



Specialized in characterization of electrical properties of materials at high temperatures and under controlled atmosphere

# ProboStat™

The ProboStat™ is a cell and sample holder for measurements of electrical properties, transport parameters, and kinetics of materials, solid/gas interfaces and electrodes under controlled atmospheres at high temperatures.

A ProboStat™ system may offer a cost-effective alternative to developing and building your own cell for studies, characterization and testing of inorganic materials, electroceramics, fuel cell components, membrane materials, etc.

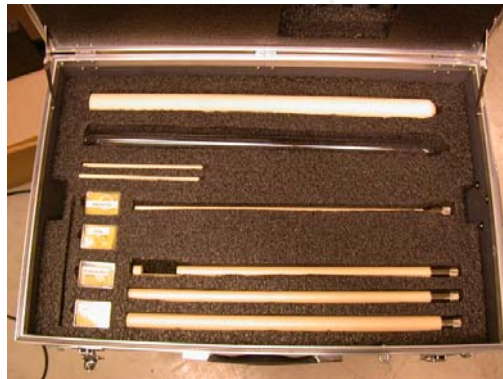
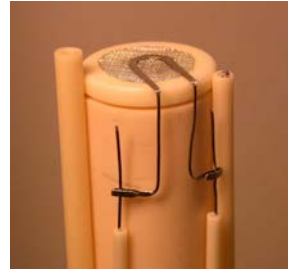
## *Properties and methods*

- Conductivity vs T,  $pO_2$ ,  $pH_2O$ , etc.
- DC, AC, impedance spectroscopy
- Dielectric properties, loss, etc.
- Disk, van der Pauw, and bar geometries
- 2, 3, or 4 electrodes
- Ionic transport number
- Proton transport number in oxides
- Seebeck coefficient
- I-V-characteristics
- Fuel cell components and single cell testing
- Electrode kinetics
- H/D isotope effects
- Electrochemical pumping, gas permeation and electrocatalysis with gas analysis (e.g. GC or MS) on outlets
- Sensor testing
- Hot zone accessories (noble metal and ceramics parts) for most methods can be supplied by us, but instructions for user manufacture are included in the manual.

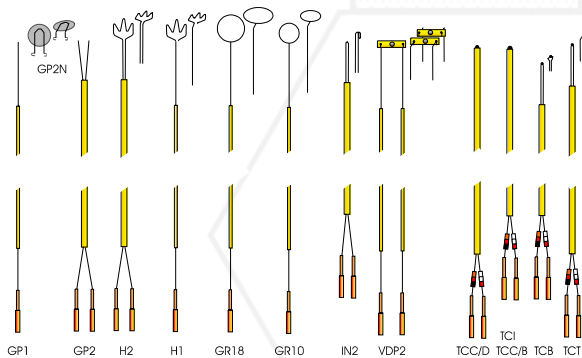
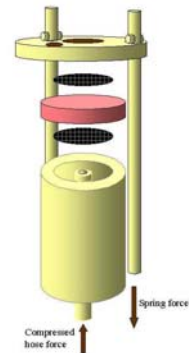


## Specifications

- Outer, enclosing tube diameter: 40 mm
- Overall length: Ca. 85 cm for the full length version
- Single end cell assembly
- Sample fixation: spring force via alumina rods
- All hot-zone electrical leads detachable via feedthrough mini-connectors
- Support tube systems from 10 to 25 mm diameter detachable
- Up to 25 mm diameter disk samples
- Up to 50 mm long bar samples
- Temperature: typical long term: <math><1400^{\circ}\text{C}</math>; shorter term: <math><1600^{\circ}\text{C}</math>
- Atmosphere: Oxidizing or reducing, wet or dry, from small overpressure to low vacuum
- 6 BNC electrode connections for impedance spectrometers etc.
- Internal shields bridging (for SI 1260 , HP 4192A etc.), ground and guard switches
- 3 thermocouple connections
- 4 Swagelok quick-connects to 1/8" tubing for gases (other connections on request)
- Standard materials: Alumina AL23, Pt, Pt10%Rh, Ni-plated brass
- Water cooling (or heating) of cold end base unit possible
- Spare parts supply, also of hot zone consumables
- Custom-made solutions to special requirements may in many cases be offered.



The ProboStat™ system can be delivered with a wide range of sample support tubes, outer tubes etc.



Different types of electrode connections and thermocouples can be supplied with the ProboStat™ system.



## Accessories

### Tubular heating mantle

Custom tubular heating mantle suitable for temperatures more moderate than usually obtained with regular furnaces.

A typical model is of ca. 30 cm length and covers temperatures from ambient up to 650°C. Power supply is by standard 110 or 220 V AC, regulated by an integrated type K thermocouple.

### Power supply and controller

For general use (furnaces and heating mantles) but specially designed for systems with two thermocouples, e.g. a ProboStat™ in furnaces or mantles that have integrated thermocouples.



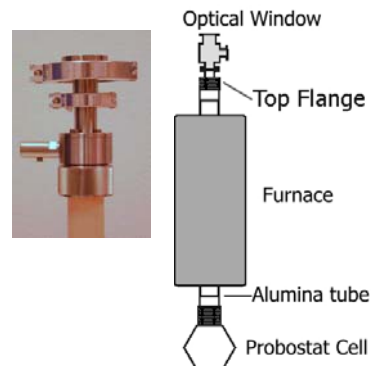
### Cell for dielectric measurements at high temperature

The ProboStat™ system can be equipped with a liquid cell assembly to measure the dielectric constant of liquids at high temperatures.

### Top Flange

Open end outer tubes and 40 mm Ø flange for **evacuation** and **optical access** to disk sample top surface/electrode. Stainless steel.

Vacuum may be useful for baking, high voltage experiments, annealing and general atmosphere control. The optical window may be used for laser interferometry etc.



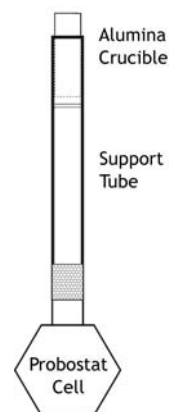
### Crucible Holder

Crucible holder support tube that fits in the ProboStat™ and lets you perform **controlled atmosphere anneals** of powders and samples.

### High Voltage Feedthroughs

High voltage (HV) feedthroughs allow experiments with ferro- and piezoelectric materials. Up to 10 kV is possible with two feedthroughs (outside of the support tube) of an otherwise standard ProboStat. The final voltage limit depends on the user's sample configuration, atmosphere, and temperature

High voltage feedthroughs can be fitted to new ProboStat™ base units.





## Company Profile

NorECs was founded in 2001 by Prof. Truls Norby and Dr. Yngve Larring of the Department of Chemistry/Centre for Materials Science, University of Oslo. The company offers equipment and experience based on more than 20 years of development and research in the group of professors Per Kofstad (1929-1997) and Truls Norby. The equipment is still being developed and manufactured in close collaboration with the research group and workshops at the Department of Chemistry.

Presently, NorECs' main product is the ProboStat™ high temperature sample holder system for electrical and other characterization at high temperatures. It is delivered to and in use in numerous high-ranking institutions worldwide, many of them involved in SOFC research in the USA. Each unit is furnished to fit the customer's methods and conditions of investigation.

New auxiliary products for temperature and atmosphere control are being developed, and also extensions of the sample holder and temperature control to meet the special demands of investigation of dielectrics, ferroelectrics, piezoelectrics, and intermediate temperature fuel cell and membrane materials.

Over time NorECs aims to commercialize a broader range of scientific equipment, materials, and applications derived from Norwegian academic research. Focus will be on electroceramics, their properties, characterization, and applications at high temperatures.

Norwegian organization and VAT registration number:  
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