

# Electrochemical Laboratory

## General Description

The Electrochemical Laboratory is equipped with a number of unique, custom-made apparatuses for electrochemical characterization, measurements, and tests at high temperatures and pressures. The laboratory also hosts a range of instrumental facilities for conducting conventional electrochemical measurements. The unique techniques developed by our staff scientists combined with the state-of-the-art facilities allow us to lead sophisticated research in hot technological areas, attracting sponsors and collaborators from the government, universities, and private industries. The laboratory researchers have a high level of expertise in electrochemistry, interfacial processes, fuel cell technologies, corrosion, electrochemical kinetics, transport processes, chemical thermodynamics, and other fundamental areas of science. Specialization of the laboratory includes (1) electrochemical measurements in high temperature subcritical and supercritical aqueous systems, (2) high temperature microelectrophoresis studies, and (3) development of new materials and systems for high temperature proton exchange membrane (PEM) fuel cells. We have all necessary capabilities for fabrication, complete electrochemical characterization, and performance tests for both PEM fuel cells and solid oxide fuel cells.

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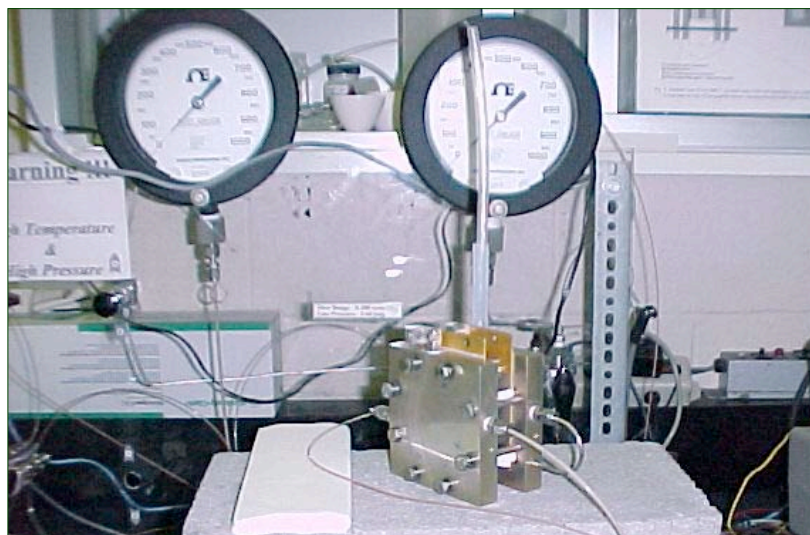
## Key Equipment

**Proton Exchange Membrane (PEM) fuel cell** facilities include fuel cell test stations for the operating temperature range from ambient to 150°C, a high-temperature cell for membrane conductivity measurements, a high-temperature permeability apparatus, ovens, and hot-press equipment.

**Gamry Instruments electrochemical test station** provides a wide range of instrumental capabilities including electrochemical impedance spectroscopy, polarization measurements, and corrosion studies.

**High temperature zetameter** is used for electrophoresis (zeta potential) measurements in colloidal suspensions with the particle size 0.1-5 micron at temperatures up to 250°C and pressures up to 20 MPa.

**High-temperature electrochemical cell** can be used to study solution chemistry, electrochemistry, and corrosion processes at temperatures up to 450°C and pressures up to 40 MPa. The systems were designed to withstand concentrated solutions under the extreme conditions.



PEM Fuel Cell Test Station

**Rotating Disk Electrode System (BASi RDE-2)** can be used for studying electrode kinetics under controlled hydrodynamic conditions. The cell is equipped with interchangeable electrode tip and allows studying a wide selection of electrode materials.

**High-temperature water loops** are equipped with an external pressure-balanced reference electrode, YSZ pH electrode, oxygen meter, flow meters, and thermocouples and allow evaluation of corrosion resistance and corrosion inhibition methods, such as hydrothermal deposition of coatings.

# Equipment Capabilities

## PEM fuel cell test station:

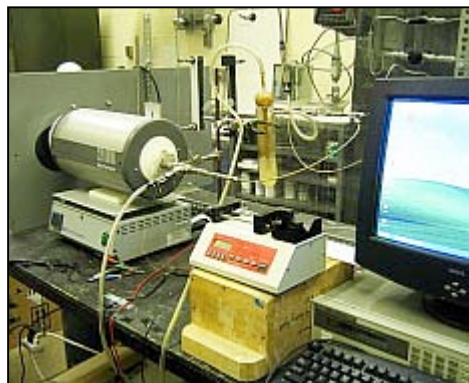
- Voltage-current curves up to 150°C
- Gas or liquid fuels;
- Dynamic polarization and cyclovoltametric measurements;
- Effect of humidity, flow rate, and temperature.
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## High-temperature diffusion cell:

- Permeability of polymeric membranes at temperatures up to 200°C and pressures up to 10 MPa

## High-temperature electrochemical cell:

- Potentiometric measurements at temperatures up to 450°C and pressures up to 40 MPa;
- Precision of  $\pm 5$  mV under the extreme conditions;
- Dilute or concentrated solutions;
- Long-term tests under the extreme condition;
- pH, redox potential, ECP, electrochemical noise analysis, and electrochemical kinetics.



## Solid oxide fuel cell test station (above):

- Voltage-current curve at temperatures up to 1000°C with either gas or liquid feeds;
- Dynamic polarization and cyclovoltametric measurements.

## Rotating Disk Electrode System, BASI RDE-2 (right):

- Electrode kinetics measurements;
- Rotation: 5-10,000 RPM;
- Small sample volume 10-15 ml;
- Easy electrode exchange;
- Gas purging (at 5 psi)

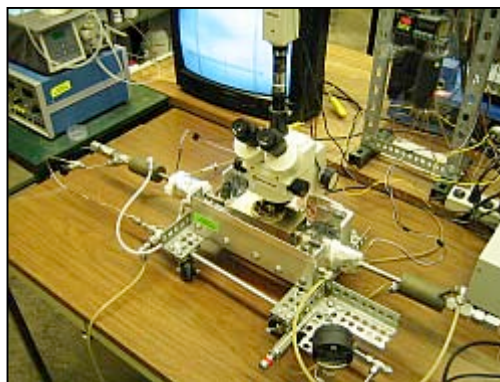


## Gamry electrochemical measurement system:

- Electrochemical impedance spectroscopy;
- Dynamic and stepwise polarization
- Galvanostat / potentiostat;
- Electrochemical noise analysis;
- Zero resistance ammetry (ZRA);
- Two-, three-, and four-electrode configurations;
- Corrosion resistance.

## High-temperature zetameter (below):

- Microelectrophoresis measurements in particle suspensions at temperatures up to 250°C and pressures up to 20 MPa;
- Particle size range: 0.1-5 micron;
- Zeta potential ( $\zeta$ ) vs. pH.



## Key Contact

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