

ADVANCED ANALYTICAL INSTRUMENTATION AND FACILITIES FOR IN SITU REACTION STUDIES

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Capabilities

Various types of analytical instrumentation to conduct standard chemical/physical characterizations and to study in-situ gas-solid reactions are available at the National Energy Technology Laboratory. These systems have unique capabilities to study in-situ gas/solid reactions at high temperature and/or high pressure. The systems can be utilized to determine reaction mechanisms, the extent of reactions and reaction kinetics. Analytical instrumentation includes both surface and bulk analysis techniques.

Thermogravimetric Analysis (TGA) Systems

- Determination of both the extent of gas/solid reactions and chemical kinetics
- High temperature and high pressure capabilities

Fourier Transform Infrared Spectroscopy (FTIR) with High Temperature Diffuse Reflectance Accessory/Gas Exposure Cell

- Capability to study reaction mechanisms by identifying intermediates and reaction products formed in-situ during gas/solid reactions.
- Chemical characterization and structural changes of materials.

Scanning Electron Microscopy/X-Ray Microanalysis

- Determination of elemental composition and distribution
- Determination of surface morphology of materials at various magnifications through secondary electron and backscatter electron image acquisition
- Image processing and analysis
- Insitu analysis at high temperature
- Gas exposure capabilities to study gas/solid reactions
- Multi-sample analysis capabilities

X-Ray Photoelectron and Auger Electron Spectroscopy

- Determination of surface elemental composition and oxidation states of solid materials
- Insitu analysis at high temperatures
- Gas exposure capabilities to study gas/solid reactions
- Multi-sample analysis capabilities

Atomic Force Microscope

- Analysis at both room temperature and high temperature
- Gas exposure capabilities



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Other Analytical Capabilities for Physical and Chemical Characterization

Physical Characterization

- Particle Size Analyzer
- BET Surface Area & Pore Volume Analyzer
- Helium Density Analyzer
- Viscometers
- Specific Gravity Meter
- LECO Calorimeter

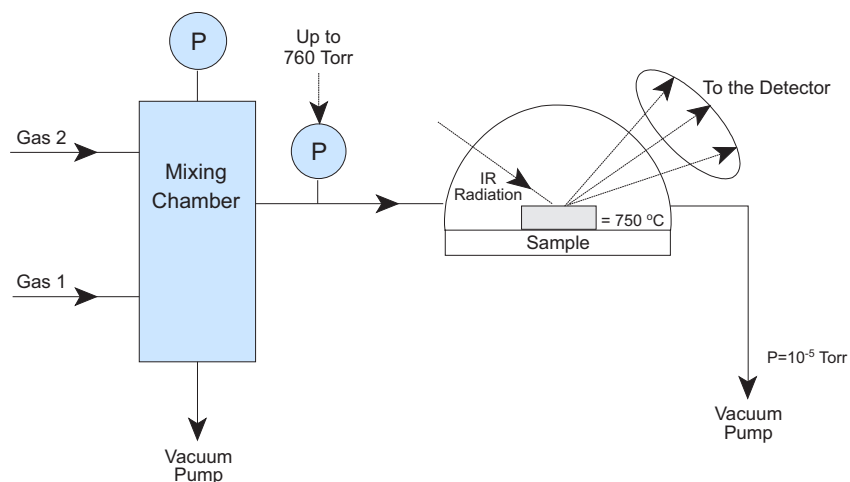
Reaction Studies

- Volumetric Absorption Apparatus
- Micro Reactor

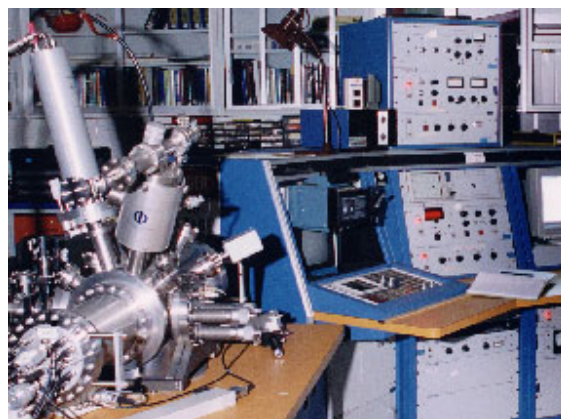
Chemical Analysis

- X-ray Florescence
- Atomic Absorption Spectroscopy
- C, H, N Analyzer
- LECO Sulfur Analyzer
- Moisture, Ash & Volatile Matter Analyzer
- Gas Chromatography
- Nuclear Magnetic Resonance
- Mass Spectroscopy
- Inductively Coupled Plasma Spectroscopy

Diffuse Reflectance FTIR



Scanning Electron Microscopy



X-Ray Photo Electron and Auger Electron Spectroscopy