

Overcoming Hydrogen-Bonding in On-line Spectroscopy of Hydrofluoric Acid

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Honeywell Technical Data Sheet

Anhydrous Hydrogen Fluoride

CAS Number 7664-39-3

UN Number: 1052

PRODUCT SPECIFICATION

<u>Parameter</u>	<u>Limit</u>	<u>Test Method</u>
Assay as Hydrogen Fluoride (weight %)	99.95	H5.3-17: Difference
Nonvolatile Acidity (NVA) as H ₂ SO ₄ (ppm)	100	H5-7: Titrate residue to Phenolphthalein Endpoint
Sulfur Dioxide (ppm)	50	H5-11: Iodimetry
Water (ppm)	200	H5.3-18: Conductivity of Laboratory Sample
Arsenic (ppm)	25	H5-14: Colorimetry- Supplemented for AsF ₆

Notes: (1) Anhydrous Hydrogen Fluoride may contain minor amounts of impurities other than those specified. Customers should discuss particular concerns with their Industry Manager.

(2) Analytical methods are conducted using latest revision.

Available on <http://www.HFacid.com>

Measure ppm Impurities On-line in HF

Benefits

- Reduce - Grab Sampling, Exposure
- Improve - Turnaround, Precision, Process Control

Challenges

- Materials Compatibility
- Unusual properties of HF
- Could not reproduce in laboratory
- Lab Instrument in plant environment

Enablers

- Quality people at Plant, Vendors, Engineering, Lab

Experimental Conditions

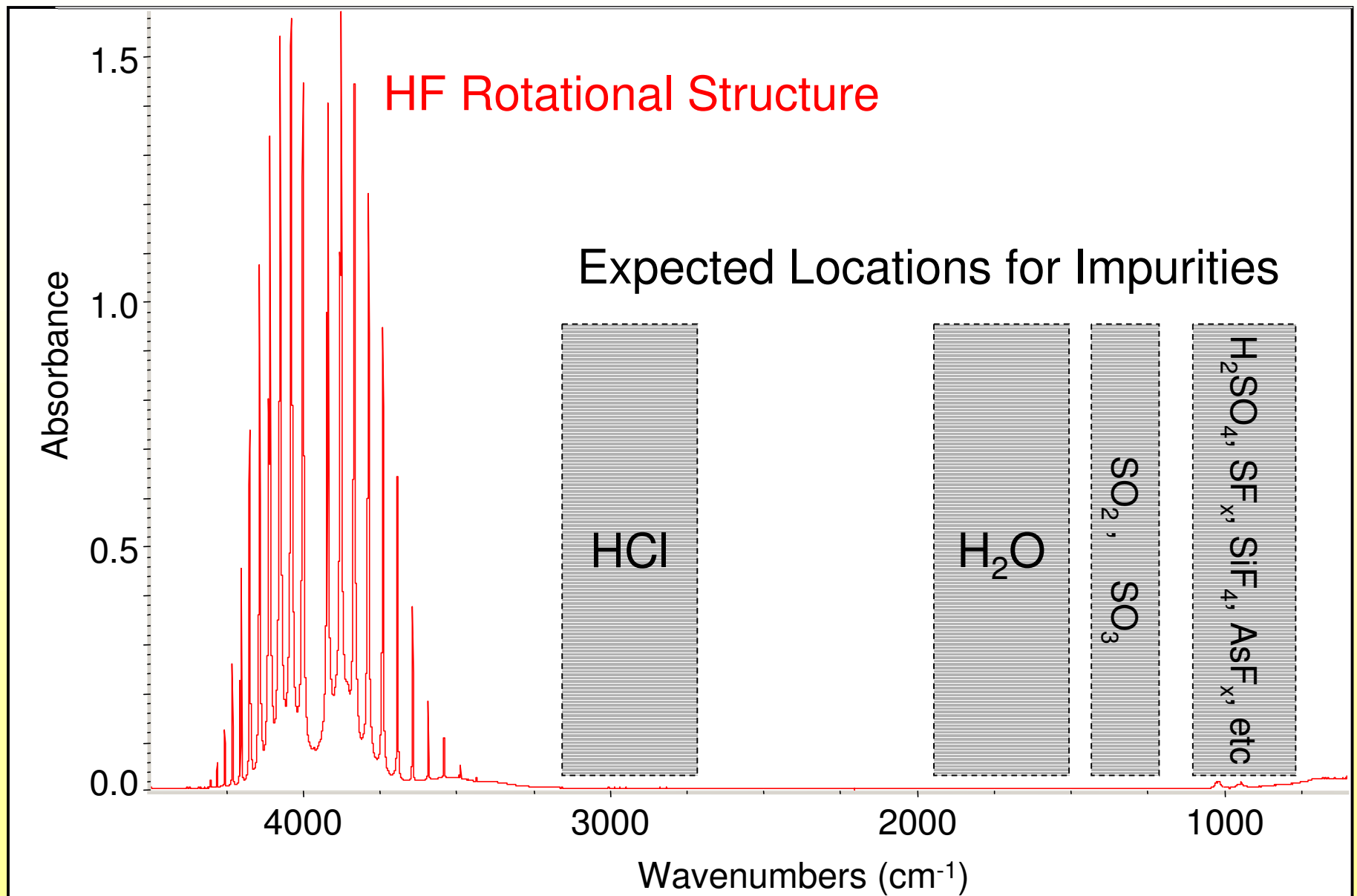
Sampling

- Anhydrous HF
- Heat Tracing at 105 °F
- Manifold with By-Pass and N₂ Purge
 - ↳ Dynamic and Stop flow capabilities
- Safety Shut-off at several points

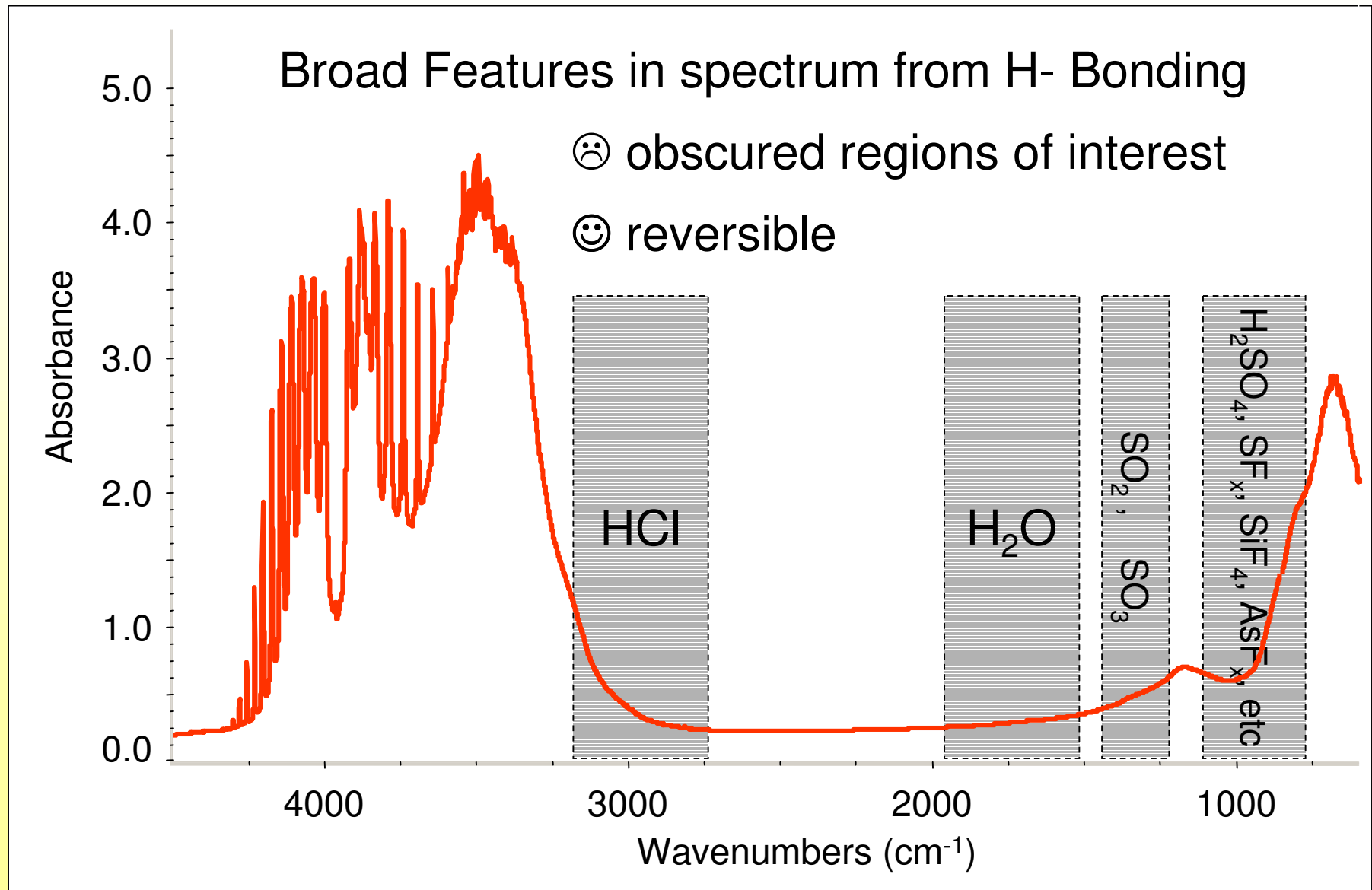
Instrumentation

- IRGAS 100 Demo unit
- 20 cm direct pass detection cell
 - ↳ independent heating control
- IRGAS software

Ideal FTIR Spectrum of HF Gas



Severe Hydrogen Bonding



IRGAS Demo Instrument with Manifold



Leak Testing the On-Line HF Analyzer



Demo Instrument, Heat Traced and Insulated



Http://www.HFacid.com

Honeywell-Hydrofluoric Acid - Microsoft Internet Explorer

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Y2K Readiness Disclosure

World Leader in HF

Honeywell is the world's largest producer of Hydrofluoric Acid (HF) and the leader in safe and reliable HF transportation. We supply global HF customers from ISO - certified facilities in Geismar, Louisiana; Amherstburg, Ontario, Canada; Weert, The Netherlands and Seelze, Germany.



Our Geismar facility is the world's largest HF facility. Both Geismar and Amherstburg feature the most reliable and advanced production technology. We are committed to being a Six Sigma Plus organization. Our commitment is driven by continuous dialogue with our customers to help us fully understand their specific needs. This process enables us to consistently deliver high-quality products, enhanced performance and comprehensive technical support.

Product Stewardship

Customers who rely on Honeywell get more than a quality HF product. We are also committed to the safe, reliable and consistent delivery of HF: Safety First, second and foremost is our guiding principle. No single supplier can match our breadth of experience or the support that we offer in every phase of the HF cycle.

Customer Focus

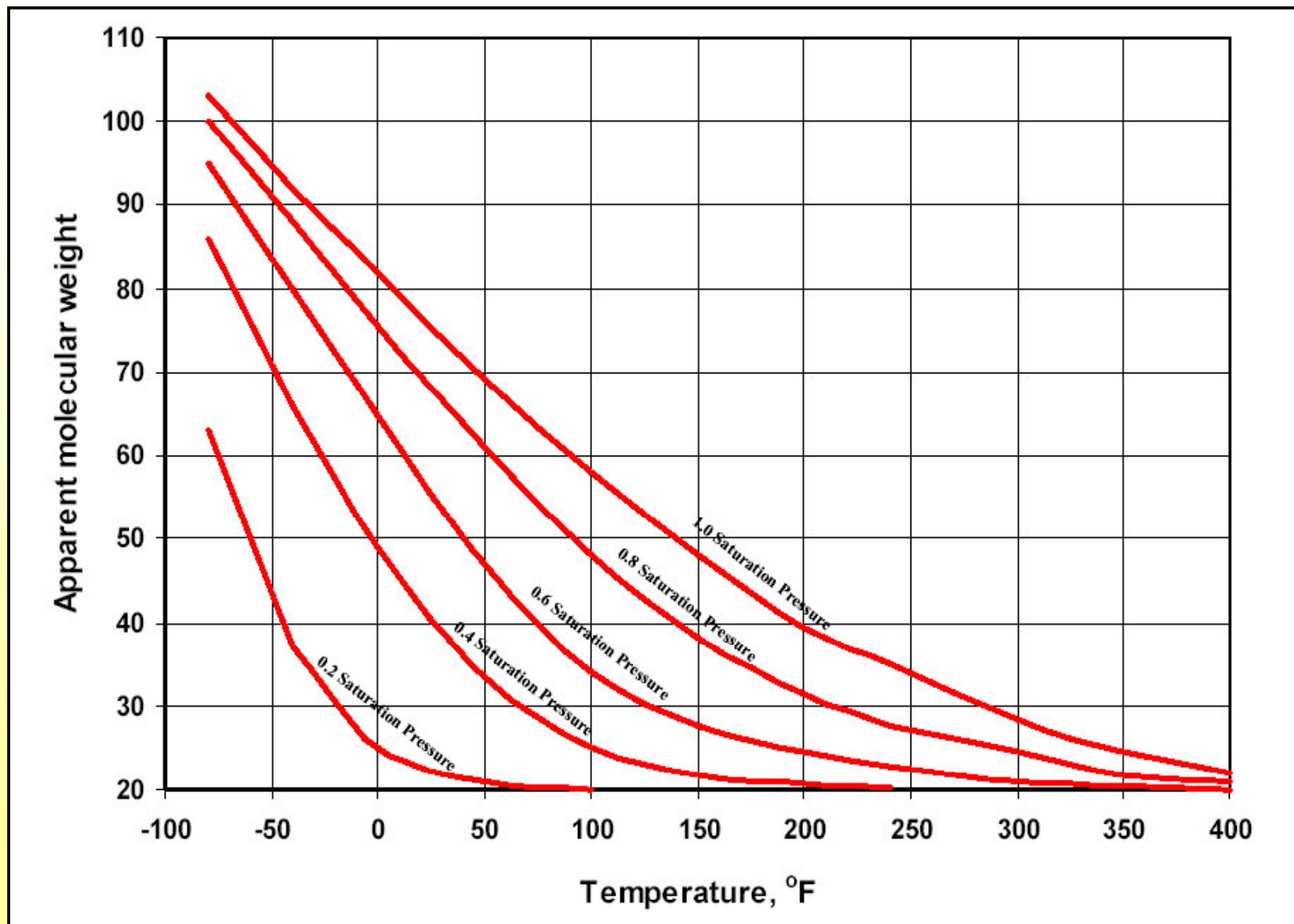
Our commitment to develop innovative solutions begins with the customer. Working with you, our Industrial Fluorines group can provide innovative solutions to improve your HF utilization, safety and performance.

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Performance Polymers & Chemicals Internet

Http://www.HFacid.com

Apparent Molecular Weight of HF vs. P, T



Strategies for Reducing Saturation Pressure

1. Reduce Total Pressure of Sample

- ☹ Condensation / Heat of Expansion
- ☹ Decrease Sensitivity

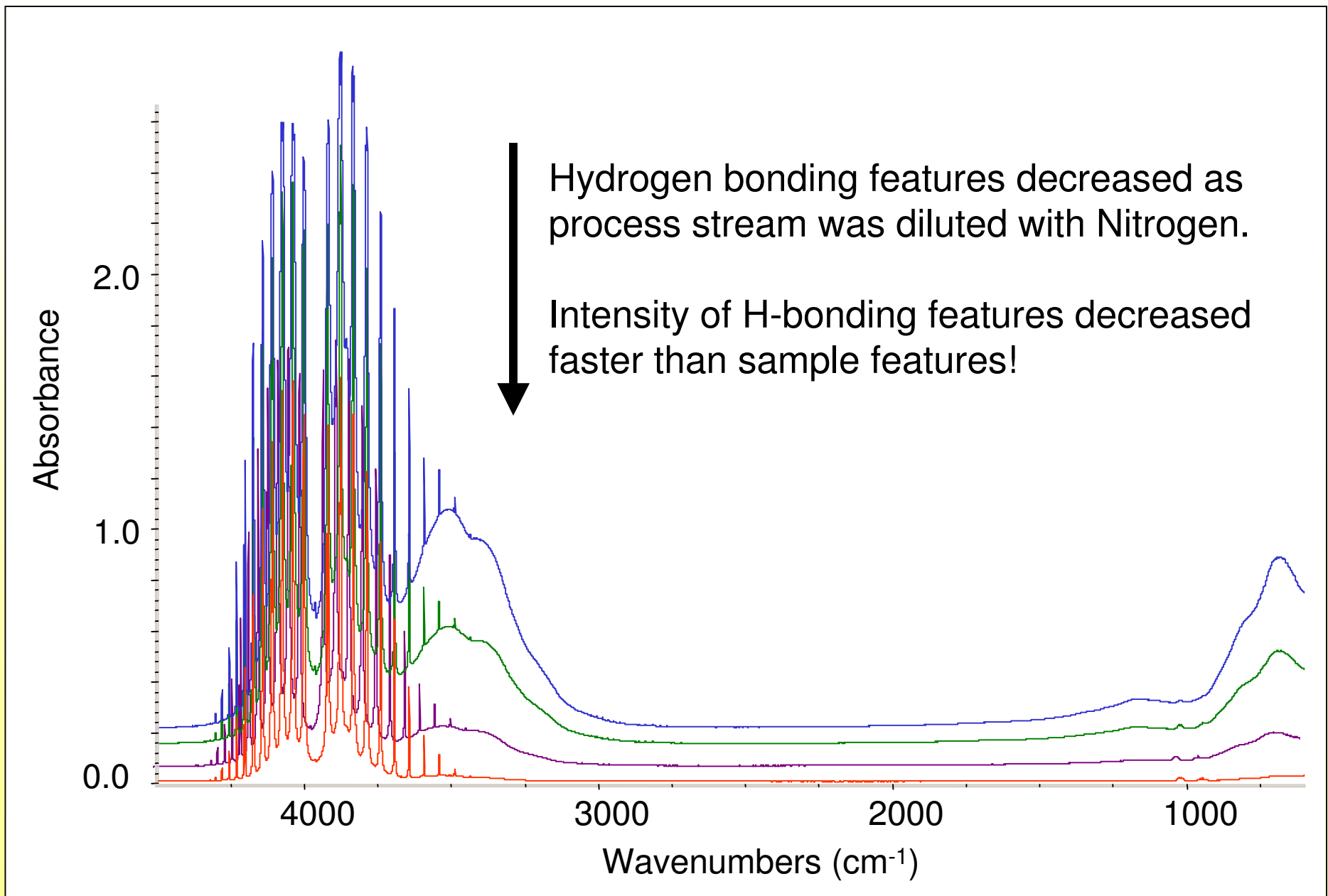
2. Dilute with Inert Gas

- ☹ Same as above
- ☹ Not Robust for Manufacturing Process

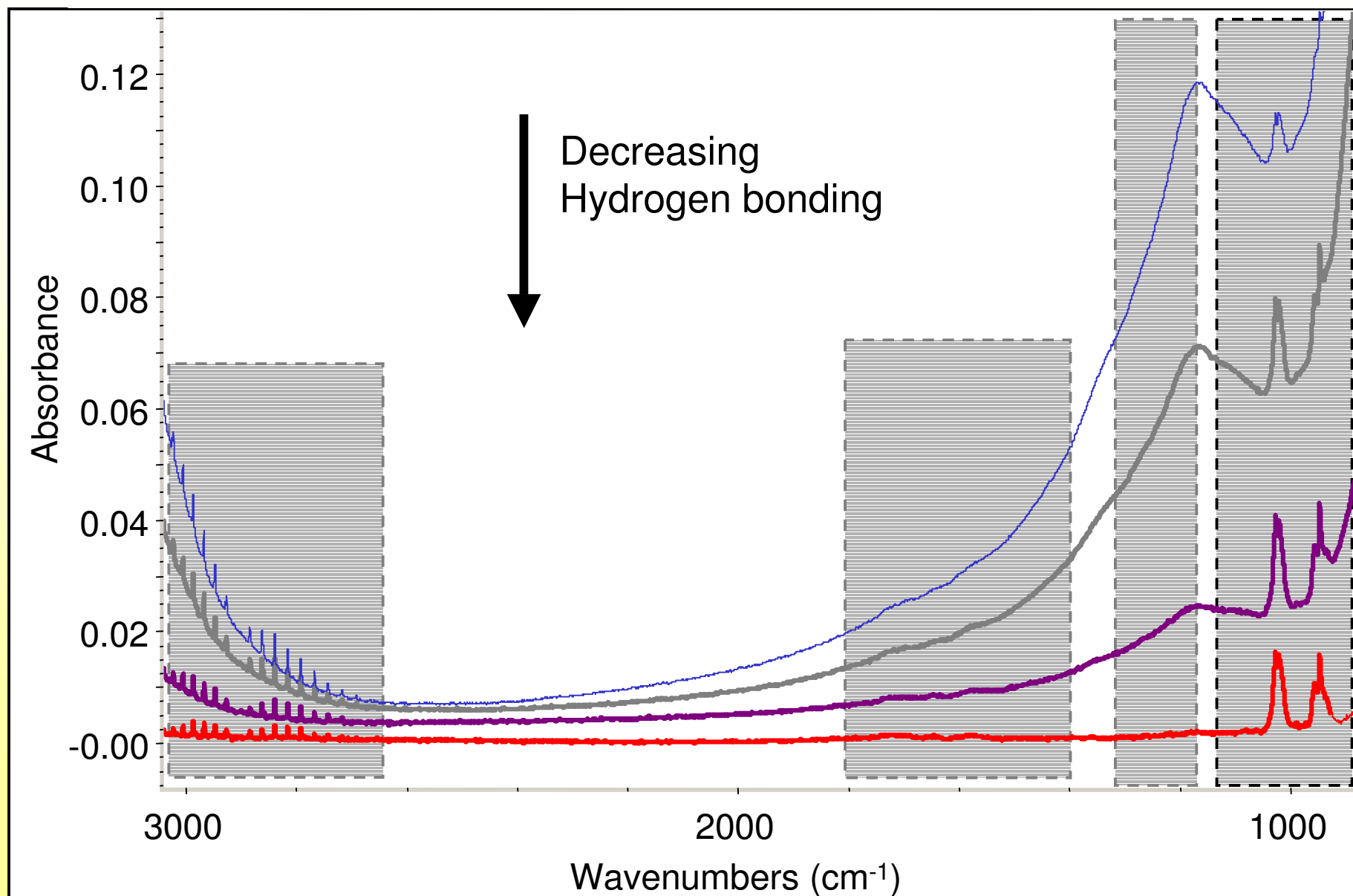
3. Increase Temperature

- ☺ Simple
- ☺ Maintain Sensitivity
- ☹ Material Compatibility

Hydrogen Bonding Reduced by Dilution

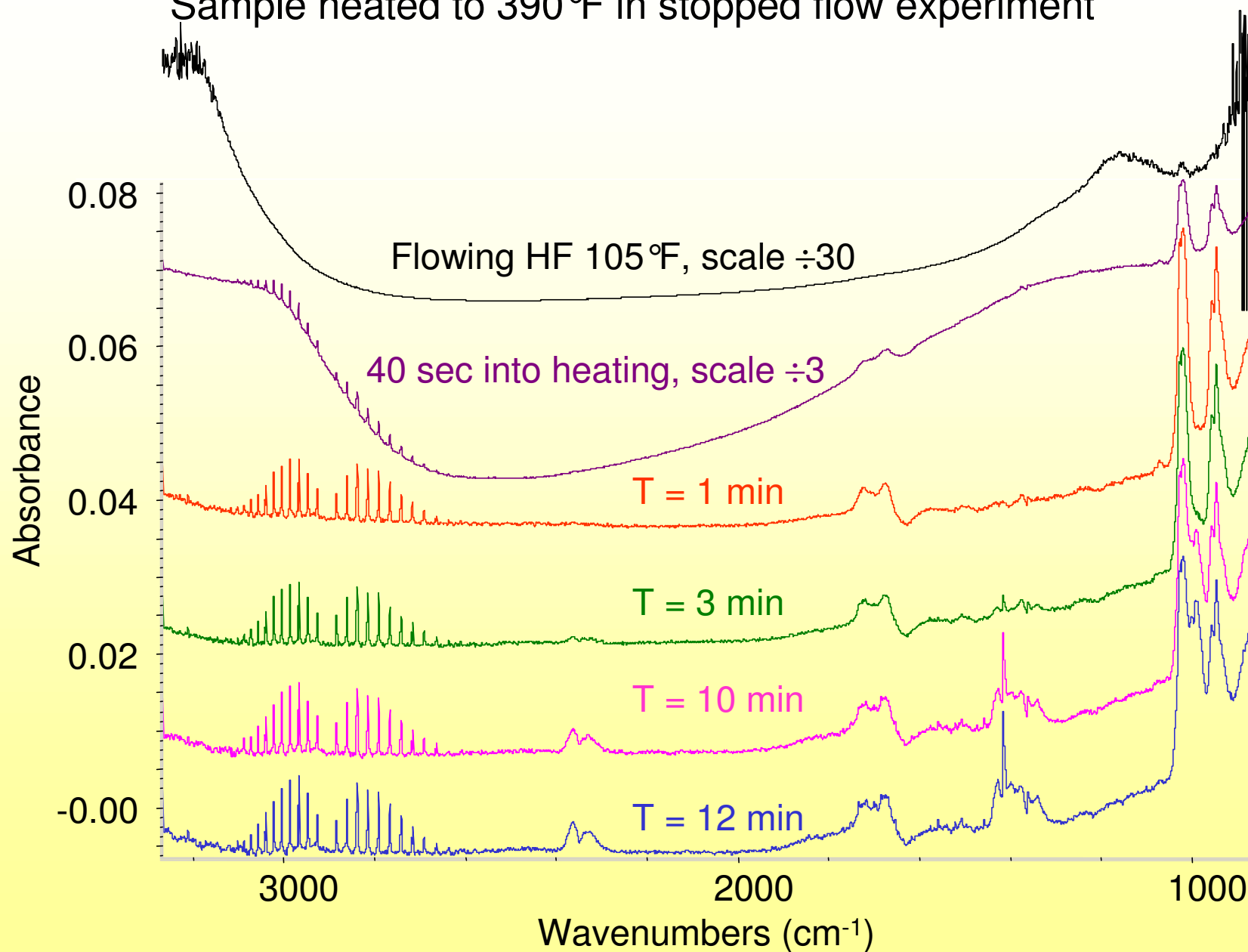


Zoom in on Dilution

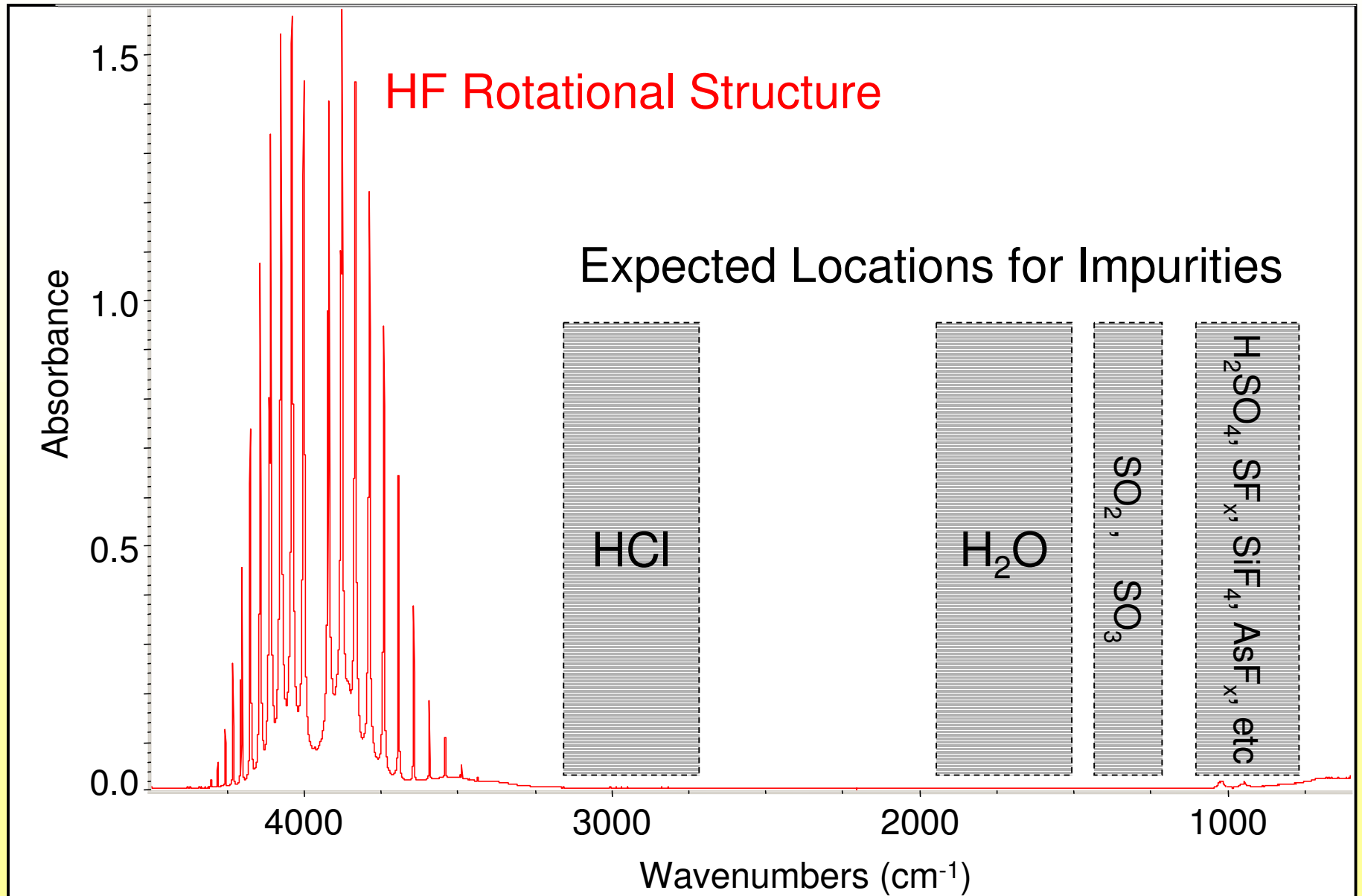


Eliminate Hydrogen Bonds by Heating

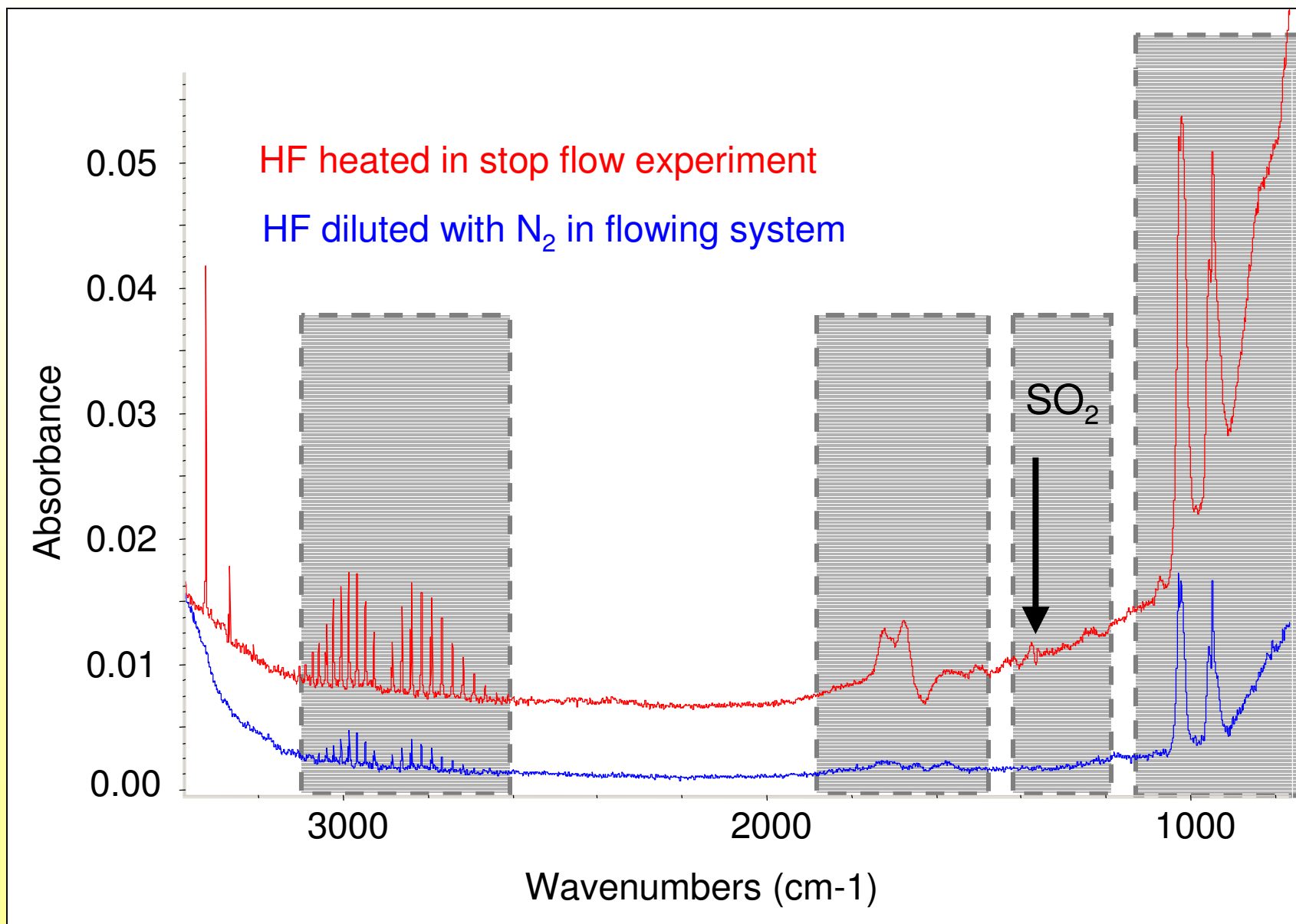
Sample heated to 390°F in stopped flow experiment



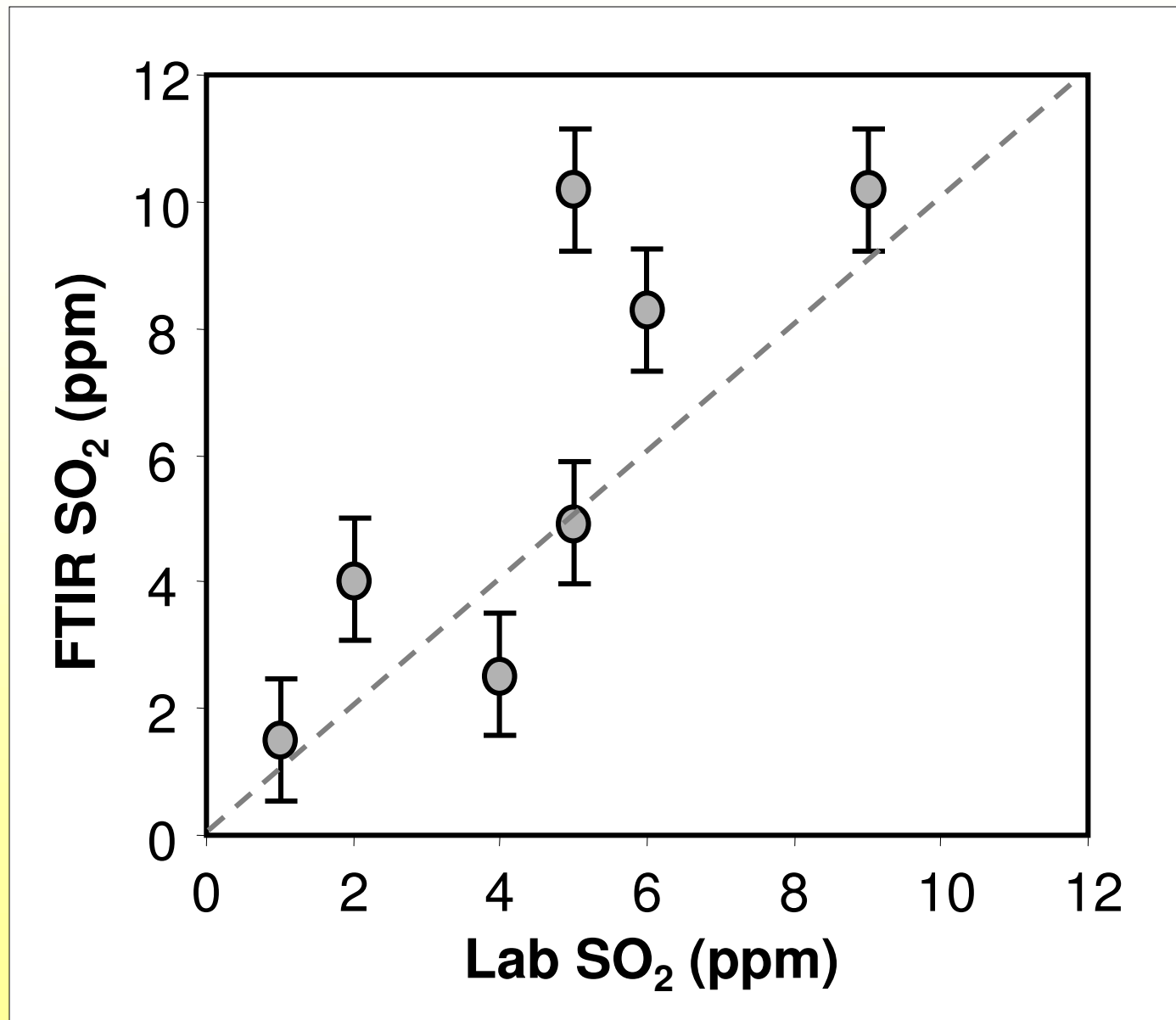
Ideal FTIR Spectrum of HF Gas



Dilution vs Heating



Compare Lab and FTIR Results for SO₂



Lessons Learned for Trace Analysis in HF

Safety Safety Safety

- Shut-offs, check valves, PPE
- Alarms for Low-flow & High pressure
- Materials Compatibility

Sampling

- Heat >> Dilution for Reducing H-bonding
- Materials Compatibility
- Manifold improved flexibility

Instrumentation

- IRGAS system is robust
- ≥ 20 cm pathlength detection cell

Acknowledgements

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