

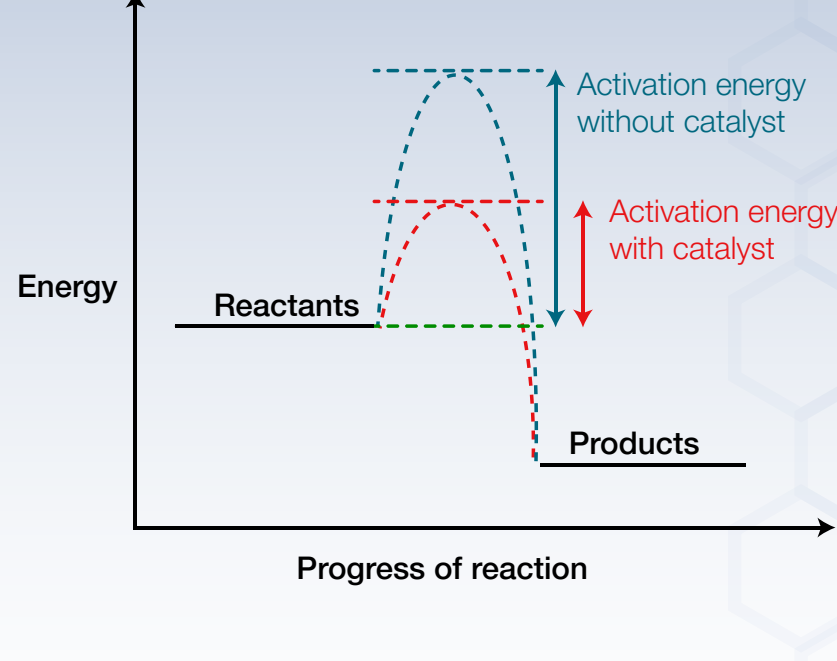
Inside the reaction

Diffuse reflectance infrared Fourier transform spectroscopy for catalyst characterization

Understanding catalyst behavior under realistic reaction conditions helps researchers investigate reaction mechanisms, monitor surface chemistry, and support catalyst development.

Catalysts and their role in reactions

A catalyst increases the rate of a chemical reaction by providing an alternative reaction pathway with lower activation energy while remaining available for subsequent reaction cycles. Researchers often work to modify or adjust catalysts for improved activity, selectivity, and stability.



Heterogeneous catalysis

The catalyst and reactants are in different phases. The reaction occurs on the catalyst surface (e.g., solid catalyst with gas or liquid reactants).

Homogeneous catalysis

The catalyst and reactants are in the same phase, typically in solution or the gas phase.

Types of catalysis

Enzyme catalysis

Biological catalysts accelerate highly specific biochemical reactions.

Autocatalysis

One of the reaction products acts as the catalyst for subsequent reaction cycles.

Important catalyst characteristics

Effective catalysts are designed to possess these key traits



High conversion efficiency



Chemical selectivity



Stability under reaction conditions



Consistent regeneration through repeated catalytic cycles

Heterogeneous catalysts

Common catalyst materials include platinum, palladium, rhodium, iron, copper, and nickel. These materials provide active surface sites that support a wide range of industrial catalytic processes.

Representative applications



Catalytic converters



Petrochemical processing



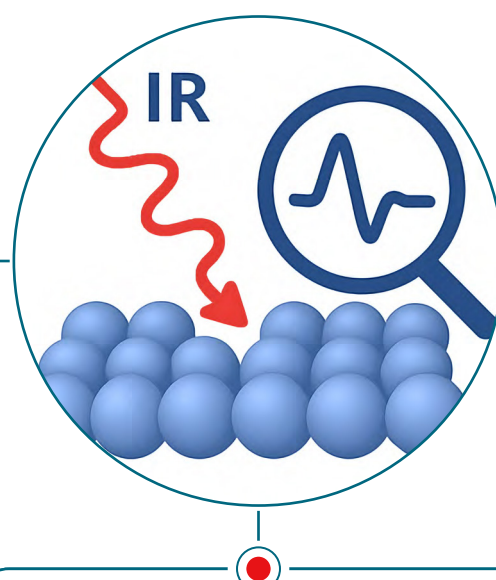
Hydrogenation



Polymer production

Catalyst characterization with DRIFTS

Diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) is one of several complementary techniques used to investigate catalyst surface chemistry under controlled reaction conditions.



Mechanistic insights

Monitor changes in surface species to provide insight into catalytic reaction pathways.

Catalyst development

Generate molecular-level information that supports catalyst optimization by evaluating adsorption behavior, active sites, and catalyst stability.

In situ analysis

Investigate catalyst surface chemistry while controlling temperature, gas composition, and other reaction parameters.

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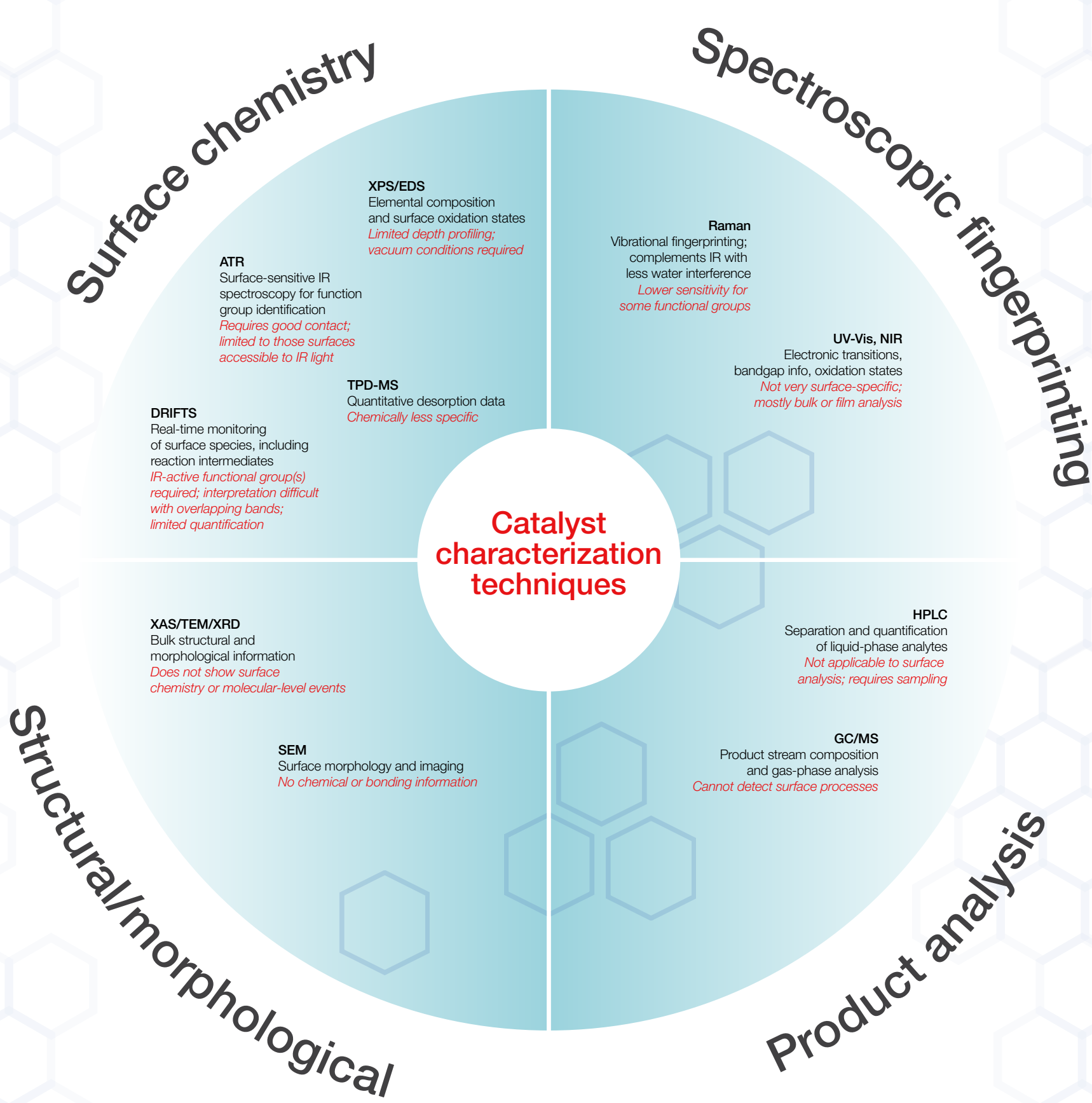
Why use DRIFTS?

Target of study	Reaction intermediates	Active sites	Adsorption and desorption	Catalyst stability	Reaction conditions
Benefit	Monitor changes in surface species during catalytic reactions.	Investigate changes in the chemical environment of catalyst surfaces.	Observe temperature-dependent surface interactions.	Monitor chemical changes associated with catalyst deactivation.	Relate spectral changes to temperature, pressure, and gas composition.
Advantages	Observes surface species and follow transformations as they happen.	Tracks changes using probe molecules like CO.	Links surface species to desorption temperature via specific IR bands.	Detects in situ chemical changes that signal catalyst breakdown.	Connects spectral changes with temperature, pressure, and gas flow.
Limitations	Overlapping bands can make interpretation challenging; limited kinetic data are provided.	Measurement of active sites is indirect, and quantification can be difficult.	DRIFTS is not as quantitative as TPD-MS.	Changes in particle size or morphology are not measured.	Data interpretation is complex due to multiple variables.

Catalyst characterization techniques

Complementary analytical techniques provide greater insight for catalyst research

No single analytical technique answers every research question. Combining complementary methods provides a more complete understanding of catalyst structure, chemistry, and performance.



A flexible platform for catalyst characterization

The Thermo Scientific™ Nicolet™ iS50 FTIR Spectrometer, with a configurable platform well-suited to support catalyst research, enables in situ DRIFTS measurements when paired with the Harrick Scientific™ Praying Mantis™ diffuse reflectance accessory and high-temperature reaction chamber. Together, these instruments help researchers investigate catalyst behavior under realistic reaction conditions.



Flexible configuration

- Supports diffuse reflectance, ATR, and transmission sampling techniques
- Compatible with multiple detector configurations and application-specific accessories
- Expandable platform designed to adapt to evolving catalyst research requirements

Support catalyst research

- Investigate catalyst surface chemistry
- Study catalytic reaction mechanisms
- Monitor catalyst behavior during temperature-programmed experiments
- Generate data to support catalyst development and optimization

Complementary sampling for in situ DRIFTS

Harrick Scientific Praying Mantis diffuse reflectance accessory

Designed for diffuse reflectance measurements of catalyst powders and other solid materials, this accessory complements the Nicolet iS50 FTIR Spectrometer by supporting in situ catalyst characterization under controlled reaction conditions.

High-temperature reaction studies

- Temperature range from -150°C to 910°C
- Pressure capability up to 34 bar
- Controlled gas-flow experiments for catalyst characterization

Temperature-programmed workflows

Templink™ software links temperature control with spectral acquisition to automate measurements at user-defined temperature setpoints, supporting efficient experimental workflows.

Reading DRIFTS spectra

DRIFTS measurements acquired using the Nicolet iS50 FTIR Spectrometer with the Harrick Scientific Praying Mantis accessory provide information about changes in catalyst surface species during chemical reactions. Researchers can correlate spectral changes with reaction conditions to better understand catalyst behavior and support catalyst development.

