QUANTITATIVE MEASUREMENT OF INTEGRATED BAND INTENSITIES OF BENZENE (C_6H_6) VAPOR IN THE MID-INFRARED AT 278, 298 AND 323 K

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Pressure broadened (1 atm. N_2) laboratory spectra of benzene vapor (in natural abundance) were recorded at 278, 298, and 323 K, covering 600-6500 cm^{-1}. The spectra were recorded at a resolution of 0.112 cm^{-1} using a commercial Fourier transform spectrometer (FTS). Pressure of each benzene vapor sample was measured using high precision capacitance manometers and a minimum of nine sample pressures were recorded for each temperature. The samples were introduced into a temperature-stabilized static cell (19.94(1) cm pathlength) hard-mounted in the spectrometer. From these data a fit composite spectrum was calculated for each temperature. The number density for the three composite spectra was normalized to 296 K. The spectra give the absorption coefficient (cm^2 $molecule^{-1}$, naperian units) as a function of wavenumber. Integrated band intensities (cm $molecule^{-1}$ and atm^{-1} cm^{-2}) for intervals corresponding to the stronger benzene bands were derived and are compared with previously reported values. We discuss and quantify error sources and estimate our systematic errors to be 3% for stronger bands. The measured absorption coefficients and integrated band intensities are useful for remote sensing applications such as its measurement in planetary atmospheres and assessment of the environmental impact of terrestrial oil fire emissions, and studies of dense parts of envelopes surrounding interstellar molecular clouds. We focus on the ν_4 band (Herzberg notation) at 674 cm^{-1}, the strongest infrared band that is currently being measured in Titan's stratosphere by the Composite InfraRed Spectrometer (CIRS) during Cassini spacecraft fly-bys, and we compare our results with previously reported measurements. The intensity ($cm^{-2}atm^{-1}$) for the ν_4 band integrated from 615 to 735 cm^{-1} is 427±13 at 278 K, 428±13 at 287 K, and 426±13 at 323 K, indicating no dependence with temperature.