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Outline for CHEM 475 Module

Catalyst characterization using thermal conductivity detector

1. Introduction
 - 1.1. Principles of thermal conductivity
 - 1.2. Explanation of thermal conductivity detector
 - 1.3. Experimental setup
2. Application of thermal conductivity detector for catalyst characterization
 - 2.1. Why is important to know the characteristics of a catalytic material?
 - 2.1.1. Reactor design
 - 2.1.2. Catalyst deactivation
3. Sample Preparation
 - 3.1. Catalyst materials can be purchased or synthesized
 - 3.2. Pre-treatment
 - 3.2.1. Temperature reduction
 - 3.2.1.1. H₂ reduction with temperature ramp
 - 3.2.2. Surface purging
 - 3.2.2.1. He purging with temperature ramp.
4. Type of experiments
 - 4.1. Temperature-programmed desorption (TPD)
 - 4.1.1. This technique will help us determine:
 - 4.1.1.1. Number of active sites.
 - 4.1.1.2. Type of actives sites.
 - 4.1.1.3. The strength of the active sites
 - 4.2. Temperature-programmed reduction (TPR)
 - 4.2.1. This experiment is used to determine the number of reducible species in a sample.
 - 4.2.2. The experiment will indicate at what temperature the species were reduced.
 - 4.3. Temperature-programmed oxidation (TPO)
 - 4.3.1. This experiment is designed to determine if the sample can be oxidized and if the sample was previously reduced
 - 4.4. Pulse Chemisorption
 - 4.4.1. Determines the active surface area of the material, metal dispersion, estimates particle size.
5. Data Analysis
 - 5.1. Peak integration
6. Limitations of the technique
 - 6.1. Only for solid samples
 - 6.2. Requires sufficient mass of active catalyst