HIGH-RESOLUTION MICROWAVE AND INFRARED MOLECULAR-BEAM STUDIES OF THE CONFORMERS OF 1,1,2,2-TETRAFLUOROETHANE

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High-resolution microwave and infrared molecular-beam spectra have been measured for 1,1,2,2-tetrafluorethane (HFC134). For the higher-energy, polar, C_1-symmetry, *gauche* conformer, microwave spectra have been recorded for the normal and mono-^{13}C isotopomers and analyzed to determine a C-C bond length of 1.512(4) Å and a CCF angle of 109.7(3)°. A tunable microwave-sideband CO_2 laser and electric-resonance optothermal spectrometer have been used to measure the infrared spectrum of the ν_6, C-C stretch of the *gauche* conformer near 906 cm^{-1}. Microwave-infrared double resonance and precise ground- state combination-differences provided by the microwave measurements guide the assignment of the spectrum. A *b*- and *c*-type spectrum is observed and fit to a Watson asymmetric-top Hamiltonian to within the experimental uncertainty of 0.3 MHz. The high quality of the fit and the similarity of the centrifugal distortion constants to the ground-state values indicate that the band is effectively unperturbed. A number of strong unassigned lines are present in the spectrum. These transitions do not display any microwave-infrared double resonance effect. The attribution of these transitions to the nonpolar *anti* conformer is ruled out since the transition intensities are sensitive to the field strength of the inhomogeneous electric field used to focus the molecules. Pulsed slit-jet diode-laser spectra have been recorded for the ν_{16}, *anti* conformer near 1127 cm^{-1}. An *a*- and *c*-type hybrid band is observed consistent with previous low-resolution assignments of this vibration to a B_u mode. A total of 522 non-blended transitions were assigned and fit to determine ground- and excited-state constants. The ground- state constants of $A = 5134.952(65)$, $B = 3148.277(27)$, and $C = 2067.106(43)$ MHz are the first experimental determination of rotational constants for this conformer.