

INFRARED SPECTROSCOPY OF THE HCN-(H₂/D₂)_n CLUSTERS IN THE SUPERFLUID HELIUM DROPLETS

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The Superfluid He droplet is an ideal matrix for making large sized molecular clusters, because of its extremely low temperature ($T < 0.5$ K) and very weak interaction with molecules. In this study, we observed vibrational spectra for the CH stretching band of the HCN-(H₂/D₂)_n clusters in the He droplets under a strong electric field (30 kV/cm).

For the HCN-(H₂)_n system, HCN-(*o*-H₂)_n ($n = 1-5$), HCN-(*p*-H₂)_n ($n = 1-3$), and HCN-(*o*-H₂)₁(*p*-H₂)₁ have been observed. Since *o*-H₂ ($j = 1$) has a quadrupole moment, it is supposed that the interaction between *o*-H₂ and HCN is stronger than that between *p*-H₂ ($j = 0$) and HCN. Nevertheless, the observed red-shift of the CH-stretching band for HCN-(*o*-H₂)_n is much smaller than that of HCN-(*p*-H₂)_n. This phenomenon strongly suggests that the geometrical structure for HCN-(*o*-H₂)_n and that for -(*p*-HCN)_n are distinctly different. That is, in HCN-(*o*-H₂)_n, the H₂ molecules are bonding to the N site of HCN. Contrastedly in HCN-(*p*-H₂)_n, the H₂ molecules are bonding to the H site of HCN, and affect strongly to the CH-stretching vibration. For the HCN-(D₂)_n system, we obtained the same conclusion. In addition to the vibrational spectra under the strong electric field, we mention vibrational-rotational spectra for HCN-(H₂/D₂)₁ clusters under the field-free condition.