INFRARED SPECTRA OF HYDROGEN CLUSTERS SEEDED WITH CARBON DIOXIDE

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It is now possible to probe cold (<0.5 K) helium clusters in the size range $N \sim 2$ to 70 by means of the vibration-rotation spectrum of an embedded infrared chromophore molecule such as CO_2,[a] often with atom-by-atom resolution. To some extent, hydrogen clusters can also be studied in this way, as shown by our previous work in which CO,[b] OCS,[c] and N_2O[d] were the chromophores.

Here we extend the study of hydrogen clusters to the case of CO_2 as the probe. The symmetry of CO_2 provides an important difference compared to the other probe molecules. This has the effect of eliminating half of the rotational levels (for the normal $C^{16}O_2$ or $C^{18}O_2$ isotopomers) and of accentuating the differences between $para$-H_2 and $ortho$-H_2 clusters. As in the case of $(H_2)_N$-OCS and $(H_2)_N$-N_2O, we find that $(H_2)_N$-CO_2 cluster transitions are relatively easy to identify up to about $N = 7$, but difficult to follow above this point. However, in contrast to the previous work there is intriguing evidence for a series of weak but regularly-spaced transitions which may extend to $N \sim 15$ or beyond.

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[c] J. Tang and A.R.W. McKellar, *J. Chem. Phys.* **121**, 3087 (2004).
[d] J. Tang and A.R.W. McKellar, *J. Chem. Phys.* **123**, 114314 (2005).