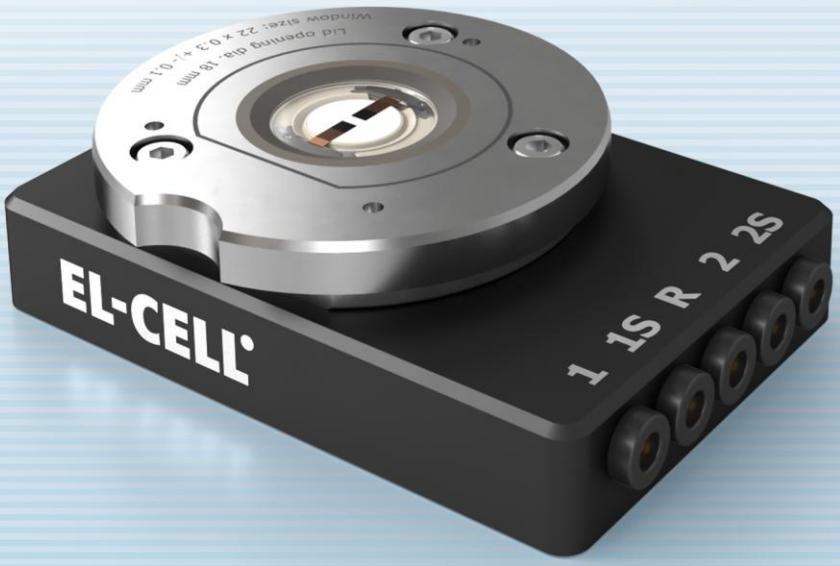
EL-CELL®
electrochemical test equipment

User Manual

Release 1.41

ECC-Opto-10

Electrochemical test cell



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1 Preamble

1.1 Purpose and Target Audience

This manual covers the design, function, operation, and maintenance of the device described. It is intended for the device's end users. An end user can be defined as any person who interacts directly with the device described. The term "end user" typically refers to laboratory personnel who have been specifically trained to operate this instrument and are familiar with all the necessary precautions required for working in the laboratory.

Only an authorised and properly qualified and experienced person 18 years of age or older may use the device described, who:

- has read and understood these installation and operating instructions
- is familiar with the installation and operation of this or a similar device
- is aware of all possible dangers and acts accordingly

1.2 Storage Instructions

Make sure you have read and understood the complete instructions and all safety information before using this product. Failure to follow these instructions may result in minor or serious injury.

Follow all instructions. This will prevent accidents that could result in property damage or injury. Keep all safety information and instructions for future reference and pass them on to subsequent users of the product.

The manufacturer is not liable for property damage or injuries resulting from incorrect handling or failure to comply with the safety instructions. In such cases, the warranty becomes void.

1.3 Obtaining Documents and Information

A current version of the documentation is available on the following website:

https://el-cell.com/support/manuals/

Alternatively, you can scan this QR code
to access the website:

2 Product Description



The ECC-Opto-10 test cell is designed for the operando characterisation of electrodes using optical methods such as light microscopy or Raman spectroscopy in reflection mode.

The ECC-Opto-10 is connected to the battery tester via a 2 mm cell cable with banana plugs. It can be used with the PAT-Tester-x-8 as well as potentiostats and battery testers from third-party manufacturers.

2.1 Features

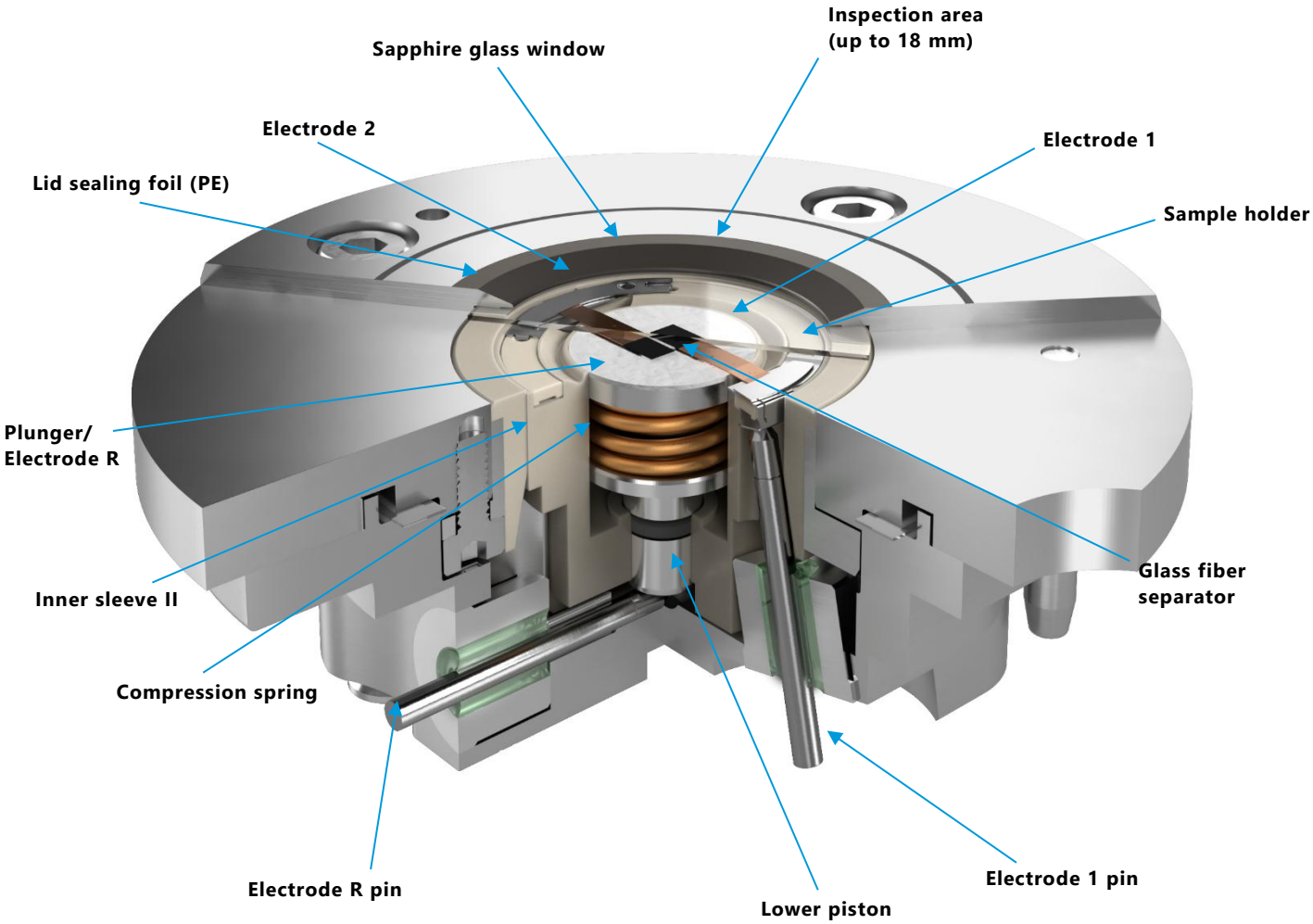
2- and 3-electrode cell with optical window for aprotic electrochemistry

High cycling stability due to glass-to-metal seals

Suited for light microscopy and Raman spectroscopy

Fits on standard microscope sample stages (76 × 26 mm (DIN ISO 8037-1))

2.2 Working Principle of the ECC-Opto-10 (Side-by-side Setup of Electrodes)



3 Technical Data

Length: 77.5 mm

Width: 51 mm

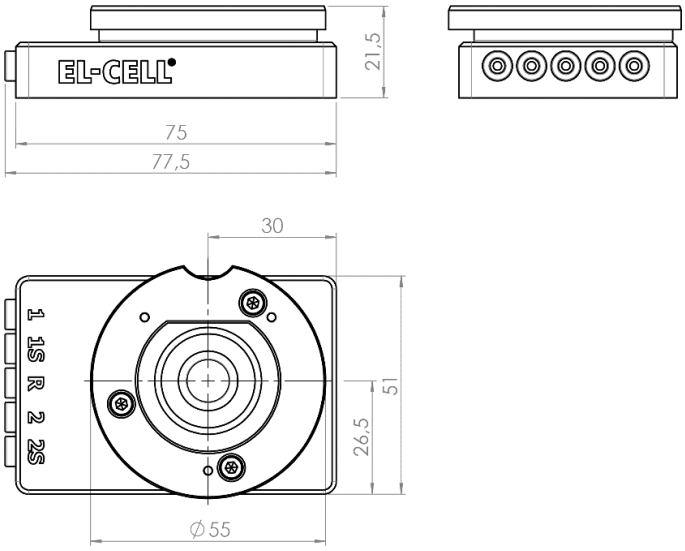
Height: 21.5 mm

Weight: 0.3 kg

Temperature resistance: -20 to 70°C

Electrode R diameter: <= 10 mm

Dead volume: 1.8 cm^3



4 Intended Use

The ECC-Opto-10 test cell is an electrochemical measuring instrument designed for laboratory use. It may only be used by trained personnel and only as described in this manual.

5 Safety Precautions

Use proper safety precautions when using hazardous electrode materials and electrolytes. Wear protective glasses and gloves to protect you against electrolytes that may accidentally spill out during filling and disassembly. Upon cell disassembly, dispose of all materials properly. Metallic lithium and some insertion compounds may decompose severely in contact with water and other solvents, potentially causing a fire.

6 Assembly

Please note: All assembly steps will be carried out in an inert glove box atmosphere. Dry all components in a vacuum oven at 80°C (120°C for parts made of PPS) for at least 12 hours.

Note on using the optional lid unit with a beryllium window: We strongly recommend placing a thin polyimide foil between the window and the electrode to prevent chemical reactions with beryllium. The film must also be heated to 120°C for at least 12 hours prior to installation.

Once fully assembled, the cell is hermetically sealed, allowing operation in an ambient atmosphere.

The test cell can be used in several configurations, which differ mainly in the type and size of the working electrode, the charging geometry (the positions of the working and counter electrodes relative to each other), and the connection to the potentiostat (2- or 3-electrode). The following describes the cell assembly in several parts.

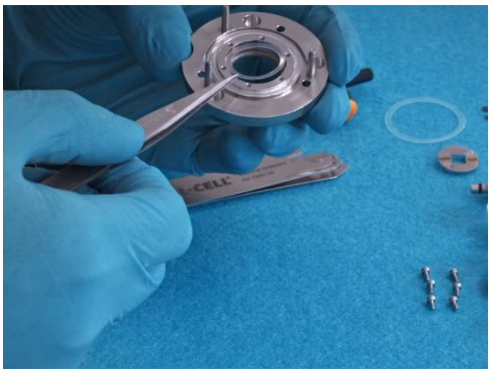
6.1. Lid assembly

6.2. Instructions for assembling the cell for the side-by-side arrangement of electrodes.

6.3. Instructions for assembling the cell for the face-to-face arrangement of electrodes.

These instructions are also available as videos on our website, el-cell.com.

6.1 Lid Assembly



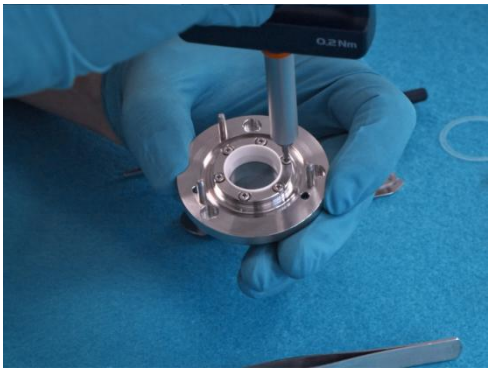
1. Turn the lid upside down. Insert the foil sealing into the lid.



2. Insert the window.

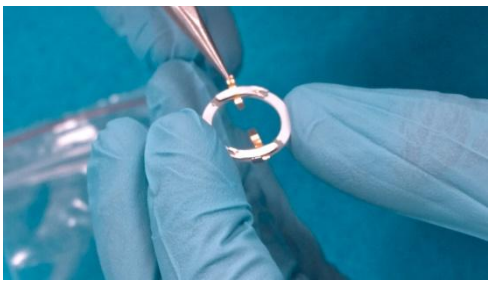


3. Insert the window thrust ring.

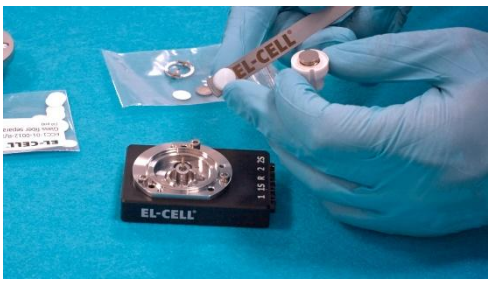


4. Attach the window flange and screw in the screws using the torque screwdriver 0.2 Nm.

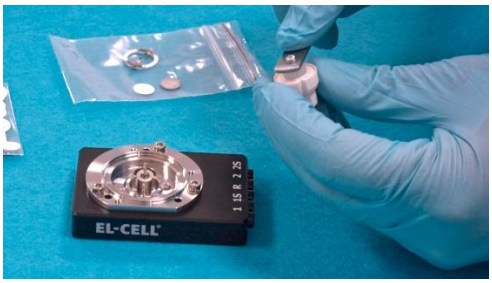
6.2 Assembling the Cell With a Side-by-side Sample Holder

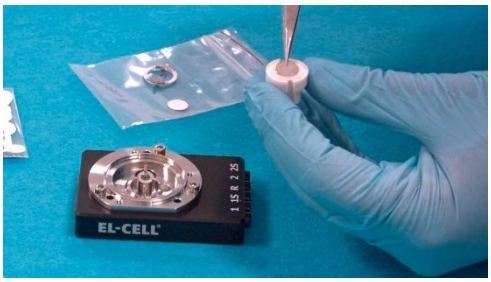


1. Assemble the lid as described above. Then attach the electrode strips to the sample holder.

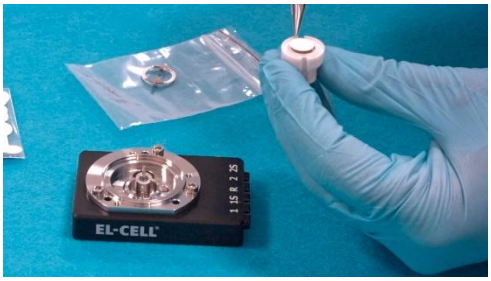


2. Use the loading tweezer to push the piston into the sleeve.



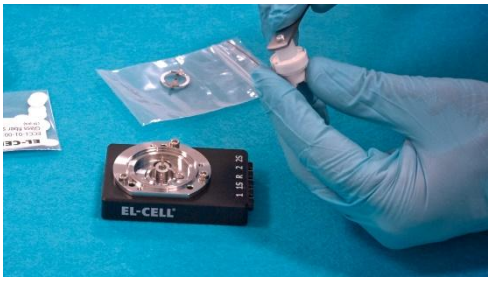


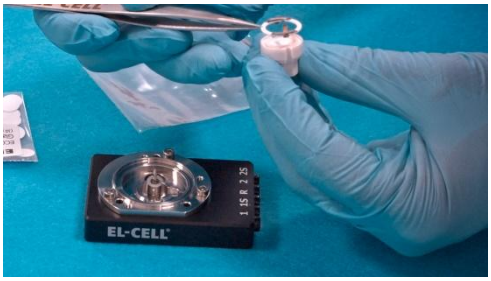
3. Put the electrode R, lithium metal, in this case, on top of the piston.

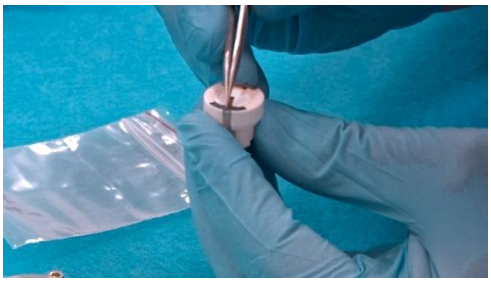


4. Put the separator on top and push it down using the loading tweezer.

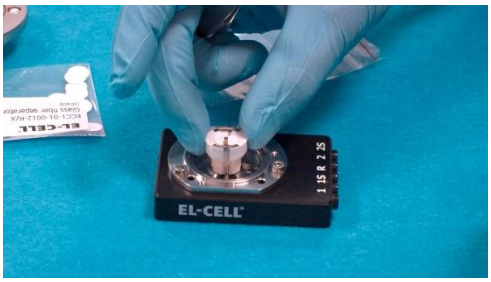
The separator must not be more than 10 mm in diameter. A smaller separator may be useful to prevent the sample holder from contacting the electrolyte.



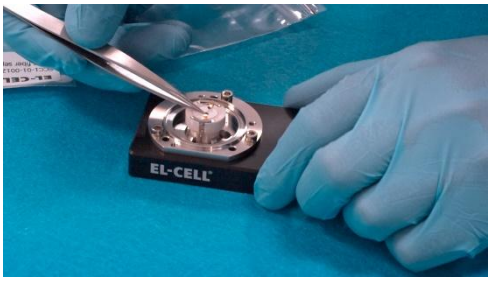




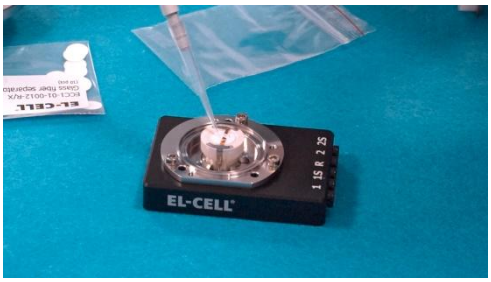
5. Attach the sample holder and press it down.



6. Insert the assembly into the cell base.

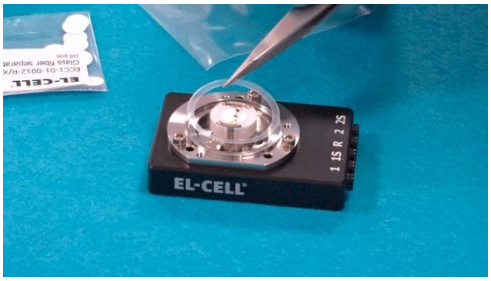


7. Ensure the electrode strips are correctly aligned before attaching the lid.

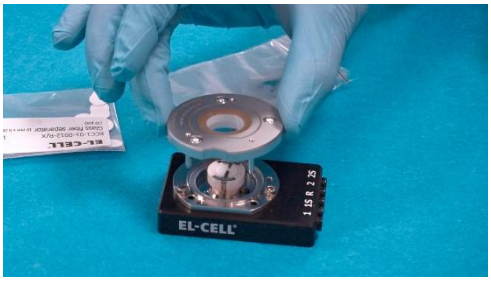


8. Drop the electrolyte onto the separator/electrodes. Use only the amount of electrolyte necessary to impregnate the porous material. Avoid excess electrolytes. Typically, around 30 µl of electrolyte is suitable.

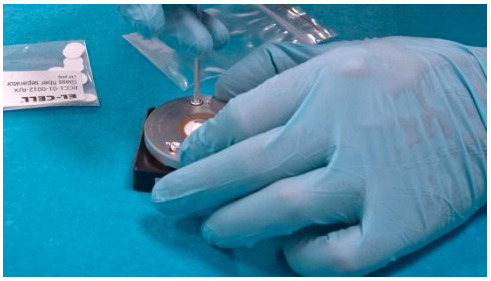
Note that the electrolyte will be squeezed out of the separator when the cell lid is attached.



9. Insert the PE foil seal.



10. Put on the cell lid. Make sure that the flat side of the cell base and the straight line on the lid are parallel.



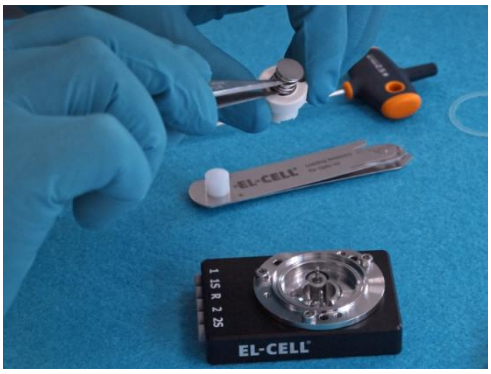
11. Double-check the proper alignment of the electrode strips.

Then press down the lid and tighten the three screws firmly with the 2.5 mm hexagon screwdriver.



12. The ECC-Opto-10 is now ready for testing. It can now be removed from the glove box.

6.3 Assembling the Cell With a Face-to-Face Sample Holder



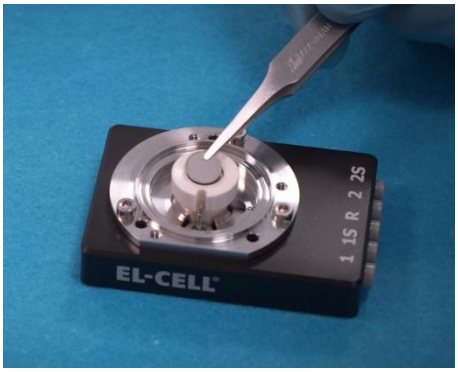
1. Follow the lid assembly steps. Then insert the lower piston into the inner sleeve.



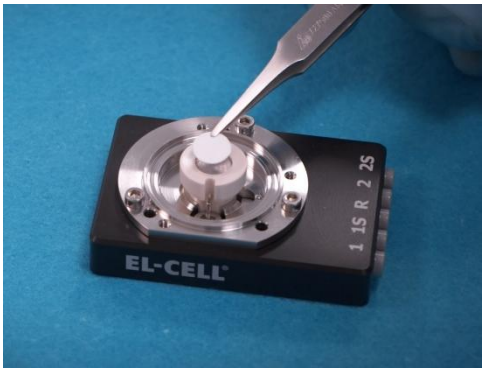
2. Use the loading tweezer to push the piston into the sleeve.



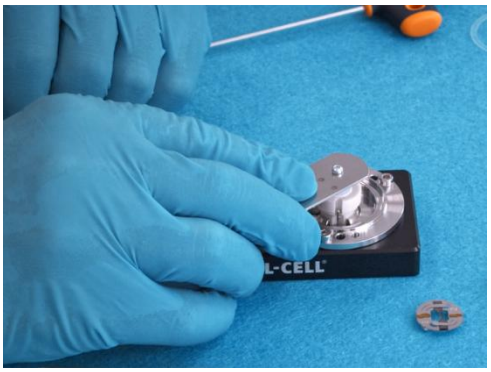
3. Place the assembly into the cell base.



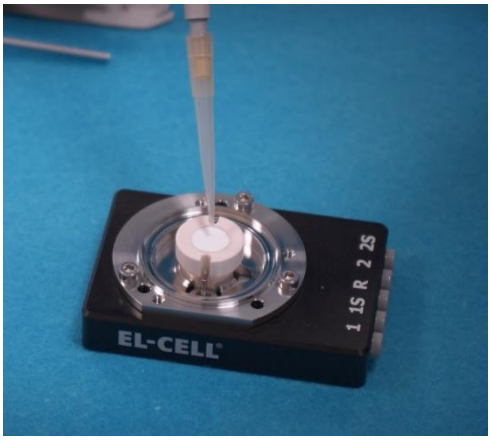
4. Put the electrode R, lithium metal, in this case, on top of the piston.



5. Put the separator on top. The separator must not exceed 10 mm in diameter. A smaller separator may be beneficial in preventing the sample holder from coming into contact with the electrolyte.

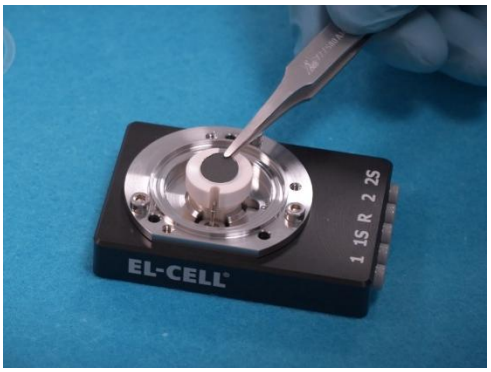


6. Use the loading tweezer again to push the cell stack further down.

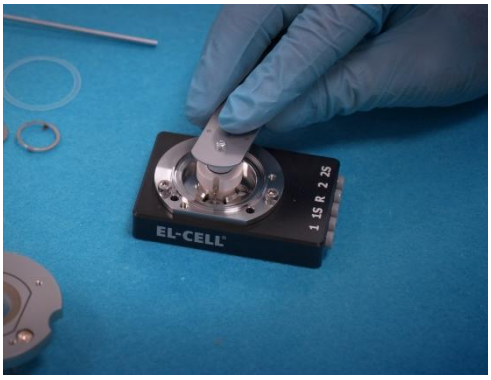


7. Drop the electrolyte onto the separator. Use only the amount of electrolyte necessary to impregnate the porous material. Avoid excess electrolytes. Typically, less than 50 µl of electrolyte is suitable.

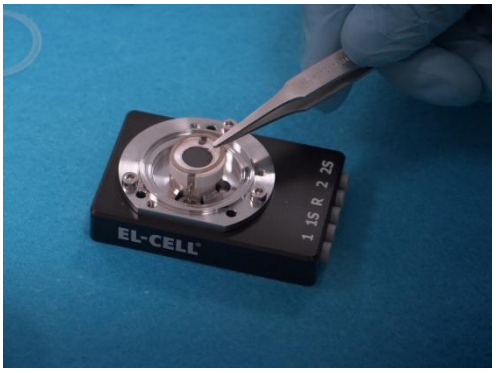
Note that the electrolyte will be squeezed out of the separator when the cell lid is attached.



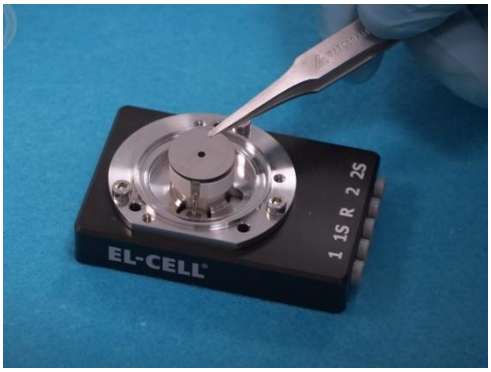
8. Put the self-standing electrode on top. If the electrode has a grid-like current collector, the grid must point downward toward the separator.



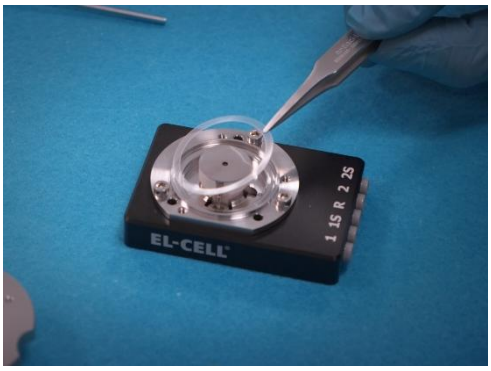
9. Push down the electrode stack using the loading tweezer.



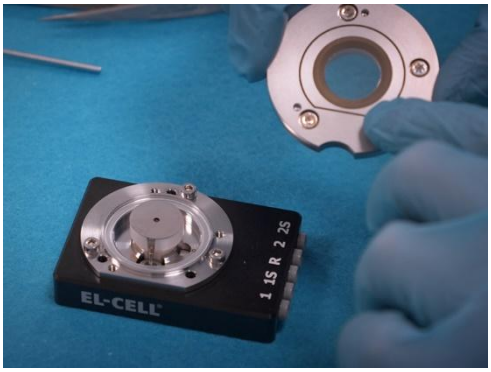
10. Insert the contact ring.



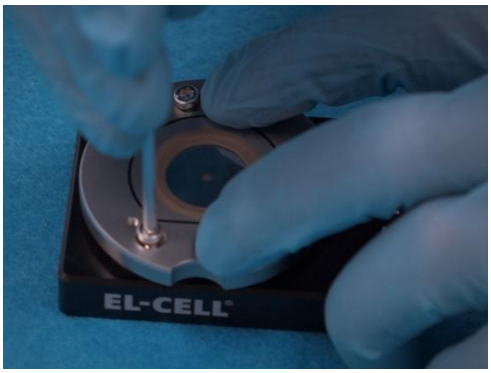
11. Put the holed current collector on top. Select the hole size according to the magnification used by the microscope.



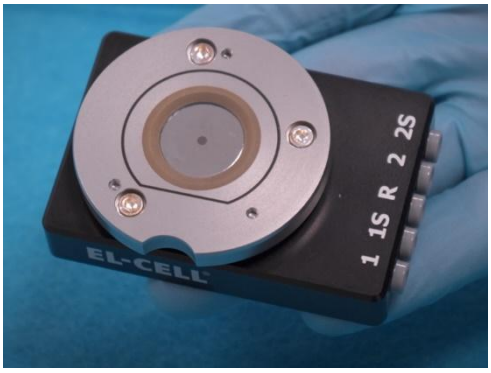
12. Insert the second foil seal.



13. Put on the cell lid. Make sure that the flat side of the cell base and the straight line on the lid are parallel.

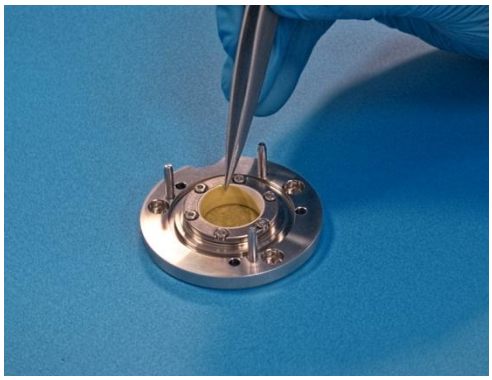


14. Finally, screw the cover on with the 2.5 mm hexagon screwdriver.

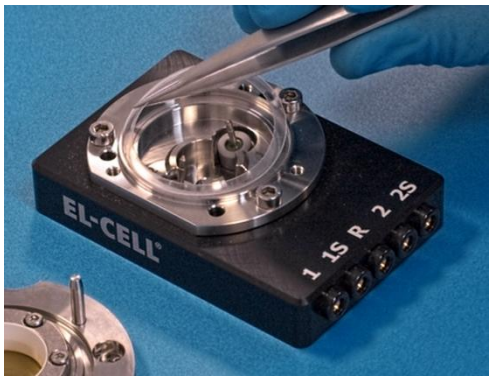


15. The ECC-Opto-10 is now ready for testing.

6.4 Assembling the Cell With a Face-to-Face Mesh Sample Holder and a Beryllium Window



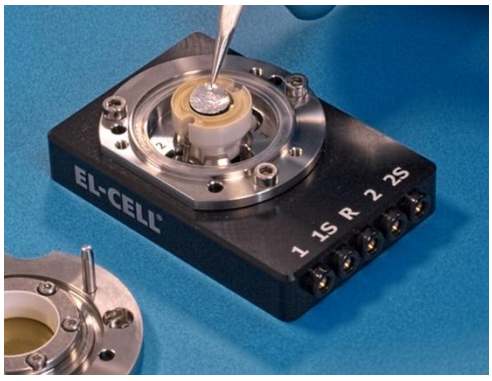
Place a polyimide film inside the lid to prevent chemical reactions with the beryllium during the experiment.



Insert a foil seal into the cell base.



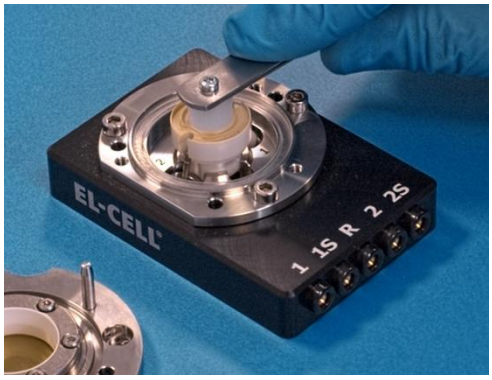
Insert the piston.



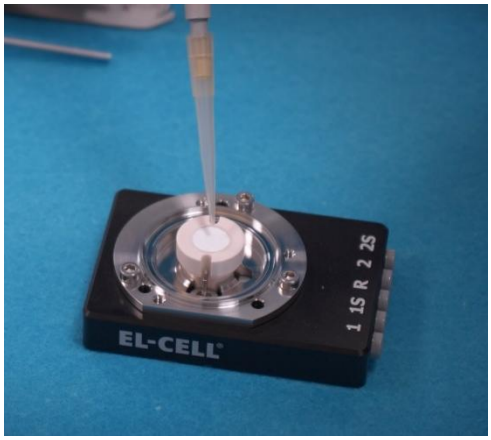
Place the lower electrode on top of the piston.



Put the separator on top of the electrode.

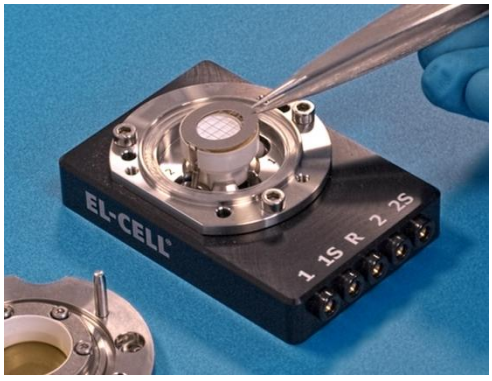


Push down the electrode stack using the loading tweezer.

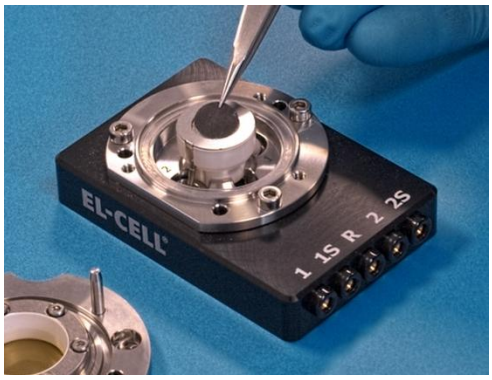


Drop the electrolyte onto the separator. Use only the amount of electrolyte necessary to impregnate the porous material. Avoid excess electrolytes. Typically, less than 50 µl of electrolyte is suitable.

Note that the electrolyte will be squeezed out of the separator when the cell lid is attached.



Next, position the mesh holder on the separator so that the two contact tabs fit into the recesses in the piston.



Place the self-supporting upper electrode in the centre of the mesh.



Put on the cell lid. Make sure that the flat side of the cell base and the straight line on the lid are parallel



Finally, screw the cover on with the 2.5 mm hexagon screwdriver.



The ECC-Opto-10 test cell is ready for testing an d can be removed from the glovebox.

7 Connecting the Test Cell

Connect your potentiostat to the cell's 2 mm sockets.

Please note: Sockets 1 and 1S are short-circuited inside the cell housing, as are sockets 2 and 2S.



7.1 Connecting the Test Cell to a PAT-Tester-x-8

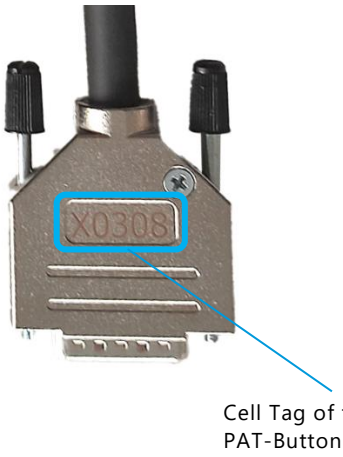
The **PAT-Channel-1 to Cell cable** (Order no.: ECE1-00-0324-A) is available for direct connection of the ECC-Opto-10 to a PAT-Tester-x-8 potentiostat.

The cable features banana plugs for connection to the cell and a Sub-D connector for connection to the PAT-Channel-1.

It also features a built-in PAT-Button for automatic detection in EL-Software. The cell tag displayed in the software is located on the Sub-D connector.



PAT-Channel-1 to Cell cable

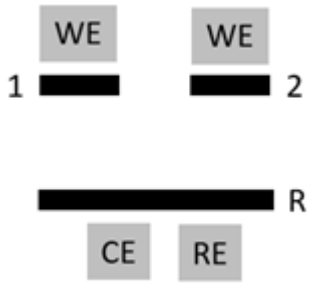


Cell Tag of the integrated PAT-Button

7.2 Connection Examples

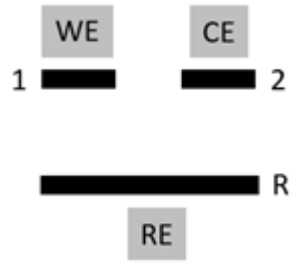
7.2.1 Connection Example 1 (Face-to-Face Setup)

Graphite disc (electrodes 1 and 2 shorted by sample holder) vs. Li metal disc (R)



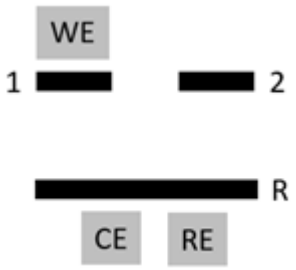
7.2.2 Connection Example 2: (3-Electrode Side-by-Side Setup)

NMC strip (1) vs. graphite strip (2) with Li metal disc (R) as reference



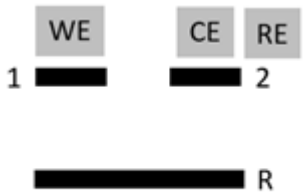
7.2.3 Connection Example 3: Side-by-Side Setup without Electrode 2

Graphite strip (1) vs. Li metal disc (R), electrode 2 is **not** used.



7.2.4 Connection Example 4: Side-by-Side Setup without Electrode R

Graphite strip (1) vs. Li metal strip (2), electrode R is **not** used



8 Disassembly and Cleaning

When working with aprotic, moisture-sensitive electrolytes such as $LiPF_6$, it is best to always leave the cell base and cell lid in the glove box. Expose cell components to room air only for cleaning or disposal.

Right after use, disassemble the cell in the reverse order of assembly. Dispose of all chemicals used properly. Clean all wetted parts with water and/or other appropriate solvents. Dry all parts immediately after cleaning at 80°C. All cell parts made of PPS are to be dried immediately after cleaning overnight at 120°C.

If the cell base is contaminated with electrolyte, clean it in the glove box with a cloth and a battery-compatible solvent such as DMC.

Never immerse the cell base in liquid. In particular, avoid contact of the electronic components on the bottom of the cell base with liquid.

Please note:

- Protect yourself against chemical hazards. Electrolytes may spill out during cleaning. Electrode materials and electrolytes may react with ambient atmosphere or solvents used for cleaning. Wear appropriate protective equipment, goggles, and gloves.
- Clean all cell parts right after disassembly. Leaving cell parts in contact with the ambient atmosphere while still being wetted with electrolyte may result in severe corrosion.

9 Unpacking

Check the contents of the packages against the list given below to verify that you have received all the components. Contact EL-CELL if anything is missing or damaged.

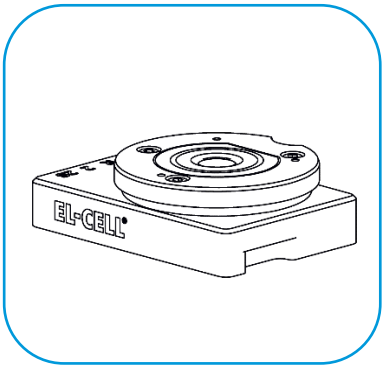
NOTE: Damaged shipments must remain with the original packaging for freight company inspection.

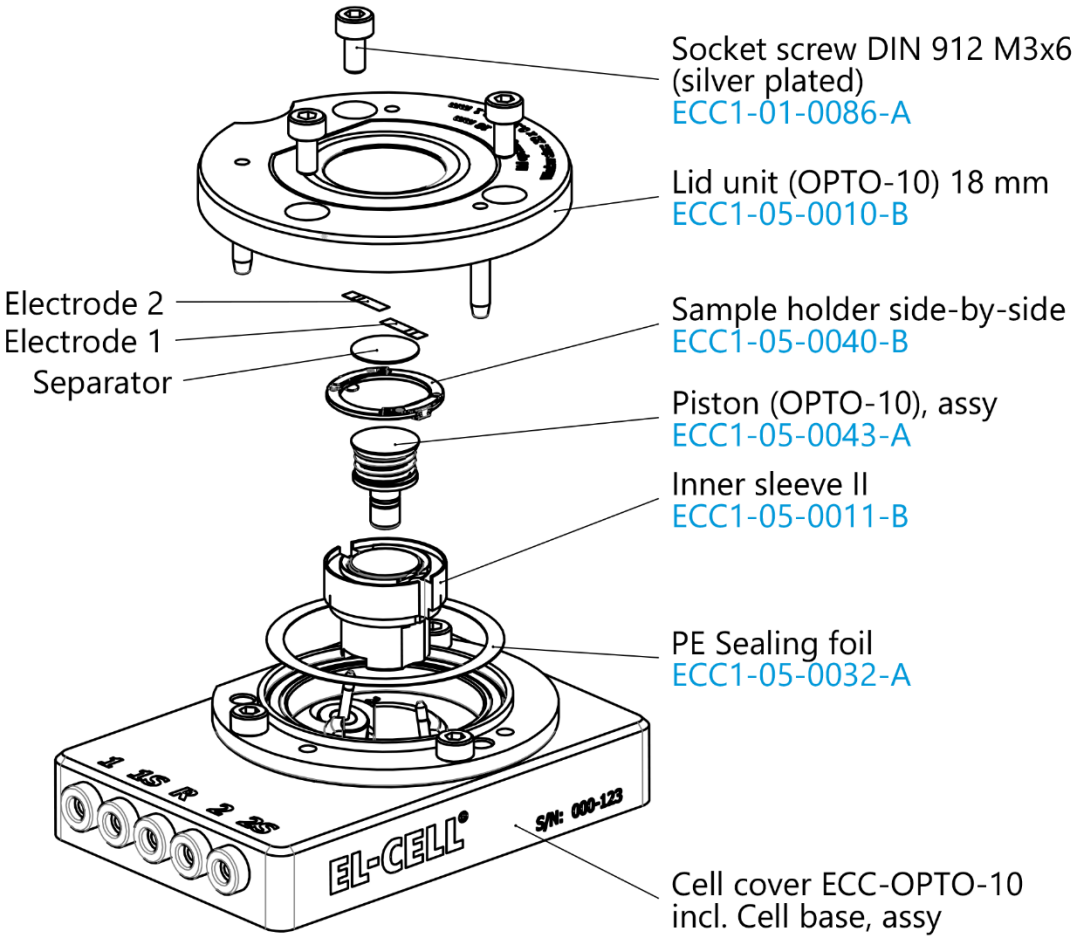
List of Components:

- **ECC-Opto-10** test cell with flat socket, fully equipped for use in both 2-electrode and 3-electrode configurations
- **Windows seal (10 pcs.)** ECC1-05-0016-B/X
- **Separator 10.0 mm x 0.26 mm, GF/A (10 pcs.)** ECC1-01-0012-R/X
- **PE Sealing foil (10 pcs.)** ECC1-05-0032-A/X
- **Loading tweezer** ECC1-09-2010-B
- **Torque screwdriver, 0.2 Nm, cross handle** WZG9021
- **Inbus bit 1.5 mm x ¼ inch** WZG9046
- **Hexagon screwdriver 2.5 mm, cross handle** WZG9047
- **Sample holder (side-by-side)** ECC1-05-0040-B
- **Contact ring (face-to-face)** ECC1-05-0039-C
- **Contact disc (50 fold)** ECC1-05-0042-C
- **Contact disc (100 fold)** ECC1-05-0042-A
- **Contact disc (200 fold)** ECC1-05-0042-B

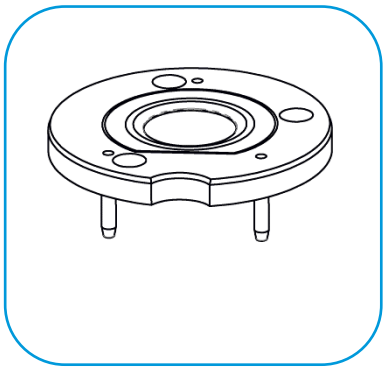
10 Components ECC-Opto-10

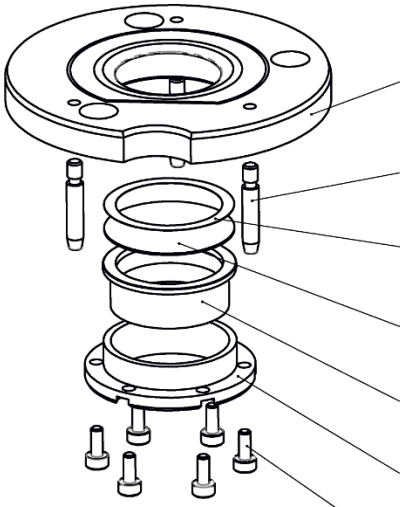
10.1 ECC-Opto-10





10.2 Lid unit (OPTO-10) 18 mm





Lid (OPTO-10) 18 mm
ECC1-05-0029-C

Guide pin
ECC1-05-0037-A

Window seal
ECC1-05-0016-B

ECC-OPTO Sapphire window (0.3 mm)
ECC1-00-0149-A

Window thrust ring II (Opto-10)
ECC1-05-0012-C

Window flange II (OPTO-10)
ECC1-05-0013-B

Socket screw
DIN 912 M2 x 4

11 Warranty

For a period of one year from the date of shipment, EL-Cell GmbH (hereinafter Seller) warrants the goods to be free from defects in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor, or, at the Seller's option, demand return of the goods and tender repayment of the price. The buyer's exclusive remedy is repair or replacement of defective and nonconforming goods, or, at the Seller's option, the repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or consequential incidental or special damages arising out of, resulting from, or relating in any manner to these goods.

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items. This warranty is void when repairs are performed by a non-authorized person or service center. At the Seller's option, repairs or replacements will be made on-site or at the factory. If repairs or replacements are to be made at the factory, the Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed by the laws of Germany.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supersedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.