Microcell HC basic setup

Electrochemistry served hot and cold

The Microcell HC basic setup has been designed to **adjust the sample temperature** when working with test cells from rhd instruments. Based on **Peltier element technique**, the accessible sample temperature range is **-40 °C to +100 °C**. The temperature is controlled with a **high accuracy of 0.1 °C** by means of precise Pt100 temperature sensors which are embedded in each test cell socket. Due to optimized control parameters and a very fast response to new temperature set points, temperature overshoots can be avoided.

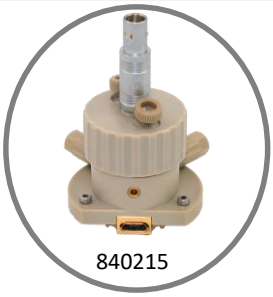
Typical Applications:

- Determination of the **temperature-dependent electrolyte conductivity.**
- Investigation of the temperature-dependent **structure and dynamics of buried interfaces**.
- Investigation of the **temperature-dependent behavior of electrochemical systems** in general.

Suggested Accessories

TSC 1600 closed

TSC battery



TSC surface

TSC spectro

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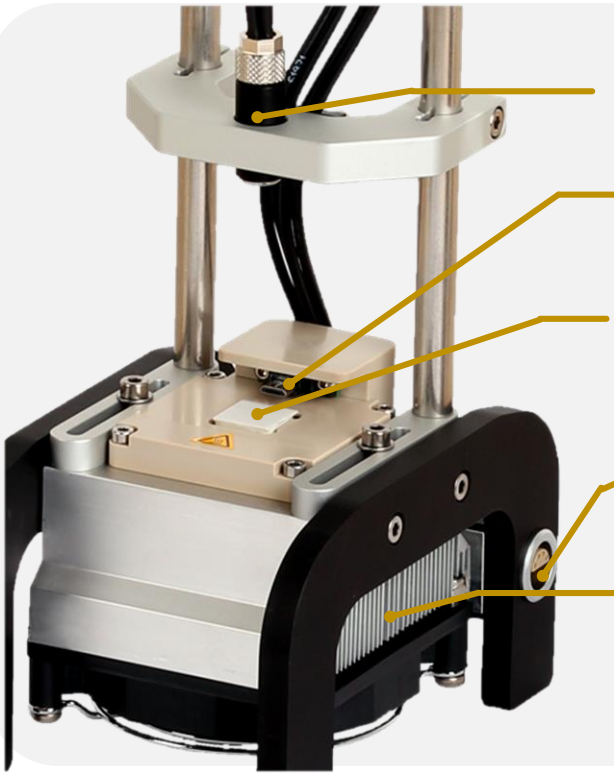
Microcell HC basic setup



Technical Specifications

Compatible test cells:	• TSC 70/1600 closed • TSC Sw closed • TSC battery • TSC surface • TSC spectro
Adjustable temperature range:	-40 °C* ↔ +100 °C *accessible in combination with rhd Cooling Box
Communication protocol (temperature controller)	Modbus RTU over RS232 or analog I/O* *requires MultiSourceBox
Mains voltage (temperature controller)	$U_{AC(rms)}$ = 100 to 240 V
Optional accessories:	• rhd Cooling Box (for lower temperatures) • MultiSourceBox

References

[1] J. Atik et al., *'Acyclic Acetals in Propylene Carbonate-Based Electrolytes for Advanced and Safer Graphite-Based Lithium Ion Batteries'*, *J. Electrochem. Soc.* **(2020)** *167*, *4*, 040509.
https://doi.org/10.1149/1945-7111/ab72dc

[2] A. Hatz et al., '*Faster Water-Assisted Lithium Ion Conduction in Restacked Lithium Tin Sulfide Nanosheets'*, *Chem. Mater.* **(2021)** *33*, *18*, 7337.
https://doi.org/10.1021/acs.chemmater.1c01755

[3] M. Ochs et al., '*Influence of Wettability on the Impedance of Ion Transport Through Mesoporous Silica Films'*, *Advanced Materials Interfaces* **(2021)** *8, 9*, 2002095.
https://doi.org/10.1002/admi.202002095

[4] D.-L. Versace et al., '*Highly Virulent Bactericidal Effects of Curcumin-Based μ-Cages Fabricated by Two-Photon Polymerization'*, ACS *Appl. Mater. Interfaces* **(2020)**, *12*, 5050.
https://dx.doi.org/10.1021/acsami.9b18693

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Microcell Passive setup

One setup for many electrochemistry applications

The Microcell Passive setup has been designed to **provide a simple and reliable test cell fixture** when working with test cells from rhd instruments.
The socket is made of anodized aluminium and offers a strain relief for the cables leading from the device to your test cell. The **test cell is** therefore kept **in place** and you have **significantly less wiring effort**. The cell fixture can be used inside of an oven or climate chamber to adjust the sample temperature. Optionally, the sample **temperature can be read out** from the Pt100 sensor embedded in the socket of each test cell

Typical Applications:

- Determination of the **electrolyte conductivity.**
- Investigation of the **structure and dynamics of buried interfaces**.
- Investigation of the **behavior of electrochemical systems** in general.

Suggested Accessories

840212

TSC 1600 closed

840214

TSC battery

840215

TSC surface

840216

TSC spectro

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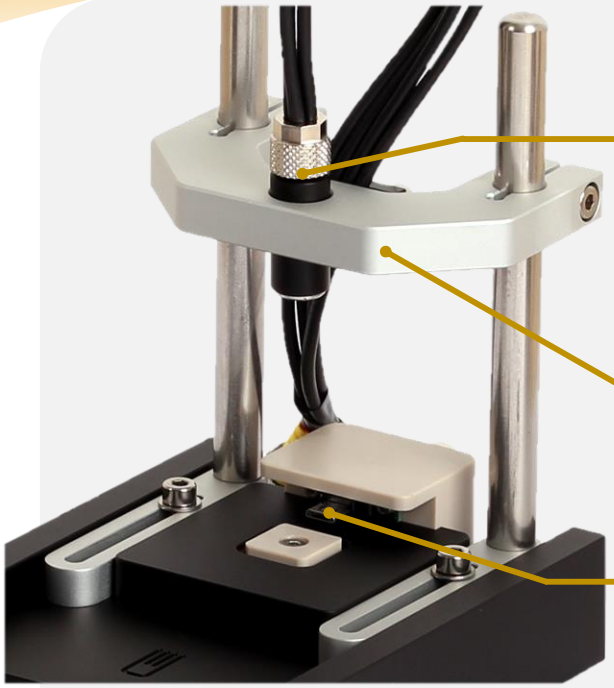
Microcell Passive setup



Technical Specifications

Compatible test cells:	• TSC 70/1600 closed • TSC Sw closed • TSC battery • TSC surface • TSC spectro • TSC raman
Temperature range during operation, e.g. inside of oven:	0 °C ↔ +75 °C
Rated values of cell stand	11.3 cm x 9.5 cm x 25.0 cm (L x W x H)
Optional accessories:	• Connector modification to read out sample temperature • Transducer box

References

[1] M. Kroll, '*Reconstruction-Simulation Approach Verifies Impedance-Derived Ion Transport Tortuosity of a Graphite Battery Electrode*', *J. Electrochem. Soc.* **(2018)**, *165*, *13*, A3156. https://doi.org/10.1149/2.0711813jes

[2] J. Schwaben *et al.* '*Efficient Syntheses of Novel Fluoro-Substituted Pentacenes and Azapentacenes: Molecular and Solid-State Properties*', *Chem. Eur. J.* (**2015**) *21*, *39*, 13758. https://doi.org/10.1002/chem.201501399

[3] J. Speulmanns et al., '*Atomic Layer Deposition of Textured Li4Ti5O12: A High-Power and Long-Cycle Life Anode for Lithium-Ion Thin-Film Batteries*', *Small* **(2021)** *17*, *34*, 2102635. https://doi.org/10.1002/smll.202102635

[4] L. Lohmeyer et al., '*1,2,5,6-Tetrakis(guanidino)-Naphthalenes: Electron Donors, Fluorescent Probes and Redox-Active Ligands*', *Chem. Eur. J.* **(2020)** *26*, *26*, 5834. https://doi.org/10.1002/chem.201905471

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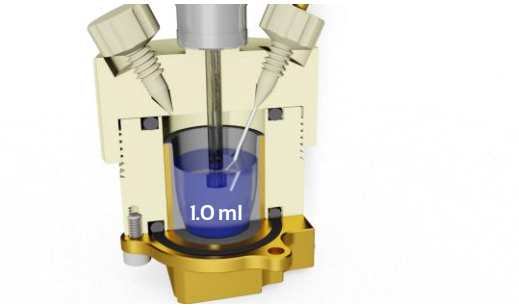
TSC 1600 closed

The classic one - for liquid electrochemistry

The TSC 1600 closed enables the electrochemical studies on **liquid air-** and **moisture-sensitive samples**, requiring **only 1.0 ml sample** volume. A **platinum crucible** serves as sample container, and usually as counter electrode as well. The cap contains four **separate platinum electrodes** insulated by glass. Two additional ports for capillaries and reference electrodes ensure a **high level of flexibility**.



Typical Applications:

- **Conductivity determination** by impedance spectroscopy
- Determination of the **electrochemical stability window** by cyclic voltammetry

Suggested Accessories

840101

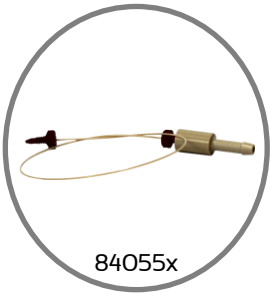
Microcell HC Basic Package

840582

Microcell Passive

84052x

Micro-Reference Electrodes



84055x

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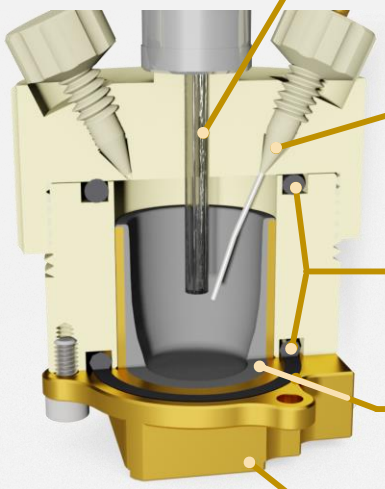
TSC 1600 closed



Technical Specifications

Suitable samples:	Liquid, gels with low viscosity
Temperature range:	-40 °C ↔ +100 °C
Materials in sample contact:	PEEK, Pt, lime soda glass, EPDM
Sample volume:	1.0 ml
Diameter Pt electrode in glass:	0.25 mm each
Option:	Cap with exchangeable electrode tips

References

[1] J. Atik *et al.*, *'Acyclic Acetals in Propylene Carbonate-Based Electrolytes for Advanced and Safer Graphite-Based Lithium Ion Batteries'*, *J. Electrochem. Soc.* **(2020)** *167, 4*, 040509.

https://doi.org/10.1149/1945-7111/ab72dc

[2] J. Landesfeind, H. Gasteiger, *'Temperature and Concentration Dependence of the Ionic Transport Properties of Lithium-Ion Battery Electrolytes'*, *J. Electrochem. Soc.* **(2019)** *166, 14*, A3079.

https://doi.org/10.1149/2.0571912jes

[3] J. Schwaben *et al.* *'Efficient Syntheses of Novel Fluoro-Substituted Pentacenes and Azapentacenes: Molecular and Solid-State Properties'*, *Chem. Eur. J.* (**2015**) *21, 39*, 13758.

https://doi.org/10.1002/chem.201501399

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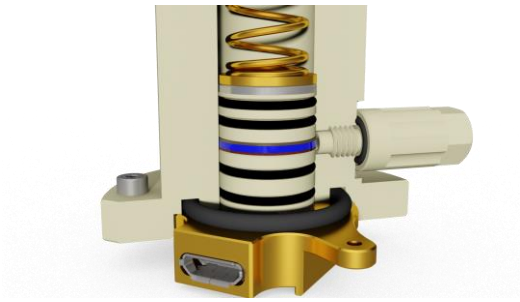
TSC battery

The Allrounder for Polymeric and Solid Samples

The TSC battery cell family enables electrochemical studies on **liquid air-** and **moisture-sensitive polymeric and solid samples**, requiring **only small sample amounts**. The sample is contacted by two stainless steel current collector electrodes in a sandwich-like assembly. By default, the PEEK housing contains **two lateral ports** for inserting **reference electrodes** or capillaries ensuring a **high level of flexibility**. Coming with two contact springs with different spring loads, the **stack pressure can be adjusted** to values up to ca. 10 bar.



Typical Applications:

- Determination of the **conductivity of solid and polymeric electrolytes**
- Determination of **MacMullin numbers of separator foils**
- Determinaton of **tortuosity values of active materials**

Suggested Accessories

840101

Microcell HC Basic Package

840582

Microcell Passive

840541

Spacer set

840531

Metal disc electrodes

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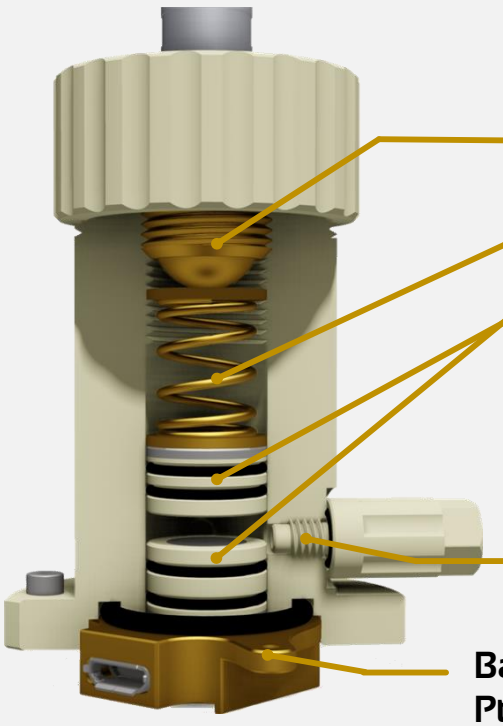
TSC battery



Technical Specifications

Suitable samples:	Polymeric foils, solid pellets
Temperature range:	-40 °C ↔ +100 °C
Materials in sample contact:	PEEK, stainless steel 1.4404, EPDM
Max. sample diameter	12.0 mm
Max. sample thickness with min. stack pressure	2.4 mm
Spring rates	2.4 N/mm 32.6 N/mm
Options:	• Electrode with punching edge • Housing w/o ports

References

[1] A. Hatz et al., '*Faster Water-Assisted Lithium Ion Conduction in Restacked Lithium Tin Sulfide Nanosheets*', *Chem. Mater.* **(2021)** *33*, *18*, 7337. **https://doi.org/10.1021/acs.chemmater.1c01755**

[2] C. Alter et al., '*Synthesis and characterization of a novel highly phosphonated water-insoluble polymer*', *J. Appl. Polym. Sci.* **(2020)**, *137*, 48235. **https://doi.org/10.1002/app.48235**

[3] M. Kroll, '*Reconstruction-Simulation Approach Verifies Impedance-Derived Ion Transport Tortuosity of a Graphite Battery Electrode*', *J. Electrochem. Soc.* **(2018)**, *165*, *13*, A3156. **https://doi.org/10.1149/2.0711813jes**

[3] L. Negre et al. , '*Ionogel-based solid-state supercapacitor operating over a wide range of temperatures*', *Electrochimica Acta* **(2016)** *206*, 490. **https://doi.org/10.1016/j.electacta.2016.02.013**

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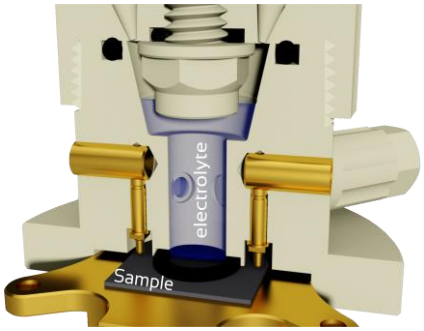
TSC surface

The Allrounder for Studying Liquid | Solid Interfaces

The TSC surface cell enables electrochemical studies on **liquid air-** and **moisture-sensitive electrolytes in contact with solid samples**, requiring **only a low electrolyte volume**. The solid sample is contacted either from below via cell base or from above via contact pins. This enables experiments with insulating materials covered with conductive layers. By default, the test cell comes with a **glassy carbon counter electrode**. The PEEK housing contains **two lateral ports** for inserting **reference electrodes** or **capillaries**.



Typical Applications:

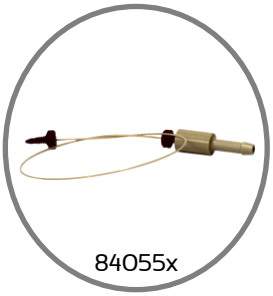
- Determination of **properties of thin layers** on conductive templates
- Investigation of the structure of **electrochemical double layers**
- Investigation of **redox reaction** and the influence of catalytic coatings

Suggested Accessories

Microcell HC
Basic Package

Microcell
Passive

Micro-Reference
Electrodes



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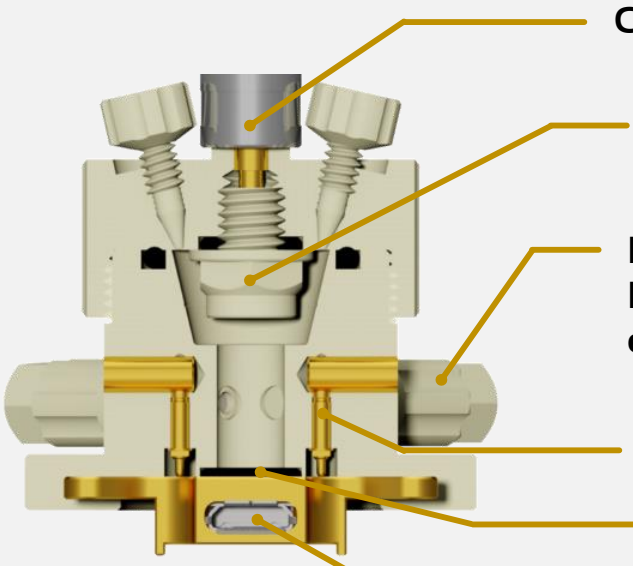
TSC surface



Technical Specifications

Suitable samples:	Flat (coated) samples, liquid electrolytes
Temperature range:	-40 °C ↔ +100 °C
Materials in sample contact:	PEEK, FFKM/EPDM, glassy carbon
Min. template size	12.0 mm (disc Ø) 10.0 mm (rectangle)
Max. template size	20.0 mm (disc Ø) 15.0 mm (rectangle)
Electrolyte volume	0.6 ml
Options:	• Other electrode materials, e.g. Pt • Re-fillable reference electrode

References

[1] J. Speulmanns et al., '*Atomic Layer Deposition of Textured Li4Ti5O12: A High-Power and Long-Cycle Life Anode for Lithium-Ion Thin-Film Batteries*', *Small* **(2021)** *17*, *34*, 2102635.
https://doi.org/10.1002/smll.202102635

[2] M. Ochs et al., '*Influence of Wettability on the Impedance of Ion Transport Through Mesoporous Silica Films*', *Advanced Materials Interfaces* **(2021)** *8*, *9*, 2002095.
https://doi.org/10.1002/admi.202002095

[3] T. Kranz et al., '*Interrelation between Redox Molecule Transport and Li+ Ion Transport across a Model Solid Electrolyte Interphase Grown on a Glassy Carbon Electrode*', *J. Electrochem. Soc.* **(2017)**, *164*, *14*, A3777.
https://doi.org/10.1149/2.1171714jes

[4] J. Wallauer et al., '*Electrochemical Kinetics of Ferrocene-Based Redox-ILs Investigated by Multi-Spectrum Impedance Fitting*', *J. Phys. Chem. C* **(2017)**, *121*, *48*, 26706.
https://doi.org/10.1021/acs.jpcc.7b09693

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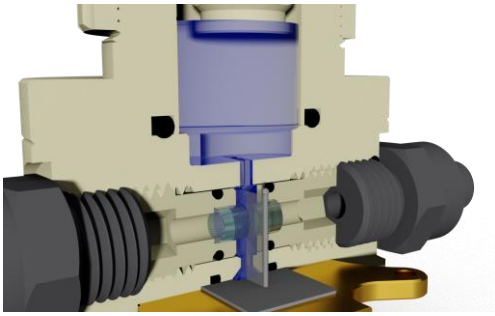
TSC spectro

A must have for UV/Vis spectro-electrochemistry

The TSC spectro cell enables **UV/Vis spectro-electrochemical studies in transmission** configuration on solutions of **air- and moisture-sensitive redox- and UV/Vis-active species**, requiring **only a small volume of electrolyte**. A **platinum mesh** is used as working electrode and **glassy carbon** as counter electrode. By default, the cell comes with **quartz glass windows**, whose **distance** from each other **can be adjusted**. The PEEK housing, as well as the cap, provide **ports for** the insertion of **reference electrodes and capillaries**.



Typical Applications:

- Investigations on **UV/Vis active redox species**
- **Permeability determination of membranes** for UV/vis active molecules
- Determination of the **life time** of short living intermediary species

Suggested Accessories

840101

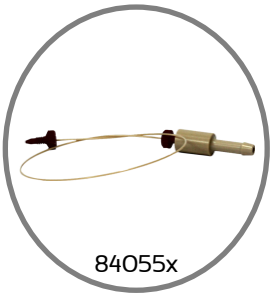
Microcell HC Basic Package

840582

Microcell Passive

84052x

Micro-Reference Electrodes



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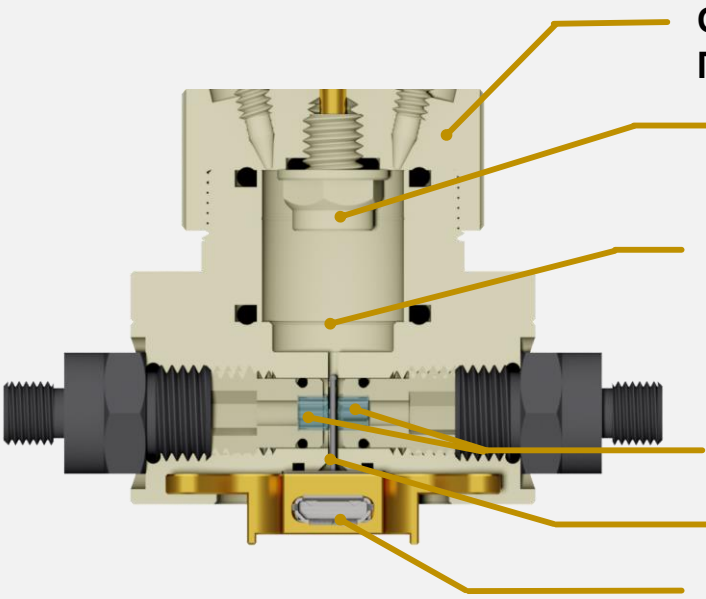
TSC spectro



Technical Specifications

Suitable samples:	Solutions of redox- and UV/vis-active species
Temperature range:	-20 °C ↔ +80 °C
Materials in sample contact:	PEEK, FFKM/EPDM, platinum, glassy carbon, quartz glass
Sample volume (standard)	2 ml
Min. sample volume (elongated counter electrode)	0.5 ml
Pt mesh electrode	152x152 wires/inch 56% open area
Options:	• Alternative counter electrode materials • Re-fillable reference electrode

References

[1] D.-L. Versace et al., '*Highly Virulent Bactericidal Effects of Curcumin-Based μ-Cages Fabricated by Two-Photon Polymerization*', ACS *Appl. Mater. Interfaces* **(2020)**, *12*, 5050.
https://dx.doi.org/10.1021/acsami.9b18693

[2] L. Lohmeyer et al., '*1,2,5,6-Tetrakis(guanidino)-Naphthalenes: Electron Donors, Fluorescent Probes and Redox-Active Ligands*', *Chem. Eur. J.* **(2020)** *26*, *26*, 5834.
https://doi.org/10.1002/chem.201905471

[3] L. Finger et al., '*Halide-Free Synthesis of Hydrochalcogenide Ionic Liquids of the Type [Cation][HE] (E=S, Se, Te)*', *Chem. Eur. J.* **(2016)** *22*, *12*, 4218.
https://doi.org/10.1002/chem.201504577

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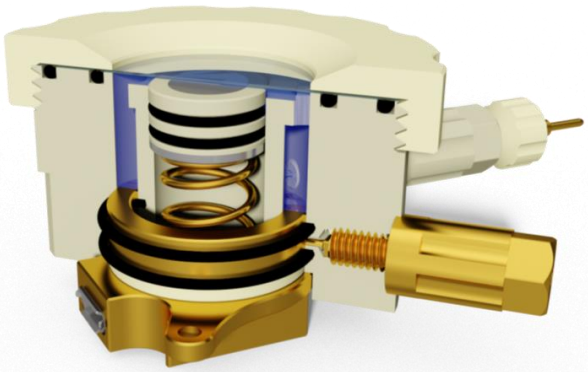
TSC Raman

Designed for in situ Raman spectro-electrochemistry

The TSC Raman enables **in-situ Raman spectro-electrochemical studies** of interfaces between electrode materials and electrolyte solutions that are **air- and moisture-sensitive**. A stainless steel electrode is used as support for the working electrode material and a gold-plated stainless steel ring as counter electrode. By default, the cell comes with a **quartz glass window**. The PEEK housing provides **ports for** the insertion of **reference electrodes and capillaries**.



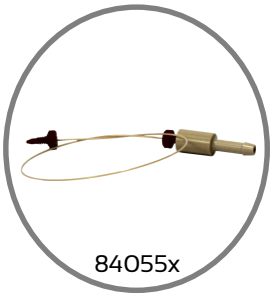
Typical Applications:

- Investigations on **battery electrode material | battery electrolyte**
- Study of **corrosion processes at metal surfaces** in contact with salt solutions in different solvents
- **SERS** experiments to shed light on double layer structures.
- All types of **light exposure experiments**

Suggested Accessories

840582
Microcell Passive

84052x
Micro-Reference Electrodes



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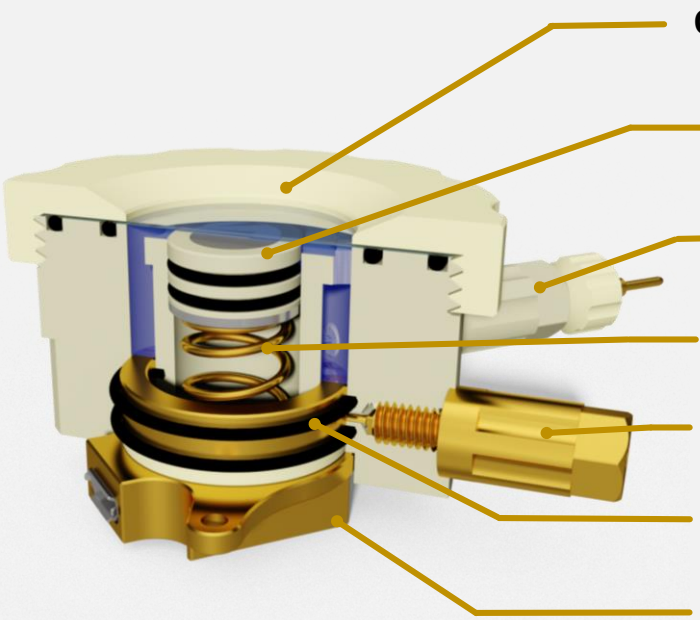
TSC Raman



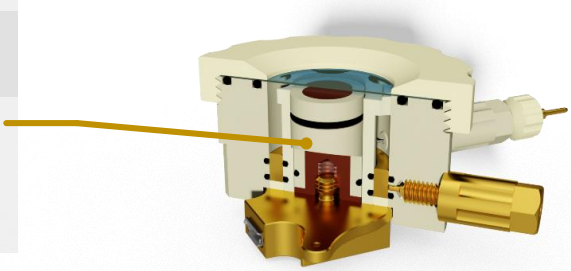
Technical Specifications

Suitable samples:	Raman-active species and interfaces
Temperature range:	+10 °C ↔ +30 °C
Materials in sample contact:	PEEK, FFKM, stainless steel, gold, quartz glass
Sample volume (standard)	2 ml
Requirements for working electrode material	Ø 12 mm, material coated on conductive substrate
Thickness of quartz window	0.5 mm
Options:	• WE contact with fixed height • Customization possible

References

[1] H. Radinger et al., *'Manganese Oxide as Inorganic Catalyst for the Oxygen Evolution Reaction Studied by X-Ray Photoelectron and Operando Raman Spectroscopy'*, *ChemCatChem* **(2021)**, *13*, 4, 1175. https://doi.org/10.1002/cctc.202001756

[2] H. Radinger et al., *'Importance of Nickel Oxide Lattice Defects for Efficient Oxygen Evolution Reaction'*, *Chem. Mater.* **(2021)**, *33*, *21*, 8259. https://doi.org/10.1021/acs.chemmater.1c02406



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