

All data taken at Pacific Northwest National Laboratory (PNNL)

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Version 1.0, July, 05

Composite spectrum for FACIDD_25T

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

Equivalent concentration x path-length of composite spectrum: 3.7898×10^{-6} grams/liter-meter

Dimer and monomer concentrations calculated from equilibrium constant as per J. R. Barton and C. C. Hsu, "P-V-T-X Properties of associated vapors of formic and acetic acid", J. Chem. And Eng. Data **14**, 1969, pp 184-187. Monomer spectrum subtracted from composite spectrum.

Sample Conditions-

- Chemical name and CAS number: Formic acid dimer, $(\text{CH}_2\text{O}_2)_2$: [14523-98-9]
- Physical properties: fw=92.0512 g/mole, mp=na, bp=na
- Supplier and stated purity: Aldrich, 96% (formic acid)
- Sample class: III (PNNL scale).
- Temperature of sample: 25.07 ± 0.02 C
- Diluent: Sample back filled with ultra high purity nitrogen to 760 ± 5 Torr
- Individual samples at 0.9025, 0.5255, 2.025, 1.532, 0.7365, 0.2435 and 3.48 Torr. Path length = 19.96 cm. Final data is a composite spectrum.
- Preparation: Multiple freeze-thaw cycles at 0 C 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: 7,200 to 540 cm^{-1} (1.389 to 18.519 microns)
- Instrumental resolution based on maximum interferometer displacement is 0.112 cm^{-1}
- Spectral interval after 2X zero-filling interferogram and 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 ($\alpha=0.85$, $\epsilon=530$)
- Composite spectrum created from 7 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 = 7.14%, Type B $\leq 3\%$
- Frequency correction (already applied): $V(\text{corrected}) = V(\text{instrument}) * 0.99999896 + 8.812 \times 10^{-4}$
- Axis units: X=wavenumbers (cm^{-1}), Y=Absorbance (base-10)
- Baseline correction via 7th order polynomial subtraction