size)	ECC-LiPunch (several sizes)	EL-Cut (+ StopRail) (several sizes)
PAT-Cell	-	•	•
PAT-Cell-Press	-	•	•
ECC-Aqu	•	-	•
ECC-Air	•	•	•
ECC-Air-Ni	•	•	•
ECC-DEMS	•	•	•
ECC-Press-Air-DL	•	•	•
ECC-Press-Aqu-DL	•	-	•
ECC-Press-Air-Aqu-DL	•	-	•
ECC-Opto-Std	•	• diameter = 10 mm	• diameter = 10 mm
ECC-Opto-SBS	•	-	■ 9.5 x 9.5
ECD-3-nano	-	• diameter = 12 mm	• diameter = 10 mm
ECD-3	-	• diameter = 12 mm	• diameter = 10 mm

– impossible

• recommended; diameter for ECC series is 18mm except for different indication

For further information about our products don't  
hesitate to contact us directly!



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electrochemical test equipment

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Map shows our headquarter and distributors.

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