CHARACTERIZATION OF ALUMINA SUPPORTED SYN-GAS CONVERSION BIMETALLIC NANOCATALYSTS

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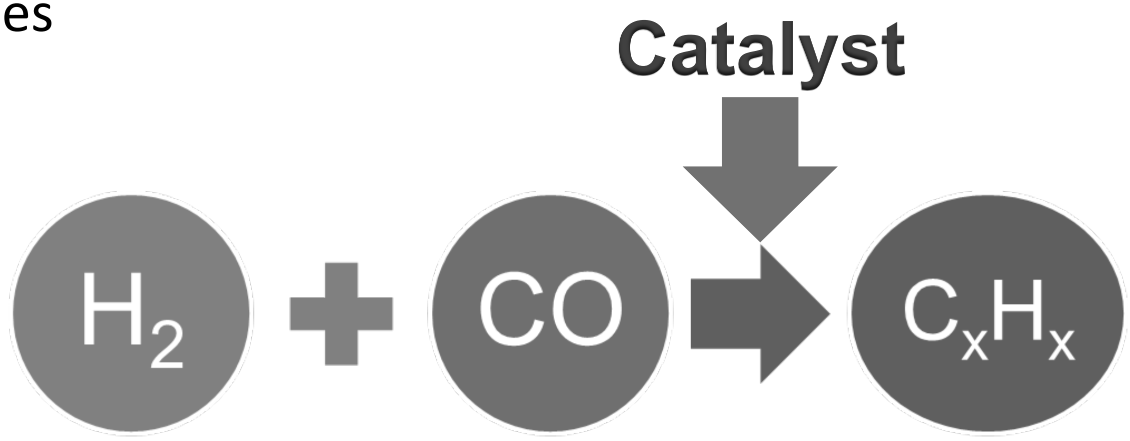
Table of Contents

- Introduction
  - Background
  - Objectives
- Characterization Methods
  - Thermal Analysis
  - Magnetic Studies
  - Surface Analysis
- Results
- Next Steps
- Acknowledgements

Introduction | Background

- Nanocatalysts used in Fischer-Tropsch reactions
- Fischer-Tropsch reactions convert syn-gas (H_2+CO) into hydrocarbon chains
- Nanoparticles are placed on alumina support structures(granules)
- Structure of granules and nanoparticles helps dictate hydrocarbon lengths
- Catalyst nanoparticle types: Fe, Cu, Co, Cu/Co, and Co/Fe in various percentages



Introduction | Objectives

- Collect, store, and analyze data
- Identify characteristics which may contribute to catalyst longevity and product selectivity

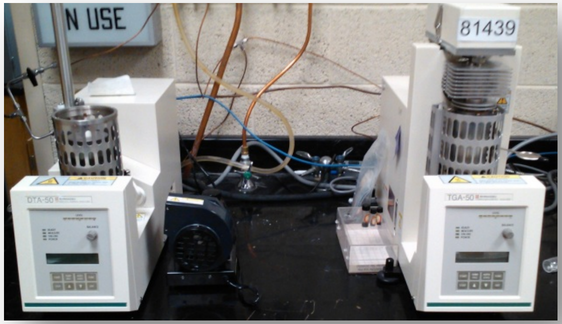
Characterization Methods

- Thermal Analysis using TGA and DTA instruments
  - Observing the change in mass of the catalyst at any temperature between ~25°C and 500°C
- Magnetic Studies using VSM instrument
  - Determining change in the magnetic properties of catalyst samples before and after gas chromatography.
- Surface Analysis using PALS & BET devices
  - The porosity of a sample contributes to its overall surface area and reaction sites.

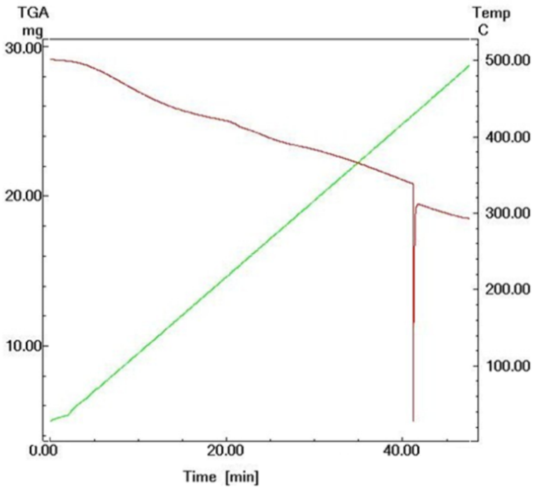
Characterization Methods

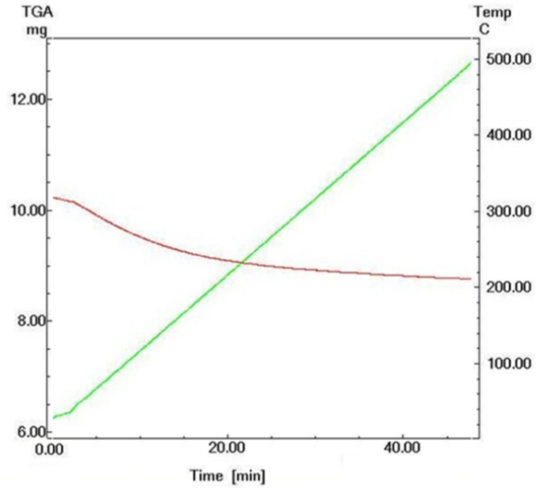
Thermal Analysis

Data collected using the TGA device shows the change in mass of the granule samples during a temperature increase from ~29^{o} C to 500^{o} C. Below are samples Co/Fe and Co respectively, both with 4% saturation of nanoparticles. Co/Fe was produced using metal nitrate loading method, and Co was produced nanoparticle metal oxide loading. See Figure 2.



DTA and TGA Devices at LA Tech

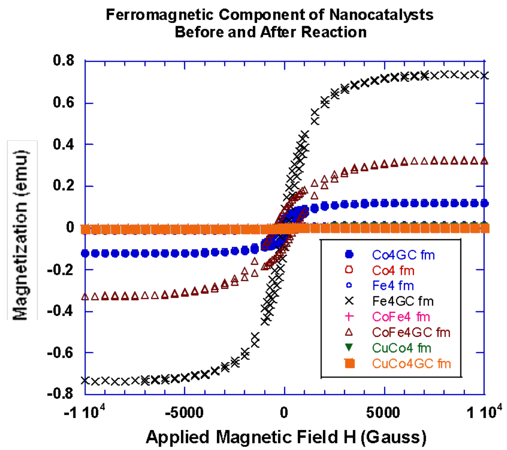


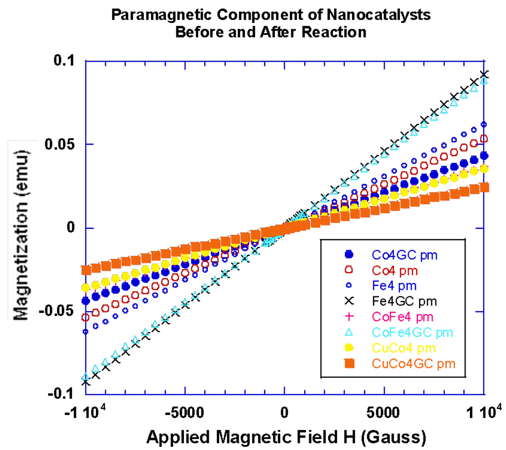


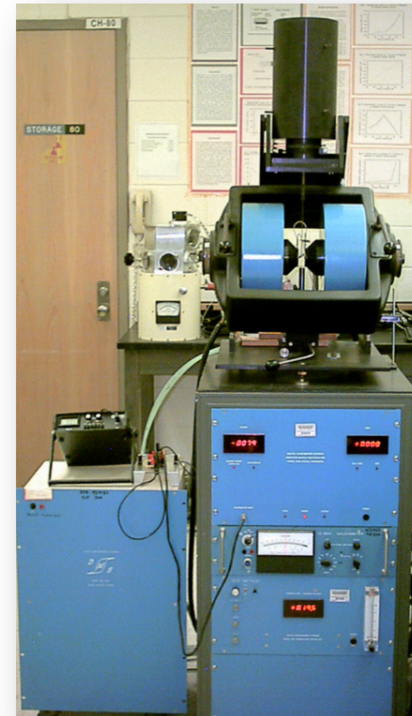
Characterization Methods

Magnetic Studies

Data collected using the VSM tests the changes in magnetic properties between catalytic material before and after having undergone Gas Chromatography(GC). The graphs below show change in ferromagnetic and paramagnetic properties.





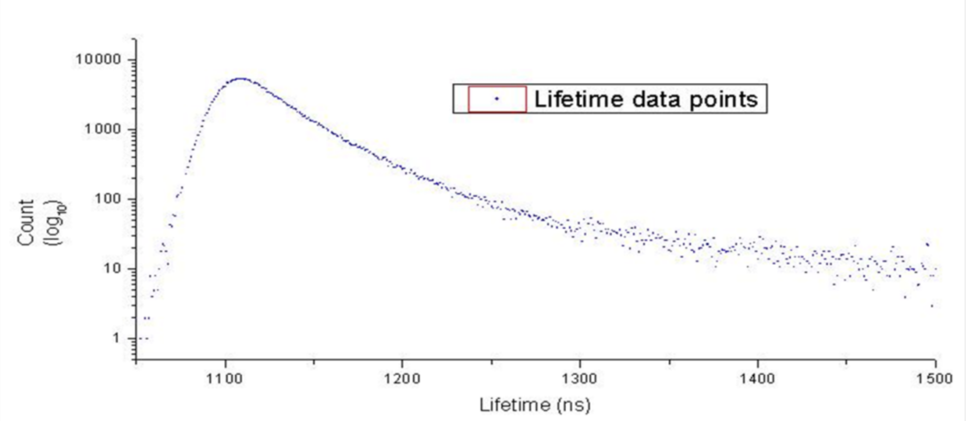


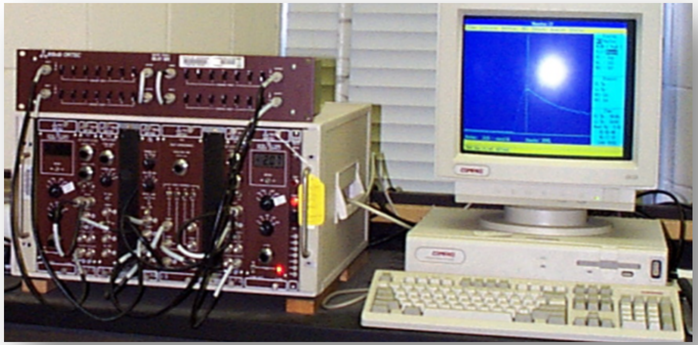
VSM Instrument
at Grambling State

Characterization Methods

Surface Analysis

Below is data collected through the PALS method of porosity determination. The samples used contained standard percentages cerium with varying amounts of nickel and iron. The method determines the porosity of the sample by counting the lifespan of positrons directed at the sample. The amount of time it takes for the positron to collide with an electron gives a lifetime curve for the different materials. From this data we calculate the mean lifetime (TM).





PALS Device
at Grambling State

Results

- VSM results indicate increasing ferromagnetic properties after gas chromatography(reaction).
- PALS data indicates that porosity of tested samples increases with iron content
- Initial TGA indicates some difference oxidation of the Co/Fe nanoparticles in comparison to the Co granules.

Next Steps

- Continue current characterization process to include a greater variety of percentages.

- Increase the sensitivity of the magnetic properties observations using a superconducting quantum interference device (SQUID) magnetometer.

- Analyze collected data and determine properties related to most effective overall catalyst for specific reactions.

Acknowledgements

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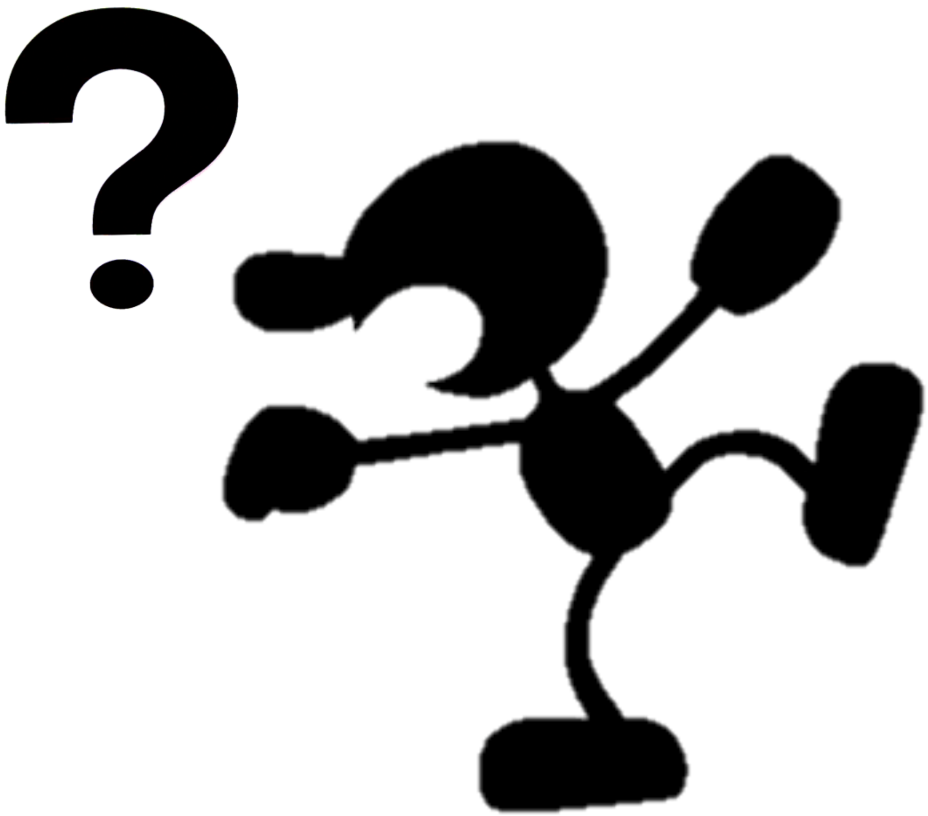
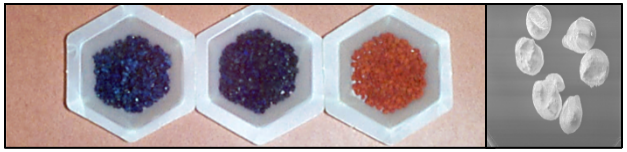
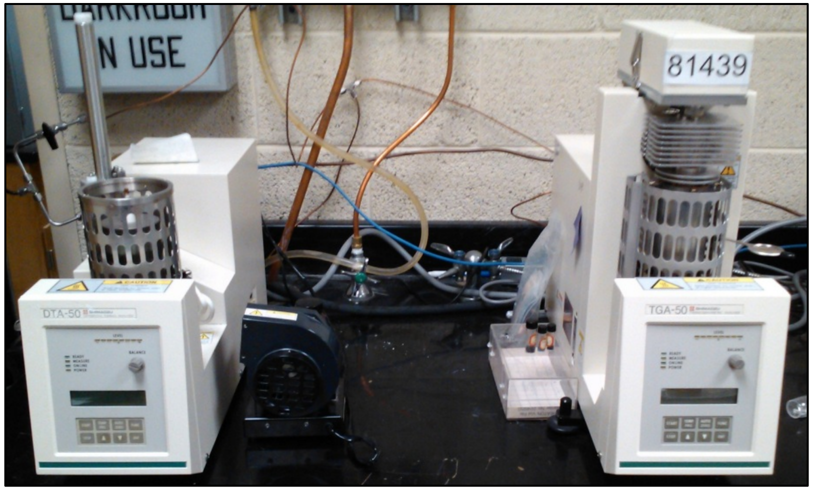
Questions?



Thermal Analysis

- Thermal Analysis data collected using DTA and TGA instruments.





DTA and TGA instruments

Magnetic Studies

Surface Analysis

BET Device