EXAMINING CONTRIBUTIONS TO LINE SHAPES IN THE ν_1 + ν_3 BAND OF ACETYLENE

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Using an extended cavity diode laser locked to a frequency comb, line shapes in the ν_1 + ν_3 combination band of acetylene have been studied. The frequency stability of this experiment produces high accuracy measurements that provide rigorous tests of line shape theories. Measurements of the P(11) line shape were made for pure acetylene and acetylene-nitrogen gas mixtures at a series of temperatures between 125 K and 296 K. Using the speed-dependent Voigt line shape model, parameters were determined by fitting data for all temperatures and pressures in a single multispectrum analysis. The resulting parameters successfully reproduce the measured line shapes and are valid for the acetylene-nitrogen system over the range of temperatures studied and combined pressures of up to 1 atmosphere.

P(11) is isolated with respect to hot band transitions and neighboring transitions of the same band, but this is an unusual case. To explore the effects of overlapping lines, the P(1) transition was measured in a series of pure acetylene measurements in a congested spectral region. Overlapping hot band lines of measurable intensities were modeled and line shape paramters were simultaneously determined for these along with the P(1) line. Additionally, the effects of line mixing between overlapping ν_1 + ν_3 lines were explored using an appropriate line mixing model.

Acknowledgments: Work at Brookhaven National Laboratory was carried out under Contract No. DE-AC02-98CH10886 with the U.S. Department of Energy and supported by its Office of Basic Energy Sciences, Division of Chemical Sciences, Geosciences and Biosciences.

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