Infrared Spectroscopy: Interpreting Spectra

Infrared spectroscopy is a powerful tool for identifying bonds in molecules. This presentation will teach you how to quickly analyze IR spectra in 1 minute or less.

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Common Misconceptions

Not for Full Structure

IR can't determine a molecule's entire structure.

Selective Analysis

We don't need to analyze every peak.

Complementary Tool

IR complements other techniques like NMR.

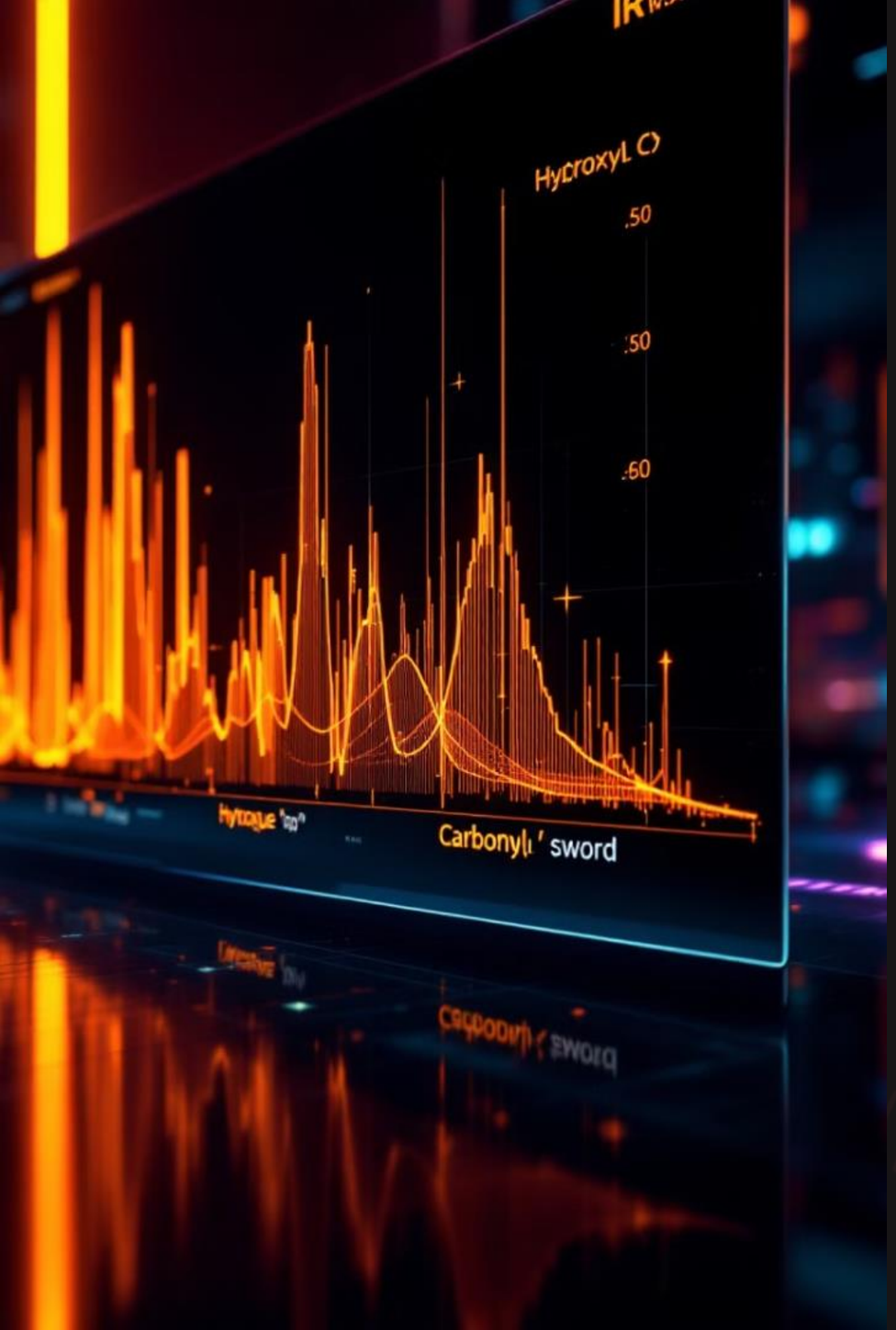
The Big Picture

What IR Measures

IR spectroscopy measures absorption of IR radiation by molecules. Peaks represent specific bond vibrations.

Key Regions

Focus on 3600-2700 cm^{-1} (X-H bonds) and 1900-1500 cm^{-1} (X=X bonds).



Two Key Questions

Hydroxyl Groups

Is there a broad peak around 3400-3200 cm^{-1}?

Carbonyl Groups

Is there a sharp peak around 1850-1630 cm^{-1}?

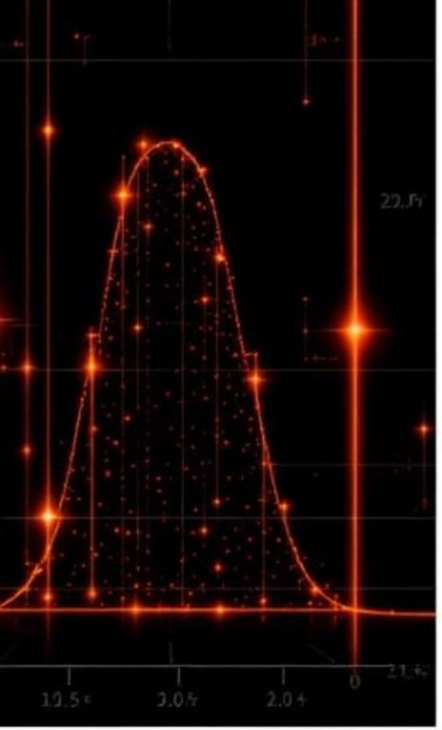
Hydroxyl Groups: "Tongues"

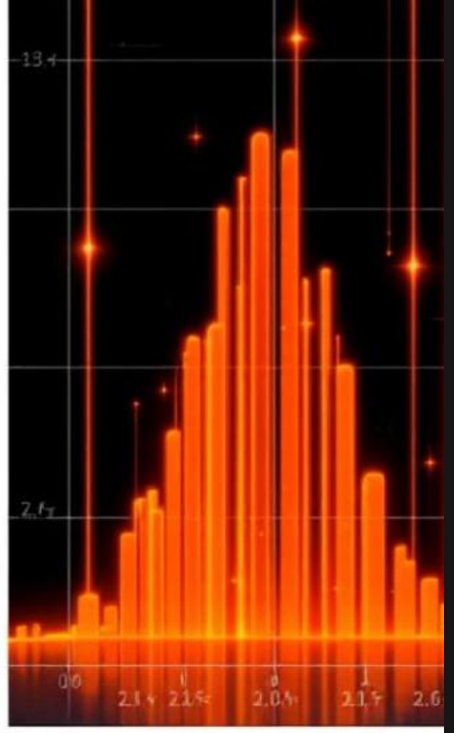
Alcohol OH

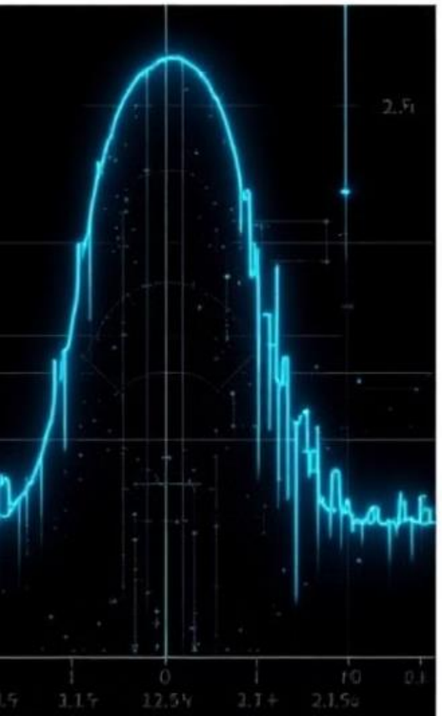
Broad peak due to hydrogen bonding. Varies in appearance.

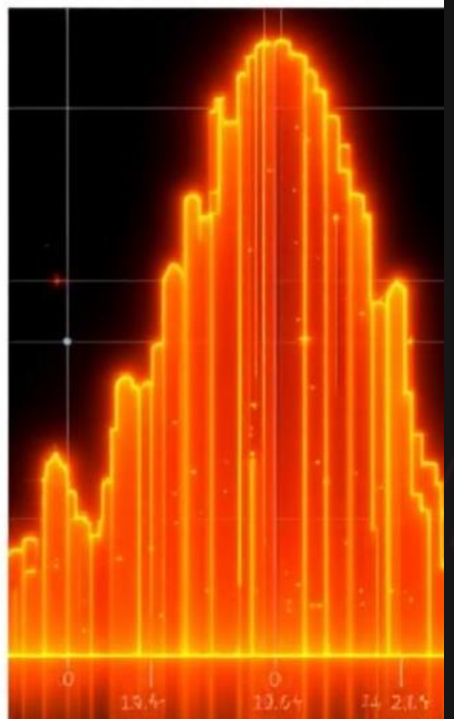
Carboxylic Acid OH

Even broader "hairy beard" appearance.









Carbonyl Groups: "Swords"

1. **Aldehydes**
   1740-1690 cm^{-1}
2. **Ketones**
   1750-1680 cm^{-1}
3. **Esters**
   1750-1735 cm^{-1}
4. **Carboxylic Acids**
   1780-1710 cm^{-1}

Additional Diagnostic Areas

1

C-H Stretch Boundary

3000 cm^{-1} divides sp^2 and sp^3 C-H bonds

2

Triple Bonds

2200-2050 cm^{-1} indicates C≡N or C≡C

Quick Analysis Tips

Check Formula

Use molecular formula to guide your search for functional groups.

Degrees of Unsaturation

Calculate to determine possible functional groups.

1-Minute Analysis

Focus on "tongues" and "swords" for quick insights.

Practice Makes Perfect

Study Examples

Familiarize yourself with various IR spectra.

Look for Patterns

Recognize characteristic peaks for different functional groups.

Apply Knowledge

Use these techniques to quickly analyze unknown compounds.

Understanding IR Spectroscopy: Key Regions and Functional Groups

This presentation will guide you through the essential aspects of interpreting IR spectra. We'll focus on diagnostic regions and functional group identification.

Carbonyl Stretch: A Crucial Indicator

Aldehydes

1740-1690 cm^{-1} (e.g., benzaldehyde, propanal)

Ketones

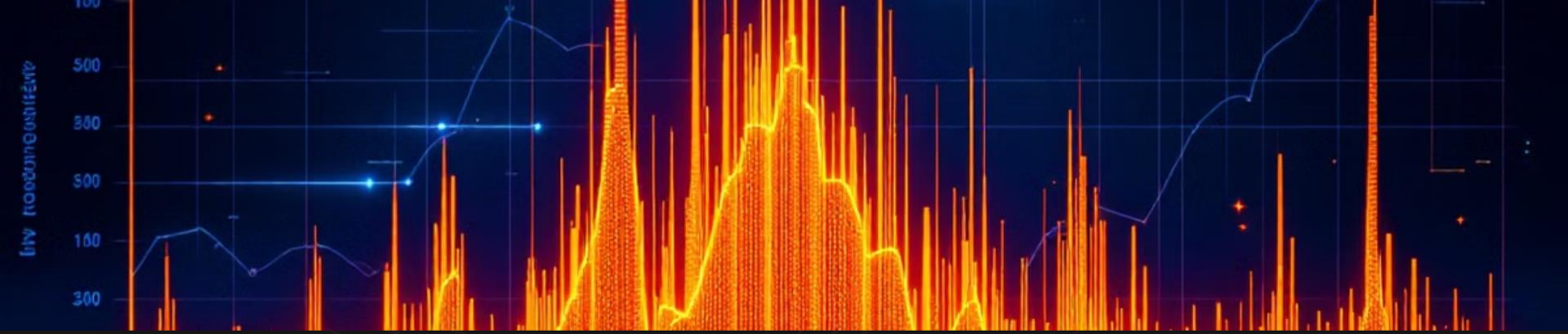
1750-1680 cm^{-1} (e.g., 2-pentanone, acetophenone)

Esters

1750-1735 cm^{-1} (e.g., ethyl acetate, methyl benzoate)

Carboxylic acids

1780-1710 cm^{-1} (e.g., benzoic acid, butanoic acid)



More Carbonyl Stretches

Amides

1690-1630 cm^{-1} (e.g., acetamide, benzamide)

Anhydrides

Two peaks: 1830-1800 cm^{-1} and 1775-1740 cm^{-1}

Key Rule

C=O stretch never appears below 1630 cm^{-1}

C-H Stretch Boundary

Above 3000 cm^{-1}

Indicates sp^2 hybridized C-H bonds (e.g., 1-hexene, benzene)

Below 3000 cm^{-1}

Indicates sp^3 hybridized C-H bonds (e.g., hexane)

Triple Bond Region

Ghost Town

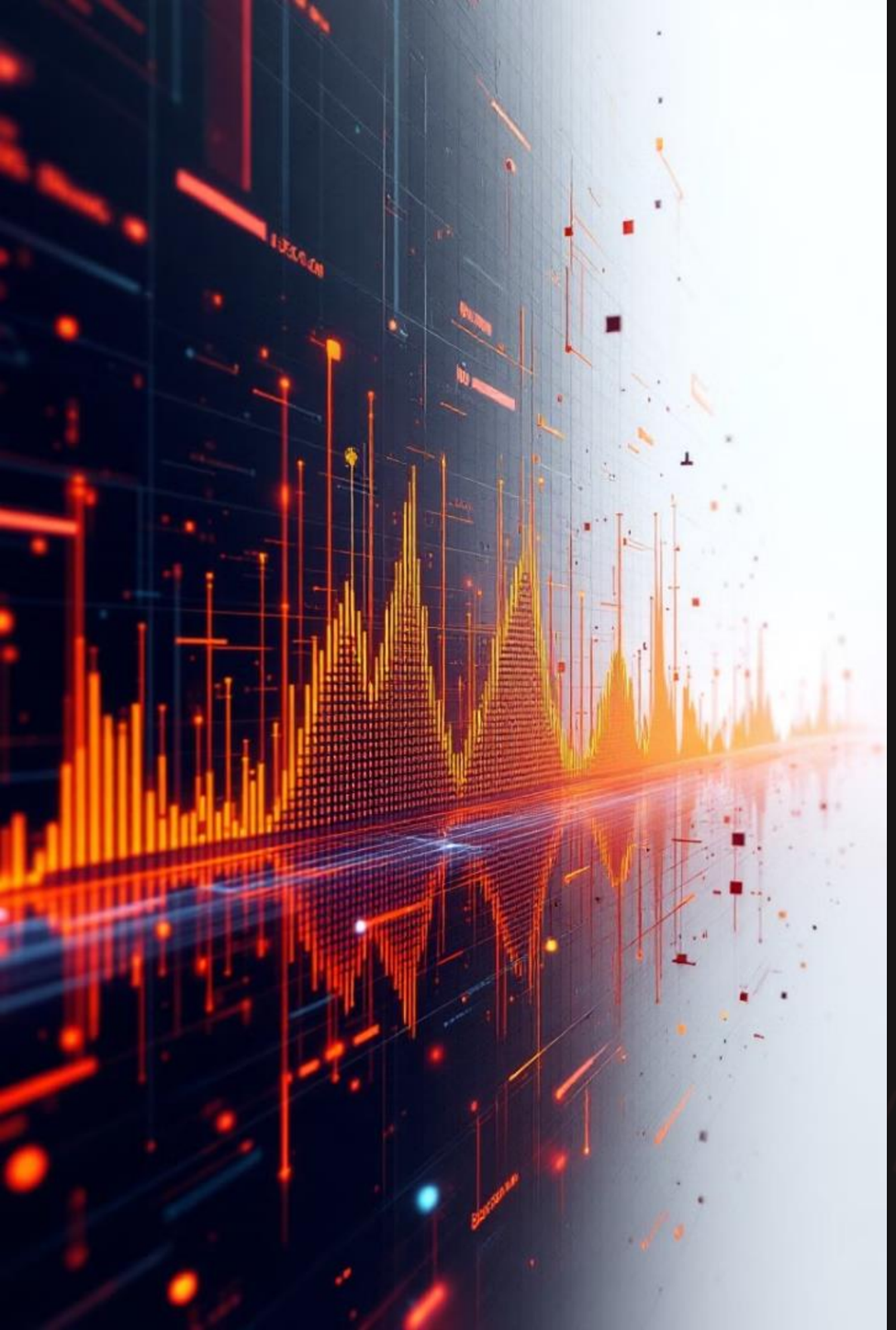
2000-2400 cm^{-1} region is typically empty

Alkynes and Nitriles

Peaks in this region often indicate triple bonds

Terminal Alkynes

Strong C-H stretch around 3400 cm^{-1}



1-Minute Analysis: Glucose Example

1

OH Present

Peak around 3300 cm^{-1}

2

No C=O Stretch

No strong peak around 1700 cm^{-1}

3

No Alkene C-H

No peaks above 3000 cm^{-1}

Amines, Amides, and Terminal Alkynes

Amines

N-H stretches in 3200 cm^{-1} region

Amides

N-H stretches and C=O stretch

Terminal Alkynes

C-H stretch around 3400 cm^{-1}

Key Takeaways

1

Carbonyl Stretch

Around 1700 cm^{-1}, varies by functional group

2

C-H Stretch Boundary

3000 cm^{-1} divides sp^2 and sp^3 hybridized bonds

3

Triple Bond Region

2000-2400 cm^{-1}, rare but distinctive