

# HIGH-RESOLUTION INFRARED SPECTROSCOPY OF THE HYDROXYMETHYL RADICAL IN SOLID PARAHYDROGEN

MORGAN E. BALABANOFF, DAVID T. ANDERSON, *Department of Chemistry, University of Wyoming, Laramie, WY, USA.*

Interest in the hydroxymethyl radical,  $\text{CH}_2\text{OH}$ , stems primarily from its importance as a reaction intermediate. However, this radical is also of interest from a spectroscopic point of view with large amplitude COH torsional tunneling and out of plane  $\text{CH}_2$  wagging motions. The first IR detection of  $\text{CH}_2\text{OH}$  was accomplished via matrix isolation spectroscopy over 40 years ago by Jacox.<sup>a</sup> Reisler and co-workers<sup>b</sup> detected  $\text{CH}_2\text{OH}$  in the gas-phase using the sensitivity of double resonance ionization detected IR spectroscopy to probe the OH stretch, asymmetric CH stretch, and symmetric CH stretch vibrational modes with partial rotational resolution ( $0.4\text{ cm}^{-1}$ ). Most recently, the Nesbitt group published<sup>c</sup> the first fully rotationally resolved IR spectrum of  $\text{CH}_2\text{OH}$  via the  $K_a=0\leftarrow 0$  band of the symmetric CH stretch. These researchers were able to unambiguously assign the identified transitions to a Watson A-reduced symmetric top Hamiltonian thereby producing improved values for the symmetric CH stretch rotational constants and vibrational band origin. However, in this same work the authors point out a number of remaining unresolved issues. Motivated by these gas-phase observations, we decided to return to the matrix isolation studies of  $\text{CH}_2\text{OH}$ , however utilizing solid parahydrogen as a matrix host to improve upon the sensitivity and resolution of the previous matrix isolation studies. Based on our measurements, while the end-over-end rotation of the  $\text{CH}_2\text{OH}$  radical is quenched, rotational motion around the a-axis is nearly free permitting both A-type and B-type transitions to be resolved. In the case of the OH stretch mode, both A-type and B-type transitions are observed with an energy difference that makes sense based on the gas-phase  $\text{CH}_2\text{OH}$  rotational constants. However, for the symmetric CH stretch mode, the same mode recently assigned by Nesbitt and co-workers, two absorption features are also observed but the energy difference and intensities of the two features do not match predictions based on the rotational constants.

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<sup>a</sup>M.E. Jacox, D.E. Milligan, *J. Mol. Spec.* **47**, 148-162 (1973).

<sup>b</sup>L. Feng, J. Wei, H. Reisler, *J. Phys. Chem. A* **108**, 7903-7908 (2004).

<sup>c</sup>M.A. Roberts, E.N. Sharp-Williams, D.J. Nesbitt, *J. Phys. Chem. A* **117**, 7042-7049 (2013).