

Complete Catalyst Solutions for Your Emissions Control Needs



Dynamic Catalysts Inc.



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Who We Are

Dynamic Catalysts Inc.

- Over 40 years of catalyst experience
 - Natural gas processing
 - Petroleum refining
 - Petrochemical and chemical industry
- Supplier of quality catalyst to the petroleum refining industry
- Process operations of fluid catalytic cracking and hydro processing
- Catalytic reforming, alkylation, and nitric acid production
- PICS Registered
- Shell Qualified Supplier
- INS Registered

Dynamic Catalysts Inc.
Catalysts Sales & Consulting



Our Partner

Advanced Catalyst Systems, LLC

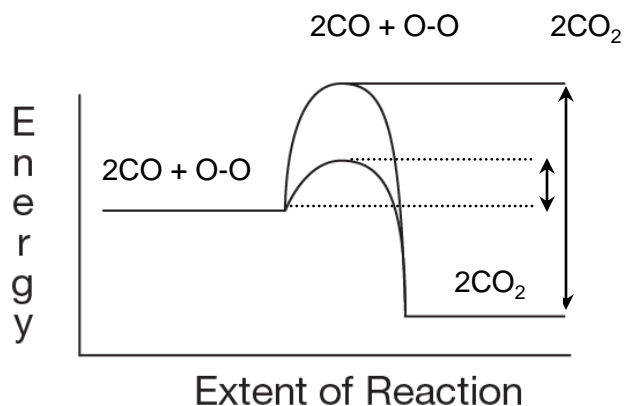
- Over 20 years experience in power plant pollution control
- Superior products at competitive pricing
- ISO 9001: 2008 Certified Manufacture
- Rapid response to customer technical and product needs
- Employee owned
- Over 100 man years of leading edge catalyst research and manufacture
- Personnel hold 32 US patents, others pending
- Professionalism, Integrity, Honesty



Catalyst Chemistry

What is a Catalyst ?

A substance that lowers the activation energy required for chemical reaction without being consumed by the reaction.



Activation Energy without Catalysts: 70 Kcal/mole of CO

Activation Energy with Catalyst: 20 Kcal/mole of CO
(Reaction with Catalysts requires 1/3 activation energy)



Catalyst Chemistry

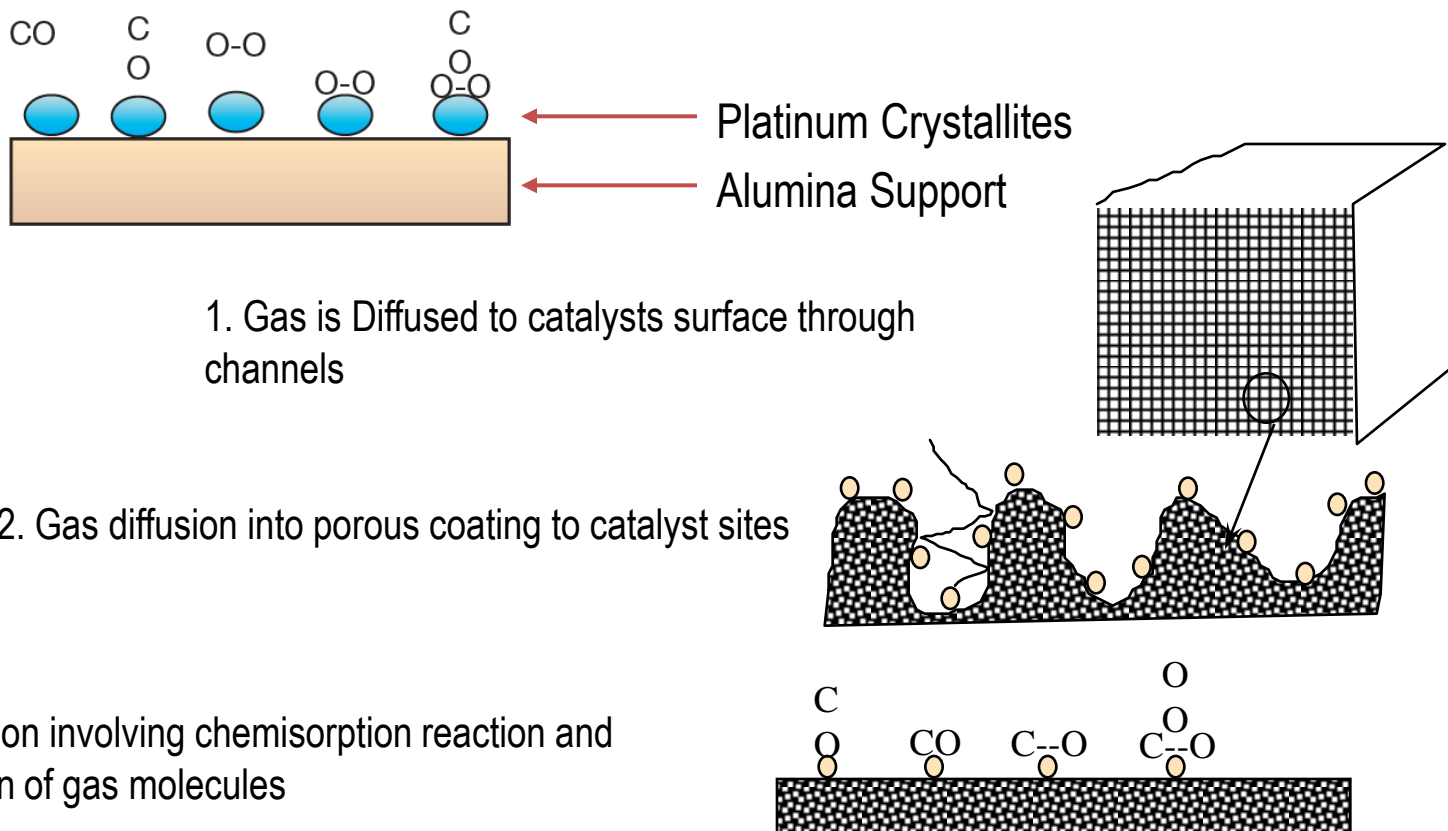
Our Products – Catalyst Components

- Platinum (Pt) –CO and hydrocarbon oxidation
- Rhodium (Rh) – reforming and destruction of oxides of nitrogen
- Aluminum Oxide (Al₂O₃) – surface for wash coat precursor
- Cerium Oxide (CeO₂) – oxygen storage on wash coat
- Zirconium Oxide (ZrO₂) – surface area stabilizer and oxygen storage



Catalyst Chemistry

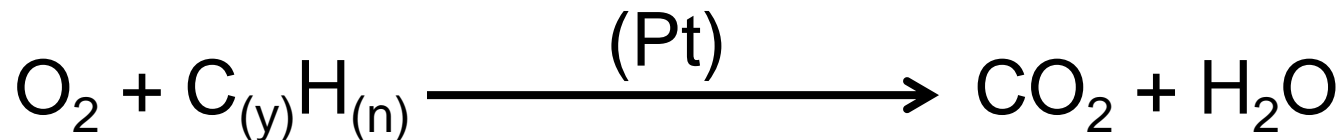
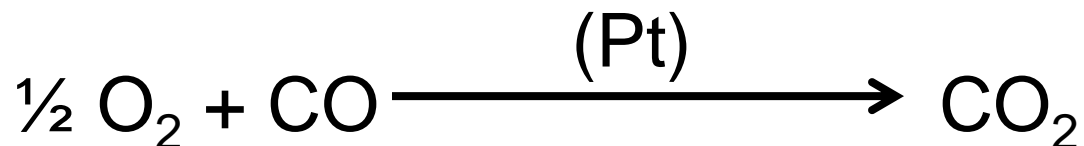
Our Products



Catalyst Chemistry

Phase 1 - Oxidation

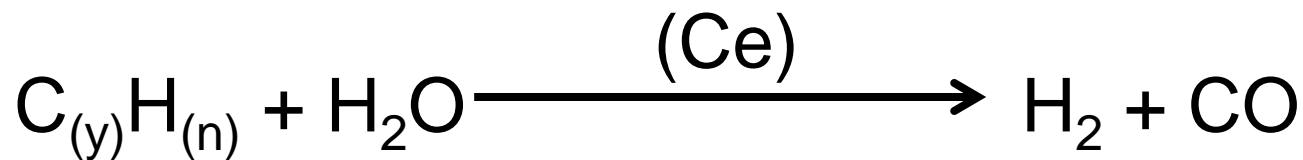
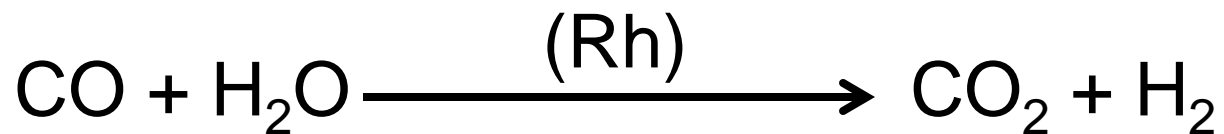
- Destruction of carbon monoxide (CO) and hydrocarbons ($C_{(y)}H_{(n)}$)
- Utilizes platinum catalyst (Pt) and oxygen (O_2)
- Produces carbon dioxide (CO_2) and water



Catalyst Chemistry

Phase 2 – Reforming

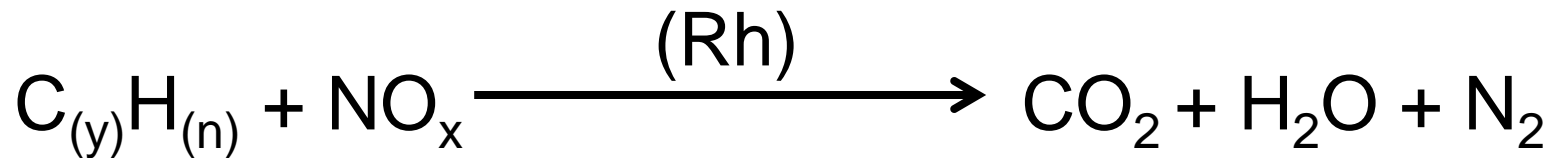
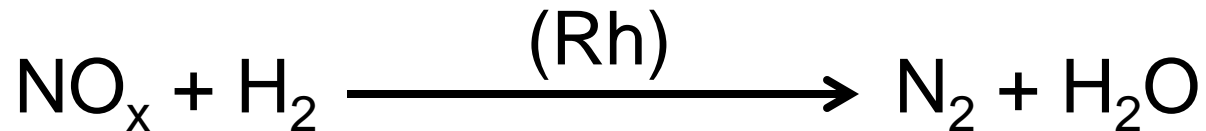
- Utilizes rhodium (Rh) and cerium (Ce) catalyst
- Produces Elemental Hydrogen (H₂) and Carbon Dioxide (CO₂)



Catalyst Chemistry

Phase 3 – Reduction

- Converts oxides of nitrogen (NO_x) to elemental nitrogen N_2 and water
- Utilizes rhodium (Rh) catalysts
- Consumes Hydrogen Produced in Reforming Reaction



Catalyst Chemistry

Catalytic System Design

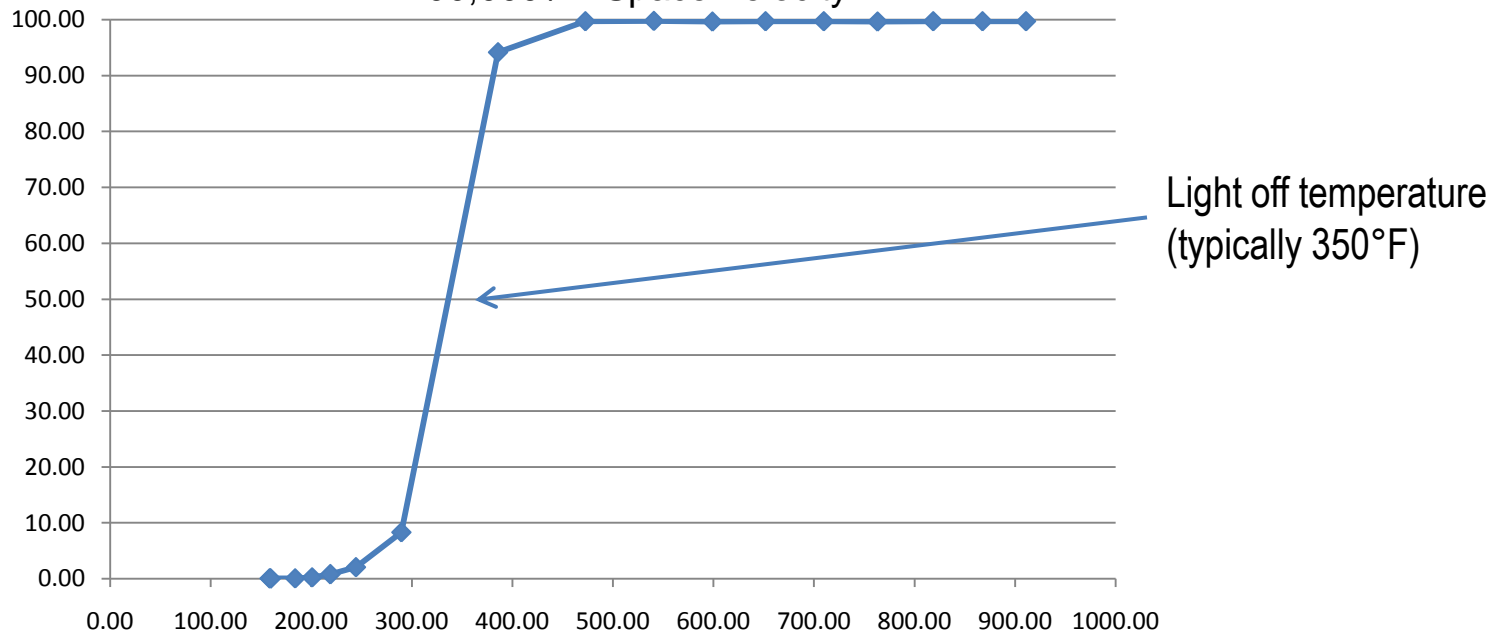
- Catalyst Design Inputs
 - Temperature
 - Flow Rate
 - Allowable Pressure Drop
 - Duct (Area) Size
 - Destruction Efficiency Requirements
 - CO
 - VOC
 - SO₂ SO₃
 - NO NO₂
- Size Catalyst and Support Structure
 - Largest Price Component = Precious Metals Cost
 - Flexibility
 - Module Size
 - CPSI (cells per square inch)



Catalyst Chemistry

Catalytic System Design

Typical Performance Curve
CO Destruction Efficiency Versus Temperature
100,000 /hr Space Velocity



Catalyst Chemistry

Catalytic System Design – Catalysts Limitations

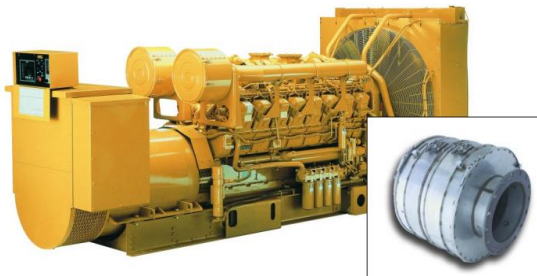
- Extreme Temperature
 - Greater than 1200°F
 - Sintering of wash coat, covers the active metal and decreases catalysts life
 - Lower than 600°F
 - Masking and Poisoning reduce efficiency
 - Pore diffusion and kinetics become limited
- Poisoning agents
 - P, Hg, Pb, As, S
 - High amounts of particulate matter



Product Applications

Pollution Control

Exhaust Gas From Stationary Engines



Exhaust From Gas Turbines in Cogeneration Plants



Manufacturing Capabilities

Quality Assurance

- Implement internal control and monitoring to assure process consistency and provide data for process improvement.
- Leverage technical and engineering expertise to assist clients in improving specification resulting in improved product quality and performance.
- Deliver a product which meets or exceeds the customers specifications and expectations in a timely manner.



Manufacturing Capabilities

Quality Assurance

- Highly Trained Personnel
- Strictly defined production procedures
- 100% inspection of all components at each step
- All production steps defined on Production Traveler
- All material requirements and quantities defined on Production Traveler
- Raw material Traceability
 - Precious Metal
 - Alumina Powder / Washcoat
 - Foil
 - Sheet Metal



Manufacturing Capabilities

Quality Assurance

- ACS' core technical expertise is supplemented by the highest attention to quality assurance and control inspections.
- Critical parameters are tracked throughout the production process to ensure precise catalyst loadings and product performance.
- Process quality control includes 100% inspection of substrates and ACS laboratory testing of each catalyst coating before application.
- Quality variances are detected early in the process enabling prompt corrective action.
- All QC data and production records are integrated with ACS' Management Resource Program, "JobBOSS".



Manufacturing Capabilities

Diagnostic Analysis

- Diagnostic and post-mortem analysis of used catalyst
- Chemical and physical characterization of deactivation means
- Development of customer/application specific catalyst regeneration procedures and catalyst protection alternatives
- Development of next generation formulations to yield improved catalyst life
- Precious metals reclamation from spent catalysts

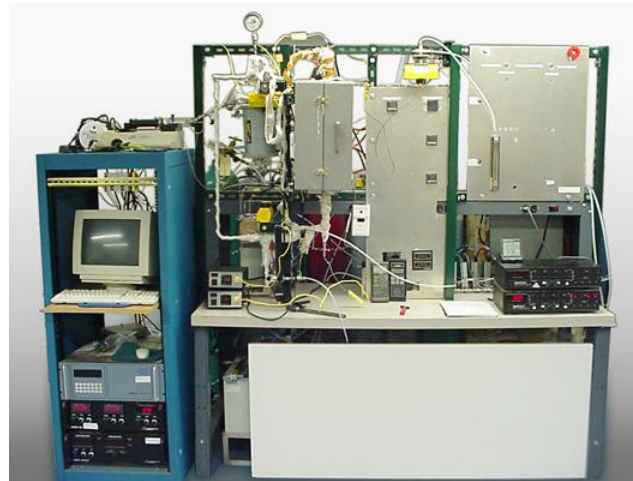
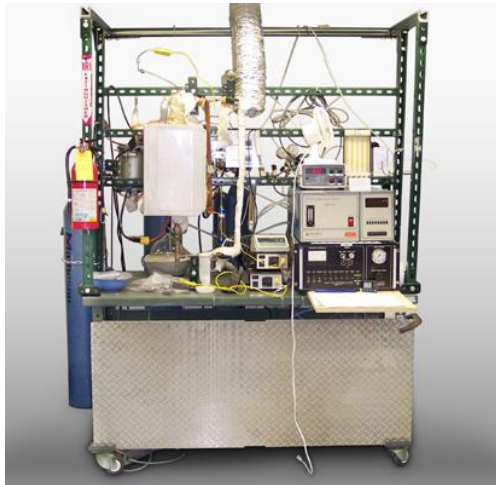


Manufacturing Capabilities

Diagnostic Analysis

Computer interfaced gas phase catalyst testing reactors.

Equipped with NO_x, hydrocarbon, CO, O₂, H₂, SO₂, H₂S, and CO₂ detectors



Manufacturing Capabilities

Diagnostic Analysis

- Gas Chromatography
- FTIR Analysis (EPA standard)
- GC Mass Spectrometry
- High Pressure Liquid Chromatography



Manufacturing Capabilities

Diagnostic Analysis

Thermal gravimetric analyzer for sorption studies



Autosorb analyzer for surface area, pore size distribution and chemisorption



Manufacturing Capabilities

Product Development

- Catalyst lab for development/evaluation of custom catalyst formulations
- Preparation and characterization of new catalyst formulations
 - Coating characterization (viscosity, particle size, adhesion, etc)
 - BET surface area
 - Thermal gravimetric analysis capabilities
- Catalyst testing facilities
 - Automated synthetic gas testing reactor
 - Online FTIR analysis for complete characterization of catalyst performance
 - Accelerated catalyst aging capabilities to study the effects of lubricant, coolant, and other additives on catalyst service life



Manufacturing Capabilities

Product Manufacturing

Catalyst substrates are designed in CAD Program and profile cut with a 50,000 PSI abrasive water jet cutter.

The water jet can cut metal sheets 10'x5' up to 2 inches thick within 0.005" tolerance.

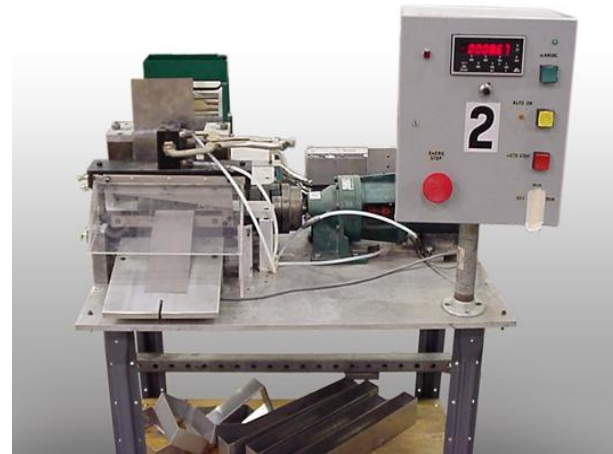
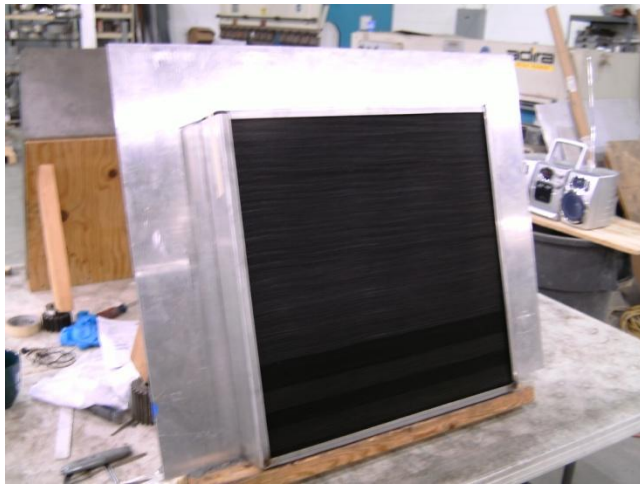


Manufacturing Capabilities

Product Manufacturing

Metal honeycomb substrates are fabricated using automated precision corrugating equipment:

- Foil width from $\frac{3}{4}$ " up to 6"
- Cell densities ranging from 16 cpsi up to 700 cpsi.



Manufacturing Capabilities

Product Manufacturing



Clients

United States

- DCP Midstream Services
- Devon Gas Services
- MidCon Compression
- Compressor Systems, Inc.
- Energy Transfer
- Kinder Morgan
- EOG Resources
- Hoover Energy
- West Texas Gas
- Highmount Exploration
- Targa Resources
- MarkWest
- XTO Energy, Inc.
- Pioneer Natural Resources
- Exterran
- Anadarko Petroleum
- Sandridge
- Enterprise Pipeline
- Holt Caterpillar

