Water containing molecular complexes studied by superfluid helium droplet spectroscopy

SUSUMU KUMA, The University of British Columbia, MIKHAIL SLIPCHENKO, Iowa State University, TAKAMASA MOMOE, The University of British Columbia, ANDREY VILESOV, University of Southern California — Superfluid helium droplets offer an ideal environment for spectroscopic studies of molecular complexes by virtue of the controllable aggregation process of embedded molecules and its weak interaction as a matrix medium. Here, we report the infrared spectroscopy of Ar-H$_2$O, N$_2$-H$_2$O, and O$_2$-H$_2$O complexes picked up in He droplets. The observed spectra in the anti-symmetric stretching vibrational region ($\nu_3$) of water around 3750 cm$^{-1}$ indicated that the water molecule in complexes rotates nearly freely in Ar-H$_2$O and O$_2$- H$_2$O, while not in N$_2$-H$_2$O. The spectra of Ar-H$_2$O and O$_2$- H$_2$O exhibited the splitting of the rotational lines, which is due to the anisotropy of their intermolecular potential. We have analyzed the observed splittings in the spectra to determine the intermolecular potentials of Ar-H$_2$O and O$_2$- H$_2$O in helium droplets. These results are compared with the corresponding potentials previously studied in both experimentally and theoretically.