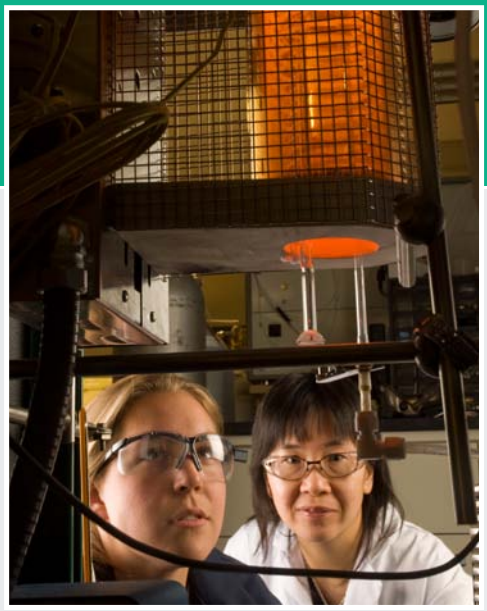
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Biomass Catalyst Characterization Laboratory

Enabling fundamental understanding of thermochemical biomass conversion catalysis and performance



NREL researchers operating the catalyst micro-activity test system (MATS). *Photo by Patrick Corkery, NREL/PIX 15698*

NREL's Biomass Catalyst Characterization Laboratory is a comprehensive materials characterization and performance testing laboratory.

Material characterization capabilities span a range of physical and chemical techniques.

Physical characterization capabilities include:

- Rapid thermal analysis
- Surface area, particle size, and pore size distributions
- Adsorption and chemisorption.

Chemical characterization capabilities include:

- Elemental composition
- Surface analysis
- Ultimate and proximate analysis
- Surface chemistry
- Crystal structure
- Fuel analysis.

Catalyst screening capabilities include:

- Fully automated, real-time screening of catalyst performance, lifetime, and regenerability
- Fuel synthesis catalyst screening in batch or flow through mode with online analytical instrumentation
- Kinetic studies of catalytic reactions.

Catalyst Characterization Instrument	Measurement Capability
TGA/DSC/FTIR	Thermal behavior/gas analysis
TGA	Thermal behavior
TPD/MS	Thermal desorption/gas analysis
Porosimeter/pycnometer	Porosity/distribution
Surface area analyzer	Surface area
ICP	Elemental analysis
Particle sizer	Particle size/distribution
LECO CHNS, TGA	C, H, N, S
GCGC x TOFS	Gas analysis
GCGC x FID	Fuel composition
XRD	Crystal structure
UV photometer	Gas analysis
Py probe GCMS	Catalytic pyrolysis
FTIR	Gas analysis
SEM/EDS	Surface analysis/composition
Raman microscope	Surface analysis/composition
Microactivity test systems	Catalyst performance

**NREL is a national laboratory of the U.S. Department of Energy,
Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

Applications

Fuel analysis

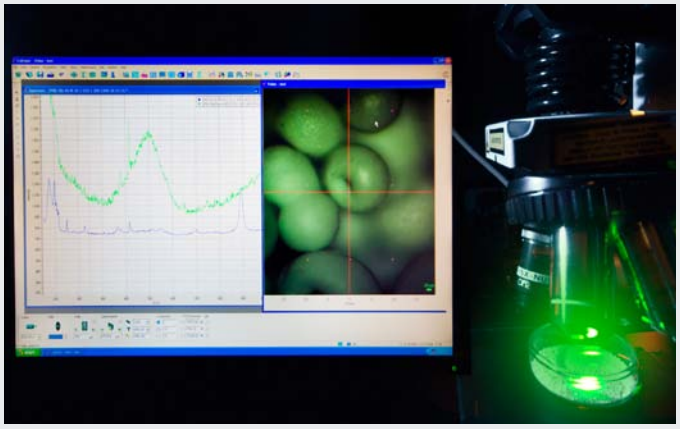
- Comprehensive chemical analysis of biomass-derived pyrolysis oil and its upgraded intermediates
- Provides understanding of how oil chemistry is influenced by feedstock and process variables, which is key to developing better oil intermediates.

Catalyst performance testing

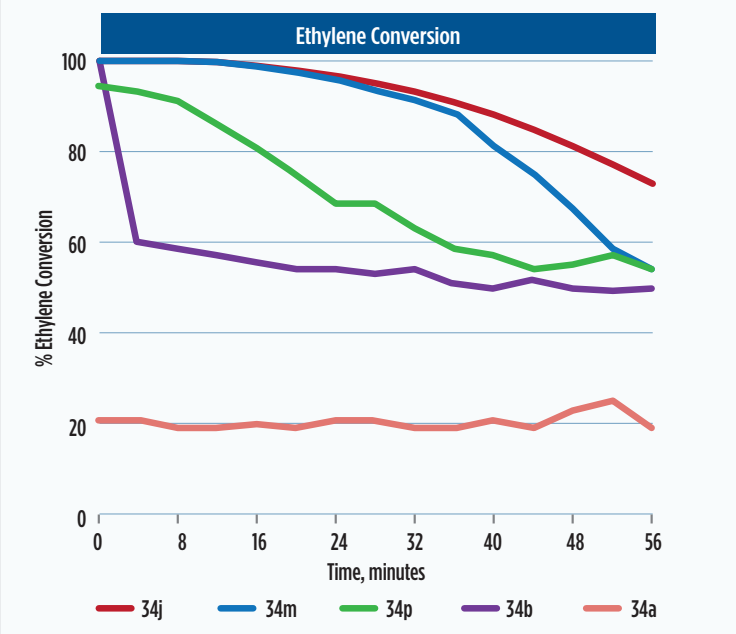
- Rapid and comprehensive catalyst screening
- Used to design more efficent, economical catalysts for thermochemical biomass conversion to fuels and chemicals.

Surface chemistry analysis

- Measure catalyst surface compositions with Raman microscopy
- Assessing catalyst surface chemistry and use-induced changes helps in designing better catalysts for fuels and chemicals production.



The Raman spectrometer is used to obtain phase and structural identification information for catalysts used in the thermochemical conversion process. *Photo by Patrick Corkery, NREL/PIX 16321*



Data obtained using the microactivity test system (MATS) show the ethylene conversion performance for five different catalysts. *Figure by NREL*

Associated publications

Yung, M., et al. (2010). "Demonstration and Characterization of a Ni/K/Mg/AD90 Used for Pilot Scale Conditioning of Biomass Derived Syngas." *Catalysis Letters* (134:3-4); pp. 242-249.

Magrini-Bair, K., et al. (2007). "Fluidizable Reforming Catalyst Development for Conditioning Biomass-Derived Syngas." *Applied Catalysis* (318); pp. 199-206.

Cheah, S., et al. (2011). "Regenerable Manganese-Based Sorbent for Cleanup of Simulated Biomass-Derived Syngas." *Energy and Fuels* (25:1); pp. 379-387.

Cheah, S., et al. (2010). "Catalysts and Sorbents for Thermochemical Conversion of Biomass to Renewable Biofuels--Material Development Needs." *Ceramic Transactions* (224); pp. 349-362.

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