FINE AND HYPERFINE STRUCTURE IN SUB-DOPPLER, INFRARED, CH-STRETCHING SPECTRA OF MONODEUTERATED METHYL RADICAL

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High resolution direct absorption spectroscopy in the CH-stretching region is used to observe fully resolved rovibrational structure and partially resolved fine and hyperfine structure of monodeuterated methyl radical (CH_2D). CH_2D is readily made by passing a mixture of CH_2DI and Ne/He through the orifice of a slit nozzle and striking a discharge, which supersonically expands to permit spectroscopic study of radicals with a rotational temperature of approximately 15 K and slit-narrowed IR line widths of 0.002 cm^{-1}. We obtained and analyzed rovibrational transitions in both the symmetric and antisymmetric CH-stretch regions. We also observed fine and hyperfine structure, arising from interactions between electron spin with molecular rotation and with H/D nuclear spins, respectively. This structure results in complex lineshapes under sub-Doppler resolution. Simultaneous least squares fitting of the set of spectral profiles is used to extract rotational, spin-rotation and Fermi contact information in the ground and vibrationally excited states.