STEP-SCAN FOURIER TRANSFORM INFRARED ABSORPTION SPECTROSCOPY OF CUBIC SOLID ACETYLENE CLUSTERS

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The infrared spectra of large acetylene clusters formed in pulsed supersonic jets have been measured in the 800-5000 cm\(^{-1}\) region using step-scan Fourier transform infrared (FTIR) absorption spectroscopy.\(^a\) The \(\nu_2\) band of C\(_2\)H\(_2\) cluster was reproduced well by two Lorentzian profiles peaked at 3234 and 3241 cm\(^{-1}\). From comparison with the spectral positions of small clusters and two solid phases in the C-H stretching region, the 3234 cm\(^{-1}\) band was assigned to the solid in the high temperature cubic phase. Another feature is invariant at 3241 cm\(^{-1}\) under various supersonic jet conditions and is therefore likely attributed to the large clusters with stable structure. The relative intensity for monomer vibration-rotation lines gives the rotational temperature of 12 K at 10% C\(_2\)H\(_2\) in Ar. The infrared absorption band of C\(_2\)D\(_2\) clusters has also been measured at 2399 cm\(^{-1}\). The deuterium isotopic shift is in good agreement with the predictions based on the harmonic oscillator model and confirms the assignment of cubic C\(_2\)H\(_2\) and C\(_2\)D\(_2\). This is the first infrared observation of cubic solid C\(_2\)D\(_2\). Although the experimental data do not allow us to estimate the precise size of cubic acetylene clusters, the cluster size is likely to be \(\sim\)10 nm.