DIRECT INFRARED ABSORPTION SPECTRA OF HELIUM CLUSTERS SEEDED WITH AN OCS MOLECULE

JIAN TANG AND A.R.W. McKELLAR, *Steacie Institute for Molecular Sciences, National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada*.

We have obtained rotationally-resolved IR spectra of van der Waals clusters composed of one OCS molecule and many helium atoms (n = 1 to about 20). The observations are made in the region of the ν_1 fundamental band of OCS, near 2062 cm^{-1}, using a rapid-scan infrared diode laser spectrometer to probe a pulsed pinhole or slit supersonic jet expansion from a cooled (T = 230 to 280 K) nozzle with fairly high backing pressures (P = 6 to 30 atmospheres). For OCS-He$_n$ clusters with $n \leq 8$, the spectra have been assigned and confirmed by microwave observations [1]. For larger clusters, something changes: perhaps the effective onset of superfluid-type behavior. The spectra are still quite strong but not yet assigned in detail. As a function of n, the O-C vibrational frequency first shifts to the blue, as we already knew from the binary complex, OCS-He [2]. Once the first 'solvation ring' of about 5 He atoms around the OCS becomes filled, the vibrational frequency starts to turn around and shift to the red, in accord with observations on larger helium nanodroplets (with $n \approx$ 10,000).

References

[1] Y. Xu and W. Jäger, private communication (2001).
[2] J. Tang and A.R.W. McKellar, *J. Chem. Phys.* **115**, 3053 (2001).