# Electrochemical Technologies

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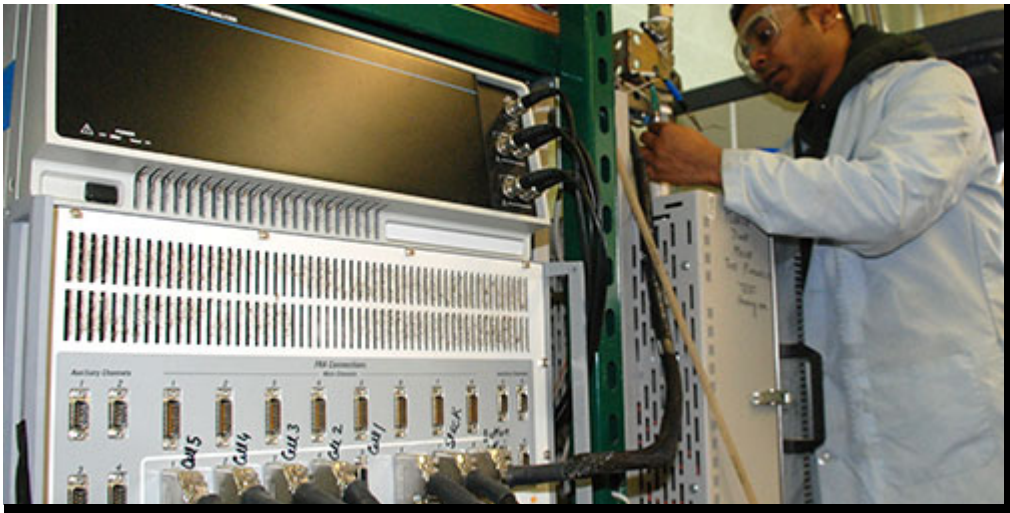
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Scientists carry out electrochemical studies on physicochemical systems for a variety of reasons: To obtain thermodynamic data, understand the kinetics of system evolution of degradation, or analyze a solution for trace amounts of chemical compounds. There are also investigations in which the system's electrochemical properties themselves are of primary interest, for example, the design of new power generation systems (e.g., fuel cells and batteries) and synthesis of new materials such as metal alloys or oxide films.

The Electrochemical Technologies Program at the EMS Energy Institute strives to be at the forefront of fundamental and applied research in a variety of electrochemical and materials science technologies. It aims to promote and facilitate the use of electrochemical probes and systems in areas of science and technology important for society, in particular, fuel cells and electrolysis, materials for deep well drilling, hydrothermal synthesis of new materials, and electrophoresis of nanoparticles. The specific expertise of this program is related to interfacial electrochemistry and corrosion in extreme environments (e.g. high temperature and pressure, high concentration).

# Research

## Fuel Cells, Electrolysis, and Batteries

- Proton exchange membrane fuel cell (PEMFC) studies at elevated temperatures and low relative humidity
- Utilization of alternative fuels for solid oxide fuel cells (SOFC)
- Novel SOFC liquid metal anode materials
- Development and characterization of new SOFC and PEMFC membranes for operating at elevated temperatures
- Development and optimization of the hybrid Cu-Cl thermochemical cycle for hydrogen production
- Electrochemical impedance spectroscopy for interfacial and corrosion studies

## Corrosion and Phase Equilibria in Extreme Environments

- Electrochemical monitoring and testing at high temperatures, pressures, and salinities
- *In situ* measurement of corrosion in extreme conditions
- Measurement and modeling of phase equilibria for brines and supercritical fluids
- Investigation of environments related to deep well drilling, geothermal power generation, and $CO_2$ sequestration

## High Temperature Nano-Electrophoresis:

- Zeta potential of nanoparticles at elevated temperature and pressure
- Electrical double layer at mineral-water interface in hydrothermal environments
- Electrophoretic deposition of particulate materials in hydrothermal systems

## Electrochemical Sensors and Probes:

- High temperature pH sensing
- High temperature reference electrodes
- Corrosion and conductivity probes in high temperature subcritical and supercritical fluids

## Computational Modeling:

- Equation of state and thermodynamics of multi-phase multicomponent systems
- Simulation of electrochemical processes and systems
- Molecular-statistical, irreversible, and chemical thermodynamic modeling of aqueous systems

## Kw Calculator

- Try using the on-line the Ionization Constant of Water Kw Calculator [2]

## CO2-Brine Phase Equilibria Model

- Try using the on-line CO2-Brine Phase Equilibria model [3]



**Links:**
[1] http://www.energy.psu.edu/elc/index.html
[2] http://www.energy.psu.edu/elc/kwcalculator.html

[3] http://www.energy.psu.edu/tools/psuco20730/index.php