About the facility

The CleanCat Facility at Northwestern University is dedicated to advancing the understanding of the catalytic function of materials for environmental and energy processes. The first of its kind at an academic institution in the United States, the lab provides students with the necessary tools for testing the catalytic properties of materials and obtaining insight into reaction mechanisms occurring on surfaces. These tools not only include the required capital equipment, but also the backing and guidance of an experienced lab manager who takes a hands on approach in ensuring that students become experts themselves. We not only train the students to use the equipment, we teach students how to collect data that answers their research questions.

Started in the fall of 2012, the facility has quickly expanded from a single lab with a reactor system to several labs containing a wide range of catalyst characterization equipment (see inside).

If you have any questions about the facility’s capabilities, or if you would like to discuss customized reactor set-ups for specialized reactions, please contact Neil Schweitzer.

About Neil Schweitzer

Neil obtained his B.S. in chemical engineering from the University of Toledo in 2004, then went on to receive his Ph.D. in chemical engineering from the University of Michigan in 2010. He was co-advised by Levi Thompson and Suljo Linic. Next, Neil spent two years as a post-doc at Argonne National Lab working with Jeff Miller and Chris Marshall. He started as the CleanCat lab manager at the beginning of 2013.

Skills and expertise:
- Catalyst synthesis
- Reaction rate experiments
- X-ray adsorption spectroscopy
- DRIFTS
- Temperature programmed experiments
- DFT calculations
- In-situ X-ray photoelectron spectroscopy

Selected publications:
BenchCAT 4000
The BenchCAT 4000 consists of four, fully automated, independently operated, plug-flow reactors used for catalyst screening, reaction order analysis, Arrhenius analysis, and deactivation analysis. Three reactors are also equipped with a stainless steel syringe pump and heated chamber (which can be heated up to 200°C) for the introduction of vapors. Each reactor can be routed to any one of four different, on-stream GC’s for direct measurement of reaction products:

- **Analytical 1** is configured with an FID for hydrocarbon analysis. We are currently planning to add a TCD for simultaneous analysis of small molecules (H₂, O₂, CO, and CO₂). The mass spec will soon be available for on-stream, gas or vapor phase analysis of unknown products.
- **Analytical 2** is configured with an FID for hydrocarbon analysis. Additionally, this unit is configured for direct injections of liquids into the mass spec for identification and quantification of liquid phase compounds.
- **Analytical 3** is configured with an FID for hydrocarbon analysis and a TCD for simultaneous analysis of small molecules.
- **Analytical 4** is configured with a TCD and intended only for gas phase, small molecule analysis (including hydrocarbons smaller than C₅).

Agilent 1200 HPLC
The Agilent 1200 is a high-performance liquid chromatography system ideal for analysis of liquid phase reaction products that have low volatility. Equipped with a high performance auto sampler, a diode-array detector, and a refractive index detector, this system is capable of analyzing numerous samples consisting of a wide range of compounds.

**Rate:** $3.50/hour

AMI-200
The AMI-200 is used for conducting temperature programmed experiments to measure the active surface area of a material, characterize the redox properties of the surface, measure the desorption characteristics of adsorbates, and even measure single-point BET surface areas after various treatments. Gases provided by the center currently include hydrogen, oxygen, carbon monoxide and inerts. A bubbler system is also available for the introduction of vapors.

**Rate:** $4.50/hour

Nicolet 6700 DRIFTS
The Nicolet 6700 DRIFTS system is an *in-situ* infrared spectrometer intended for analyzing solid powder surfaces under reaction conditions. Equipped with a gas manifold and temperature controller, the powder sample can be exposed to a wide variety of gases up to 500°C. Gases provided by the center currently include hydrogen, oxygen, carbon monoxide, and inerts. A bubbler system is also available for the introduction of vapors. Please inquire about new isotopic labeling capabilities.

**Rate:** $4.50/hour

Micromeritics 2010
The micromeritics 2010 is the staple instrument for measuring surface area and pore characteristics of solid powders in any catalysis lab. Fully automated, this instrument performs many tests simultaneously, easily generating data quickly with minimal user labor required.

**Rate:** $2.00/hour

Wet Synthesis lab
The beneficial properties of a novel catalyst are difficult to establish without comparing it to a “traditional” catalyst. We are currently planning to establish a wet synthesis lab for preparation of “traditional” catalysts, equipped with a drying oven, calcination oven, and reduction furnace.

**Rate:** $2.00/hour