

All data taken at Pacific Northwest National Laboratory (PNNL)
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Composite spectrum for HCL_5T

Effective burden of composite spectrum: 1 part-per-million-meter (ppm-meter) at 296 K

Equivalent concentration x path-length of composite spectrum: 1.501×10^{-6} grams/liter-meter

Note that some of the higher J-lines for the fundamental band of HCl exhibit “ringing”. This ringing is due to the fact that these lines do not pressure broaden significantly and act as a delta function, resulting in the instrumental response function (SINC²) characteristic of a Fourier transform spectrometer. In an effort to preserve the integrity of the data, we have resisted applying an apodization function that would “cut the feet off” of the SINC² response.

Sample Conditions-

- Chemical name and CAS number: Hydrogen chloride, HCl : [7647-01-0]
- Physical properties: M.W. 36.46 amu, F.P. -114 C, B.P. -85 C
- Supplier and stated purity: Matheson, 99%
- Sample class: I (PNNL scale).
- Temperature of sample: 5.04 ± 0.02 C
- Diluent: Sample back filled with ultra high purity nitrogen to 760 ± 5 Torr
- Individual samples at 0.92052, 23.53, 2.0844, 43.06, 1.4265 and 10.1845 Torr. Path length = 19.94 cm. Final data is a composite spectrum.
- Preparation: Multiple freeze-thaw cycles at 77 K to remove air.

Instrument Parameters-

- Bruker-66V FTIR, temperature controlled environment, evacuated optics bench
- Modified to include second aperture, between interferometer output and sample cell. This substantially reduces both “ghosting” and warm aperture effects.
- Spectral range: 6,500 to 600 cm^{-1} (1.534 to 16.667 microns)
- Instrumental resolution based on maximum interferometer displacement is 0.112 cm^{-1}
- Spectral intervals after FFT: 0.06 cm^{-1}
- Interferogram zero-fill: 2X
- Apodization: Boxcar
- Phase correction: Mertz
- Beam splitter: Potassium bromide (KBr)
- IR source: Carbide glowbar (22 V)
- Scanner velocity: 60KHz (HeNe crossing frequency)
- Number of interferograms averaged per single channel spectra: 256
- Detector: Mid-band HgCdTe, photoconductive, 77K operation
- Folding limits: 15798 to 0 cm^{-1}

Post Processing and Related Parameters-

- Non-linearity detector correction (Bruker proprietary) applied to interferogram ($\tau = 0.85$, $\nu = 530$)
- Composite spectrum created from 6 individual absorbance (base-10) spectra via classical least squares fit: Intercept=0, slope is fitted, individual absorbance values weighted by T^2 (transmission squared), all absorbance values > 1.6 are given zero weight
- Calculated and estimated errors: Type A = 2.59%, Type B = 3%

- Frequency correction (already applied): $V(\text{corrected}) = V(\text{instrument}) * 0.999997 + 5.18 \times 10^{-4}$
- Axis units: X=wavenumbers (cm^{-1}), Y=Absorbance (base-10)
- Trace carbon dioxide and SiF_4 vapor features removed via spectral subtraction
- Baseline correction via 7th order polynomial subtraction