

All data taken at Pacific Northwest National Laboratory (PNNL)

Operators: Steven W. Sharpe, Timothy J. Johnson and Robert L. Sams : [sw.sharpe@pnl.gov](mailto:sw.sharpe@pnl.gov)

Version 2.0, March, 02

Composite spectrum for SO<sub>2</sub>\_5T

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

Equivalent concentration x path-length of composite spectrum:  $2.637 \times 10^{-6}$  grams/liter-meter

### Sample Conditions-

- Chemical name and CAS number: Sulfur dioxide, sulfurous oxide, sulfur oxide, sulfurous anhydrides, SO<sub>2</sub> : [7446-09-6]
- Physical properties: fw=64.0588 g/mole, fp=-76.1° C, bp=-10° C
- Supplier and stated purity: Matheson, 99.98% (No way, lots of CO<sub>2</sub>)
- Sample class: I (PNNL scale).
- Temperature of sample:  $4.99 \pm 0.02$  C
- Diluent: Sample back filled with ultra high purity nitrogen to  $760 \pm 5$  Torr
- Individual samples at 0.55100, 6.24680, 1.30330, 21.36, 2.9210, 100.71 and 0.7720 Torr. Path length = 19.94 cm. Final data is a composite spectrum.
- Preparation: many, many, many freeze-thaw cycles at -77 C to remove carbon dioxide.

### 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 500 cm<sup>-1</sup> (1.534 to 20.000 microns)
- Instrumental resolution based on maximum interferometer displacement is 0.112 cm<sup>-1</sup>
- Spectral interval after 2X zero-filling interferogram and FFT: 0.06 cm<sup>-1</sup>
- 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<sup>-1</sup>

### Post Processing and Related Parameters-

- Non-linearity detector correction (Bruker proprietary) applied to interferogram ( $\alpha = 0.85$ ,  $\beta = 530$ )
- 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<sup>2</sup> (transmission squared), all absorbance values  $> 1.6$  are given zero weight
- Calculated and estimated errors: Type A = 0.41%, Type B = 3%
- Frequency correction (already applied):  $V(\text{corrected}) = V(\text{instrument}) * 0.99999896 + 8.812 \times 10^{-4}$
- Axis units: X=wavenumbers (cm<sup>-1</sup>), Y=Absorbance (base-10)
- Baseline correction via 7<sup>th</sup> order polynomial subtraction