



ASC PRODUCT

CATALOG

YEAR 2024



NEXT GENERATION BATTERY TESTING

WWW.SPHERE-ENERGY.EU

ADDRESS : 250BIS BOULEVARD SAINT GERMAIN, 75007 PARIS, FRANCE

PHONE +33 7 69 07-62-70

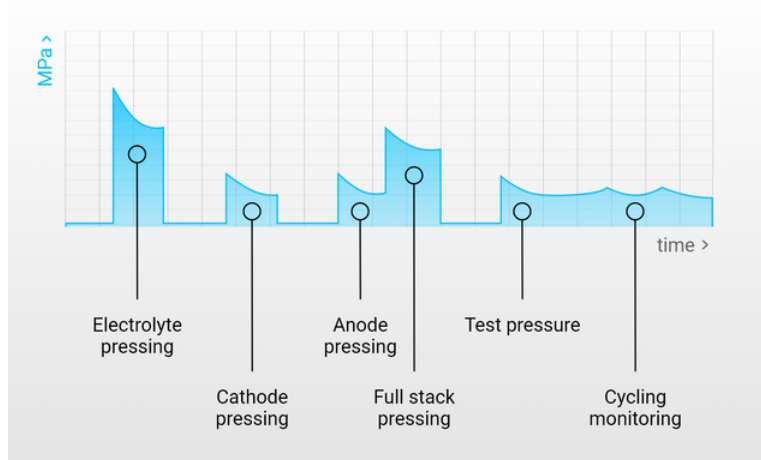
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Focus on what matters the most for solid-state battery research

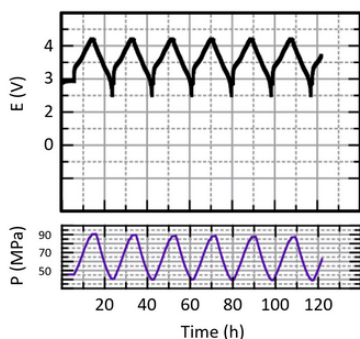
The field of solid-state battery research often faces the challenge of conducting electrochemical tests on complex samples under specific mechanical conditions. Sphere Energy has responded to this challenge by designing a range of testing equipment that is customized to meet the requirements of experiments in this area of research. Our equipment is designed to provide support in various aspects, including sample preparation, pressure, and thickness monitoring, making testing more convenient and streamlined.



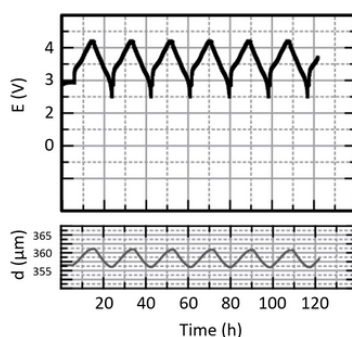
Key aspects for reproducibility and data reliability
 Pressure tracking from the initial state of sample preparation until the end of the electrochemical tests.

Direct access to relevant data

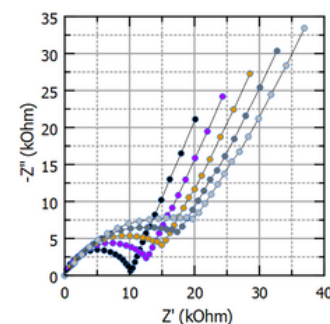
We have designed our setups to offer you convenient access to essential data while conducting tests on solid-state battery materials. Through our testing cells, pressure can be monitored not only during the sample preparation protocol but also along the entire electrochemical test phase, generating important insights about the electro-chemo-mechanical performance of your studied systems.



Pressure monitoring data of electrochemical tests.



Sample size (thickness) monitoring during electrochemical tests.



EIS measurements of a sample over different temperatures.

Pressure, thickness, and temperature are some of the parameters covered by our setup. You will find many other options to enrich your R&D activities in the following pages of this catalog. Enjoy it!



Everything you need for solid-state battery testing

Electrochemical test under precise sample geometry and pressure control

PRESSURE BEHAVIOUR OF SAMPLES DURING TEST

All ASC setups are engineered to facilitate the preparation of solid-state battery samples by enabling the in-situ pelletization of various complex material layers within the cells. The integration of each setup with a pressure monitoring system provides the capability to continuously track the pressure applied both during the formation of the sample and throughout subsequent testing phases.

Adapted setups: ASC-T+ / ASC-AD+ / ASC-A+ / ASC-AD / ASC-G / ASC-C*

**In combination with ASC pressure frame.*

Ionic conductivity measurements

EIS MEASUREMENTS UNDER PRECISE PRESSURE APPLICATION AND THICKNESS MONITORING

Our systems enable accurate monitoring of sample dimensions under applied pressure, allowing for precise correlation with impedance values and enabling exact estimations of ionic conductivity in your experiments.

Adapted setups: ASC-T+ (practical for Arrhenius plots) / ASC-A+*

**In combination with ASC pressure frame and thickness measuring options.*

Swelling tests under fixed pressure protocols

VOLUME EXPANSION AND CONTRACTION DURING ELECTROCHEMICAL TESTS

In order to get insights into breathing and swelling behavior of solid-state batteries during electrochemical tests, our setups can be combined with thickness monitoring options and the pressure can be applied via springs for fixed pressure testing protocols.

Adapted setups: ASC-T+ / ASC-AD+ / ASC-A+*

**In combination with ASC pressure frame, thickness measuring options and spring options.*

Advanced electrochemical tests with reference-electrode

ANODE AND CATHODE DECONVOLUTED VOLTAGE INFORMATION

The ASC-T+ is equipped with metallic-based reference-electrode imbedded in the internal insulation sleeve and placed at the center of the sample. Offering a flexible playground for research on solid-state batteries.

Adapted setups: ASC-T+

Advanced characterization via gas analysis

REALTIME GAS ANALYSIS OF DECOMPOSITION REACTIONS DURING ELECTROCHEMICAL TESTS

The ASC-G's built-in gas flow channels enable direct and efficient interfacing with gas analysis equipment for comprehensive gas evaluation in electrochemical tests.

Adapted setups: ASC-G



Research made simple

Compact design

- Product dimensions designed for optimal use under lab conditions.
- Perfectly suitable for glove-box handlings and transfers.

Simple usability under difficult conditions

- Reproducible results by monitoring all important parameters during testing and preparation steps.
- Prepare battery materials at their measurement location to avoid cross-contamination and pellet damage.
- A broad range of features covering: airtight cells, fixed distance pressurization, dynamic pressure management, gas analysis, temperature control, resistance measurement probe, reference-electrode, pressure and thickness monitoring.
- Simplified sample material loading thanks to the symmetric cell design.
- Long-lasting design thanks to high-end materials and replaceable wear parts.
- Time-saving mechanisms paving the way to high throughput battery testing

Modular approach

- The ASC family is made from intercompatible products - so you can easily enlarge your testing possibilities and capacities whenever needed.



ASC PORTFOLIO

SETUP OVERVIEW



ASC-T+

Advanced testing

Precision analysis of materials with pressure monitoring, temperature control and reference-electrode option.



ASC-A+

Screening tests

Airtight setup for electrochemical tests and screening of materials.



ASC-AD

Pressure stabilization

Airtight setup for tests under constant internal pressure application.



ASC-G

Gas analysis

Electrochemical testing setup for coupled in-situ analysis of gases released by battery materials.



ASC-C

Upscaled samples

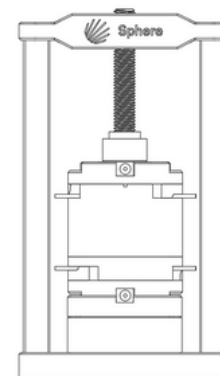
Test cell allowing large samples of up to 25 mm of diameter to reach up to 400 MPa.



ASC-AD+

Low-pressure ranges

Test setup for advanced measurements focused on pressures up to 100 MPa.



Dimensions: 210 x 120 x 100 mm

Weight: 5.5 kg

Pressure range: 0-400 MPa

Temperature range: 25 to 200°C

The ASC-T+

Advanced tests on solid-state batteries and battery materials

The ASC-T+ is a versatile setup designed specifically for tests on solid-state battery research. It provides great flexibility to meet various research requirements, which is crucial in this fast-evolving battery industry.

The setup comes with a built-in temperature control system, ensuring accurate experiments up to 200°C. Pressure application and monitoring are achieved through the use of a mechanical press (pressure frame) also provided with the setup.

Additionally, the system is capable of accommodating multiple sample sizes, ranging from 8 mm to 14.5 mm, resulting in a 3.3 times increase in the active surface area. This adaptability is essential for the development of new materials and advanced battery systems.

MAIN FEATURES

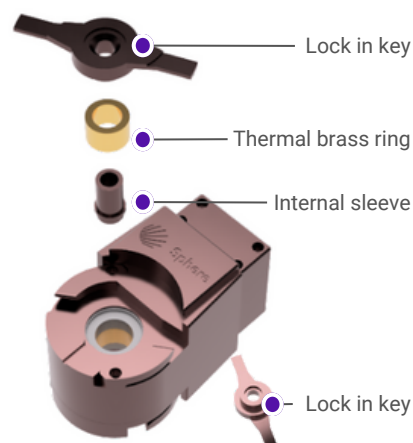
- Multiple sample sizes
- Pressure Monitoring
- Temperature control
- Exchangeable int. sleeves
- Reference electrode
- Compact dimensions
- Fixed pressure mode

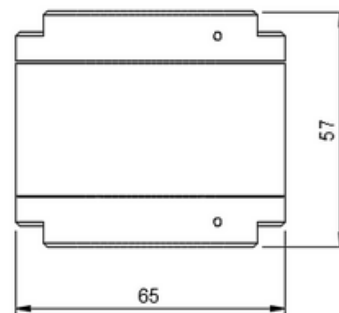
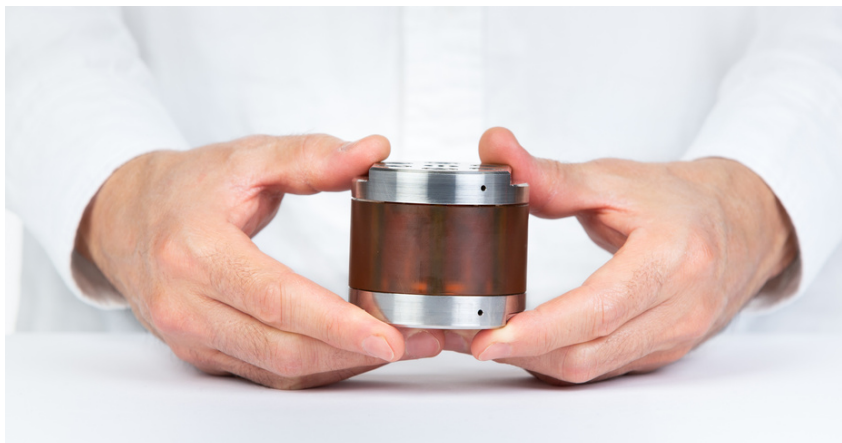
ADD-ON OPTIONS

- Fixed thickness mode
- Swelling monitoring
- Multiple spring constants
- 4-point probe resistivity

ASC-T+ setup contains:

- 1x ASC-T+ test cell equipped with built-in temperature control system
- 1x Set of pistons and internal sleeves for multiple sample diameters (8, 10, 12 and 14.5mm)
- 1x Ceramic sleeve for samples of 8 mm of diameter
- 1x Internal sleeve with reference-electrode based on Cu
- 1x Sample removing tool
- 1x Holder for weighing and loading materials in the cell
- 1x Pressure frame equipped with a pressure sensor for material pressing and pressure monitoring
- 1x Control unit equipped with a temperature control system, pressure display and analogical output for pressure data transmission to potentiostat, cyler or computer
- 1x Glove box feedthrough adaptor, set of cables and connection leads





Dimensions: 65 x 65 x 57 mm
Weight: 650 g
Pressure range: 0-400 MPa
Temperature range: -20 to 120°C

The ASC-A+

Airtight electrochemical testing cell for experiments under controlled pressure conditions.

The ASC-A+ setup is a practical solution for testing solid-state battery materials. It ensures pressure control and maintains an airtight environment, which are critical factors to consider during testing. The setup can function as a standalone cell and can be directly connected to the measuring potentiostat. The air-sealing system is based on Swagelok ferrules, which are placed in the pistons of the cell.

Pressure application is facilitated through six screws positioned around the cell, with the torque applied to these screws dictating the pressure level. This setup includes a calibrated torque wrench and a corresponding table that maps torque values to specific pressure levels, allowing for meticulous control over the sample's internal pressure.

Additionally, the ASC-A+ is designed to be compatible with the ASC pressure frame, enabling sample preparation and in-operando pressure monitoring.

ASC-A+ setup contains:

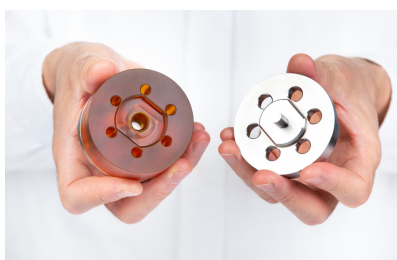
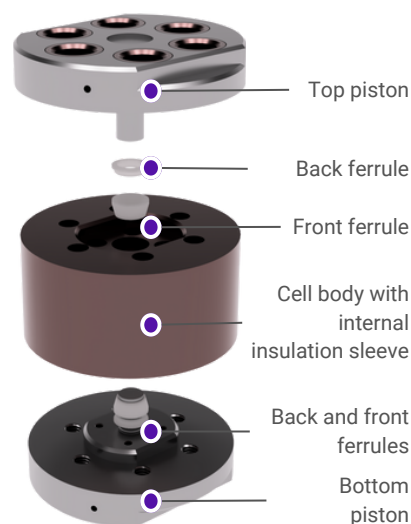
- 1x ASC-A+ test cell
- 1x Torque wrench for manual pressure setting
- 2x Internal insulation sleeves made in PEEK
- 1x Sample removing tool
- 1x Holder for weighing and loading materials in the cell
- 1x Set of tools, sealing ferrules and cables

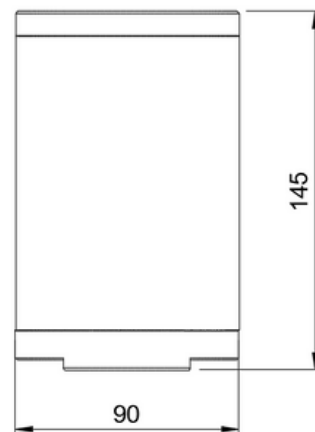
MAIN FEATURES

- Airtight
- Large pressure range
- Fixed thickness mode
- Sample diameter 8 mm
- Exchangeable int. sleeves

ADD-ON OPTIONS

- Pressure monitoring
- Swelling monitoring
- Fixed thickness mode
- Multiple spring constants





The ASC-AD+

Airtight electrochemical testing cell tailored for low-pressure conditions and under multiple cell configurations.

The ASC-AD+ is our latest product for solid-state battery testing, designed to effortlessly explore multiple sample dimensions while providing crucial data on pressure and swelling through a streamlined, user-friendly interface.

This airtight setup allows for increasing the surface area of the samples up to 3.3-fold. The built-in pressure sensor generates real-time pressure information during the tests. All this with the possibility of tuning the setup for experiments under various pressure values, from a few kPa to 100 MPa, via the fixed thickness mode (pistons blocked) or via the constant pressure mode (piston connected with spring).

The ASC-AD+ setup can also be equipped with a thickness monitoring system for precisely tracking the swelling of battery cells, providing valuable insights into the mechanical properties of battery materials.

Dimensions: 90 x 90 x 145 mm
Weight: 650 g
Pressure range: 0-100 MPa
Temperature range: -20 to 75°C

MAIN FEATURES

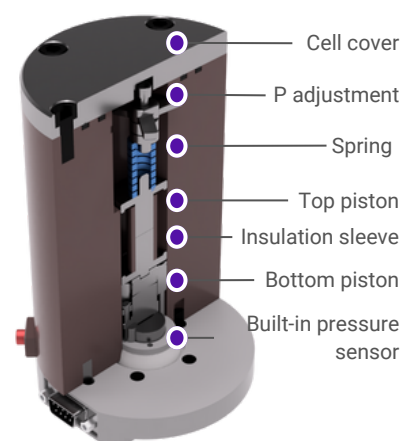
- Multiple sample sizes
- Pressure monitoring
- Swelling monitoring
- Built-in pressure sensor
- Fixed thickness mode
- Fixed pressure mode
- Exchangeable int. sleeves
- Multiple spring constants

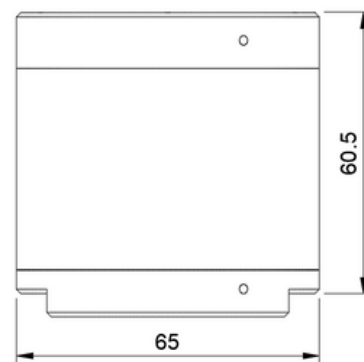
ADD-ON OPTIONS

- Swelling monitoring

ASC-AD+ setup contains:

- 1x ASC-AD+ electrochemical test cell
- 1x Control unit equipped with pressure display and analogical output for pressure data transmission to potentiostat, cycler or computer
- 1x Set of pistons and internal sleeves for multiple sample diameters (8, 10, 12 and 14.5mm)
- 1x Glove box feedthrough adaptor
- 1x Sample removing tool
- 1x Holder for weighing and loading materials in the cell
- 1x Set of loading tools and adaptors for sample preparation
- 1x Set of tools, springs, sealing o-rings and cables





The ASC-AD

Airtight electrochemical cell for tests under constant pressure.

The ASC-AD is a practical setup for electrochemical tests under stable conditions of applied pressure. This setup offers an active pressure balancing system, ensuring that the initially set stacking pressure is kept constant during the expansion or contraction of the tested materials. This is key for optimal results in long-term electrochemical cycling.

The dynamic pressure applied during the tests can be perfectly customized from 5 to 100 MPa via a variety of plungers and a selection of springs having different spring coefficients. During the sample preparation phase, the setup can apply up to 400 MPa using the pressure tool delivered with the setup. This setup is also airtight based on Swagelok ferrules and can be used for testing air-sensitive materials outside the glove box.

The ASC-AD can be used in combination with the pressure frame for sample preparation only, for example during the stage of sample densification inside the glove box. Once the cell is assembled with the sealing ferrules, it becomes a stand-alone testing cell for electrochemical tests.

Dimensions: 65 x 65 x 60.5 mm
Weight: 650 g
Sample preparation: 0-400 MPa
Test with constant P: 5-100 MPa
Temperature range: -20 to 120°C

MAIN FEATURES

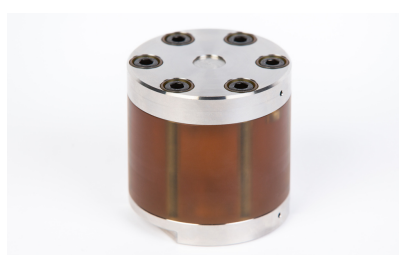
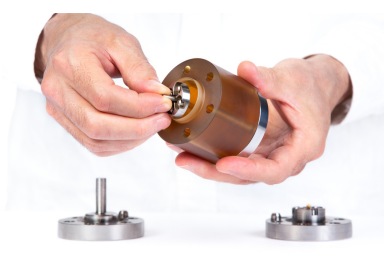
- Airtight
- Large pressure range
- Fixed pressure mode
- Sample diameter 8 mm
- Exchangeable int. sleeves

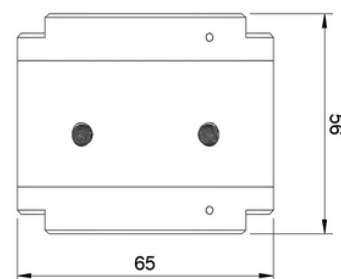
ADD-ON OPTIONS

- Multiple spring constants

ASC-AD setup contains:

- 1x ASC-AD electrochemical test cell
- 1x Compression tool
- 3x Dynamic plungers with different lengths
- 2x Internal sleeves in PEEK for samples of 8 mm of diameter
- 1x Sample removing tool
- 1x Holder for weighing and loading materials in the cell
- 1x Set of tools, springs, sealing ferrules and cables





Dimensions: 65 x 65 x 56 mm
Weight: 650 g
Pressure range: 0-400 MPa
Temperature range: -20 to 80°C

The ASC-G

Airtight electrochemical test cell equipped with gas flow channels for combined gas analysis.

The ASC-G is designed to combine the functionalities of our setups with an external gas analysis characterization technique, enabling real-time analysis of decomposition reactions and gasses released during your electrochemical measurements.

The setup is equipped with four gas channels that can be used in multiple configurations, for example for separating the gasses from anode and cathode reactions. The gas flow circulating in the channels is distributed inside the cell through a small gap placed between the pistons and the internal wall of the cell.

The setup comes with a calibrated torque wrench and a table that correlates torque values with pressure, which enables precise adjustment of the internal pressure at the sample level.

ASC-G setup contains:

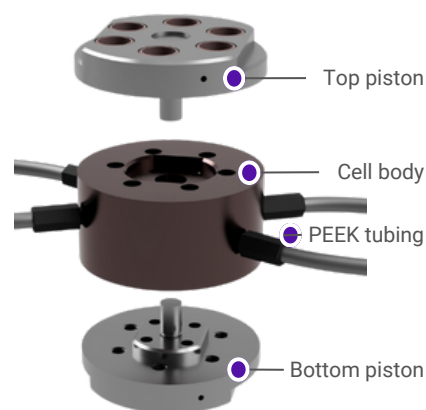
- 1x ASC-G electrochemical test cell
- 1x Torque wrench for manual pressure setting
- 4x Inlet/outlet tubes in PEEK with 50 µm of internal diameter
- 1x Sample removing tool
- 1x Holder for weighing and loading materials in the cell
- 1x Set of tools, sealing ferrules, channel stoppers, cables and accessories

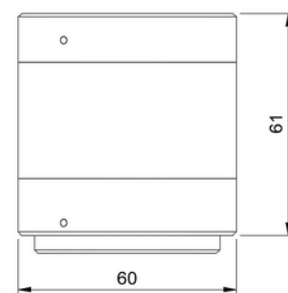
MAIN FEATURES

- Gas flow channels
- Airtight
- Large pressure range
- Fixed thickness mode
- Sample diameter 8 mm

ADD-ON OPTIONS

- Pressure monitoring
- Swelling monitoring
- Fixed thickness mode
- Multiple spring constants





Dimensions: 60 x 70 x 61 mm
Weight: 650 g
Pressure range: 0-400 MPa
Temperature range: -20 to 120°C

The ASC-C

Airtight electrochemical test cell for upscaled sample sizes.

The ASC-C setup combines the functionalities of our setups to bigger sample sizes reaching up to 25 mm in diameter. The system can host different types of samples, free powders, metallic electrodes, casted electrodes, and even fully assembled coin cells, under hermetic conditions.

The pressure applied to the sample can be set as high as 400 MPa via the six screws located in the setup. The setup comes with a calibrated torque wrench and a table that correlates torque values with pressure, which enables precise adjustment of the internal pressure at the sample level.

The system's robust design ensures consistent performance, even under the most demanding experimental setups, making it an indispensable tool for cutting-edge battery research.

MAIN FEATURES

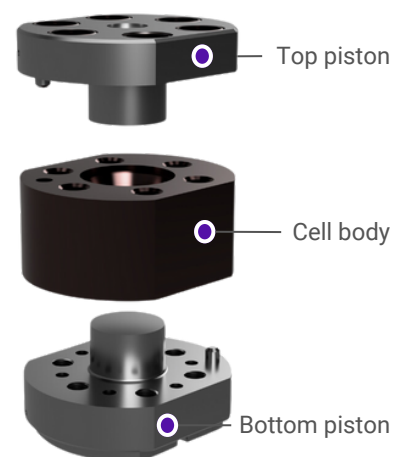
- Large internal size
- Max sample diameter of 25 mm
- Airtight
- Large pressure range
- Fixed thickness mode
- Exchangeable int. sleeves

ADD-ON OPTIONS

- Pressure monitoring
- Swelling monitoring

ASC-C setup contains:

- 1x ASC-C electrochemical test cell
- 2x Internal sleeves in PEEK for samples of 25 mm of diameter
- 1x Torque wrench for manual pressure setting
- 1x Holder for weighing and loading materials in the cell
- 1x Set of tools, sealing ferrules, cables and accessories



MAX FLEXIBILITY THROUGH OUR PRESSURE FRAME

In solid-state battery R&D, precise control over a wide range of parameters is critical for consistent innovation. Recognizing the importance of accurate pressure management, our test cells are designed for seamless integration with our mechanical press, the pressure frame. This tool is capable of delivering and monitoring up to 20 kN of force, all within a compact design that easily fits inside the small antechamber of a glove box.



The pressure frame plays a crucial role in enhancing the flexibility of our ASC setups. It smoothly integrates all the different variations of cell tests under the same pressure monitoring platform, allowing standard and accurate measurements of pressure under different tests applications.

PRESSURE MONITORING AND TEMPERATURE CONTROL

The control box plays a vital role in powering and processing all the information collected from the pressure and temperature sensors. It displays the value of the pressure applied to the the sample in real-time. The data can be transmitted to external devices via an analog output, ensuring full synchronization of pressure information with the electrochemical data from a potentiostat/cycler. This integration is important for achieving optimal performance and accuracy. The control box is also tasked with monitoring and regulating the temperature of the ASC-T+ setup, which is crucial for exploring advanced tests in the field of solid-state batteries.

Two different options of control boxes are available depending on your application:



1. ASC CONTROL BOX

This control box is designed to monitor the mechanical pressure applied to the samples inside the different cells and to control the ASC-T+ temperature. It includes an analogical output for external communication of mechanical pressure values.

1



2. ASC CONTROL BOX FOR PRESSURE

This simplified control box is designed solely for monitoring the mechanical pressure applied to samples within various cell types. It features an analog output for the external communication of mechanical pressure values.

2

THICKNESS MONITORING SOLUTIONS

Sample thickness plays a critical role in the research and development of solid-state batteries, particularly when studying solid-state electrolytes or swelling phenomena. Our options for thickness measurement provide a range of solutions that enable you to precisely assess this parameter. You can measure sample thickness in-situ and in-operando within most ASC cells using our pressure frame.



1

1. IN-OPERANDO THICKNESS MONITORING SYSTEM

The measurement relies on a displacement sensor attached to the pressure frame through an articulated arm. This setup is designed for in-operando thickness measurements, featuring data display and automated data recording via software. It offers a precision of 1 μm and 0.1 μm resolution.



2

2. IN-SITU THICKNESS MONITORING SYSTEM

The measurement is based on a micrometer attached to the pressure frame through an articulated arm. This setup is specifically designed for in-situ thickness measurements, with a data display integrated into the probe. It achieves a precision of 3 μm and a resolution of 1 μm .



3

3. WIRELESS CONNECTION FOR THICKNESS OPTION

Wireless connection between micrometer and computer for punctual data recording. Each time the triggering button is pressed, a data point is sent directly to an Excel table. The product package includes a transmitter, receiver, and necessary cables.

ASC PACKAGE

Advanced electrochemical tests with high-throughput



The ASC package is an essential toolkit for conducting comprehensive research related to solid-state batteries. It comprises of the ASC-T+ which is aptly designed for temperature and pressure-controlled electrochemical tests, the ASC-A+ which is airtight and the ASC-AD utilized for dynamic pressure control. Moreover, it is equipped with a mechanical press (pressure frame), a control box (control unit), a calibrated torque wrench, and all the necessary and useful accessories required for smooth handling. With the ability to run 3 electrochemical cells in parallel, it offers a detailed analysis of battery materials while ensuring optimal throughput.

ASC PACKAGE contains:

- 1x ASC-T+ electrochemical test cell with temperature control and pressure monitoring
- 1x ASC-A+ airtight electrochemical test cell
- 1x ASC-AD airtight electrochemical test cell with dynamic pressure control system
- 1x Pressure frame (mechanical press)
- 1x ASC control box (control unit)
- 1x Calibrated torque wrench
- 1x Glove box feedthrough adaptor, set cables and connection leads
- 1x Set of tools, cables and accessories

ASC+ PACKAGE

Advanced electrochemical tests
within large pressure ranges



The ASC+ package represents the pinnacle of our testing solutions, amalgamating the most sophisticated setups in our portfolio: the ASC-T+ and ASC-AD+. This package is best suited for deep analysis of key parameters of solid-state battery R&D.

The ASC-T+ is specifically designed to conduct temperature-controlled tests and can achieve a maximum temperature of 200°C and 400 MPa pressure. Conversely, the ASC-AD+ is optimized for low-pressure tests in an airtight environment. Both setups provide real-time pressure monitoring data and facilitate test upscaling with multiple sample sizes.

ASC+ PACKAGE contains:

- 1x ASC-T+ electrochemical test cell with temperature control and pressure monitoring
- 1x ASC-AD+ airtight electrochemical test cell)
- 1x Pressure frame (mechanical press)
- 1x ASC control box (control unit)
- 1x Glove box feedthrough adaptor, set cables and connection leads
- 1x Set of tools, cables and accessories

ASC-A+ PACKAGE

Pressure monitored solid-state battery tests



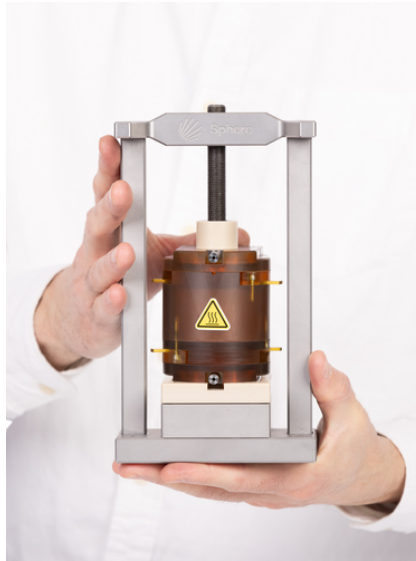
The ASC-A+ package is specifically designed for testing air-sensitive materials outside the glovebox, utilizing mechanical compression and real-time pressure monitoring. This package includes the ASC-A+ electrochemical test cell, a pressure frame, and a control box, offering a practical and robust solution for standard testing in the research and development of solid-state batteries.

ASC_A+ PACKAGE contains:

- 1x ASC-A+ airtight electrochemical test cell
- 1x Pressure frame (mechanical press)
- 1x ASC control box (control box for pressure)
- 1x Calibrated torque wrench
- 1x Glove box feedthrough adaptor, set cables and connection leads
- 1x Set of tools, cables and accessories



ABOUT SPHERE ENERGY



The world is rapidly shifting toward innovative, sustainable energy solutions, with a sharp focus on reducing CO2 emissions. At the core of this green revolution is global R&D, which plays a crucial role in the mission to discover new materials and designs for the green technologies of the future. However, a significant obstacle remains at the root of the R&D activities in this field: the lack of specialized testing equipment. This deficiency impedes the exploration of new materials that necessitate novel testing methods or data beyond the capabilities of existing technologies. Sphere Energy steps up to meet this challenge by providing the R&D community with the testing tools required to spark creativity in experimental design and analysis. Our ASC systems are at the forefront of this effort, targeting solid-state and other next-generation batteries. It provides researchers with advanced tools to assess electrochemical performance, combining traditional tests with additional key parameters, thereby empowering the pursuit of a more sustainable future.



Our products can be fast delivered worldwide when in stock. If not immediately available, we commit to delivering within 30 to 45 days.



Guaranteed responses within 24 hours, ensuring your queries are addressed promptly and efficiently.



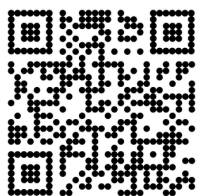
All products are backed by an official 24-month warranty



Our products are crafted with the highest standards of quality, durability and performance.



Sphere



Info@sphere-energy.eu
Sphere Energy SAS
250bis Boulevard Saint Germain
75007 Paris
France