Electrochemical Technologies Laboratory

High-Temperature Zetameter [1]

Used for measurements of electrophoretic mobility and zeta potential of particulate materials in high temperature solutions. The available instruments work at temperatures up to 250 °C and pressures up to 20 MPa. Samples with the particle size 0.1-1 micron can be studied.

Solid Oxide Fuel Cell (SOFC) Station [2]

Can be used for testing single cells and stacks. The system includes Solartron electronics to perform sophisticated impedance analysis under open circuit or polarization conditions. An Arbin provides full gas flow and temperature control. Available furnaces allow testing button, crucible, and ring cell designs. Operating temperature is up to 1200 °C

Scribner Proton Exchange Membrane (PEM) Fuel Cell Station [3]

The Scribner 850e PEM fuel cell station has the capability for an automated control of gas flow rate, relative humidity, and temperature. The system includes Electrochemical fuel cell hardware and an acquisition system for data treatment and analysis.

Electrochemical Impedance Spectoscopy (EIS)

Used for detailed electrochemical characterization of a variety of systems and processes, including fuel cell performance, corrosion, conductivity, and component degradation. Coupling EIS measurements with equivalent circuit modeling allows us to obtain specific impedance from various parts of the cell and restore the process mechanism. Impedance analysis hardware and software include:

- Solartron 1470E CellTest System
- Solartron 1252A Frequency Response Analyzer
- Gamry - Reference 600 Potentiostat & ZRA

- Gamry - PCI4 Family Potentiostat & ZRA
- Z-View Software (CNLS Fitting)
- CellTest Software
- FrameWork & E-Chem Analysis Software

Autoclave Systems for High-Temparature, High-Pressure Measurements [4]

Autoclave systems are being used to study phase equilibria and metal corrosion in conditions ranging from ambient to supercritical for aqueous and CO_2 environments. Flow-through cells have also been designed. These systems have measured in situ corrosion behavior in a variety of environments and solubility data for supercritical CO_2-brine mixtures. Our commercial vessels can operate up to 200 °C and 20 MPa, and custom systems can be designed for up to 350 up to om sMPa.

Conductivity Measurements

Several electrochemical cells are available to test the in-plane and through-plane ionic conductivity of membrane materials:

- Bekk Tech cell for in-plane measurements in gas phase with variable relative humidity (image) [5]
- Cell designed for testing inorganic conductors (pellets) in gas phase with variable relative humidity (image) [6]
- Clip cell for through-plane measurements in solution phase (image) [7]

CuCl Electrolyzer [8]

Developed to study the performance of various membrane materials and MEAs for hydrogen gas production from electrolysis of CuCl+HCl solutions. The system is designed to work with highly concentrated solutions up to 80 °C. Measured characteristics include current-potential polarization curves, open circuit potentials, EIS, and H_2 production rates.

Links:

[1] http://www.energy.psu.edu/sites/default/files/images/Zetameter.png
[2] http://www.energy.psu.edu/sites/default/files/files/SO_FuelCellStation.png
[3] http://www.energy.psu.edu/sites/default/files/images/PEM_FUEL_CELL.JPG
[4] http://www.energy.psu.edu/sites/default/files/images/Feng_autoclave.png
[5] http://www.energy.psu.edu/sites/default/files/images/Bekk%20Tech%20Cell.jpg
[6] http://www.energy.psu.edu/sites/default/files/images/CellforInorganicConductors.jpg
[7] http://www.energy.psu.edu/sites/default/files/images/ClipCell.jpg
[8] http://www.energy.psu.edu/sites/default/files/images/ElectolysisSystem.png