Invited Lectures C

September 4, Tuesday, 14:30 – 16:00

Spectroscopy of Large Hydrogen Clusters in He Droplets

Takamasa Momose

Department of Chemistry, The University of British Columbia, Canada,
momose@chem.ubc.ca

Quantum clusters of molecular hydrogen have been attracted great attention because of its possible superfluid phase. Parahydrogen has been predicted to undergo Bose-Einstein condensate (BEC) and to exhibit a superfluid phase below 4 K [1], but it has not been observed yet due to the freezing of bulk hydrogen systems at 13.8K. Clusters are known to have significantly lower freezing temperature than their bulk systems due to the size effect [2], so that one may be able to achieve fluid phase of molecular hydrogen below the predicted superfluid transition temperature. Thus, clusters of molecular hydrogen are very appealing system for the observation of possible superfluid phase of hydrogen. We have been investigating hydrogen clusters doped in He droplets by LIF spectroscopy of co-doped prove molecules [3,4]. The observed LIF spectra showed clear evidence of non-rigidity of hydrogen clusters of up to 2,000 at 0.4 K, but no signature of superfluidity was detected. Recently, we found that the lineshape of IR depletion spectra of CH_4 in He droplets carries information characteristic to superfluid environment [5]. We are now investigating properties of hydrogen clusters in He droplet using the high-resolution IR depletion spectra of CH_4. We will discuss the properties of hydrogen clusters (N = 1 - 1,000) and possible superfluid phase of molecular hydrogen based on our observed spectra.

References

[1] V. L. Ginzburg and A. A. Sobayanin, JETP Lett. 15, 242 (1972).
[2] R. S. Berry, Adv. Chem. Phys. **70**, 74 (1988).
[3] S. Kuma, et al. J. Chem. Phys. **127**, 214301 (2007).
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[5] A. Ravi et al. Phys. Rev. A **84**, 020502 (2011).

Chiral recognition in jet-cooled complexes: an electronic and vibrational spectroscopy study

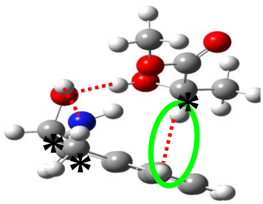
Anne Zehnacker-Rentien[1]

[1] Institut des Sciences Moléculaires d'Orsay CNRS Univ. Paris Sud F-91405 Orsay France. anne.zehnacker-rentien@u-psud.fr

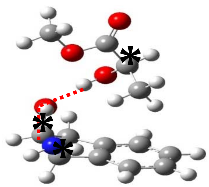
Chiral recognition plays a major role in life chemistry and is thought to happen through the formation of weakly bound complexes involving specific interactions. Forming and studying these complexes in a supersonic expansion allows shedding light on the forces responsible for chiral recognition.

We have focused on hydrogen-bonded complexes, which have been studied by means of IR-UV double resonance spectroscopy in a supersonic expansion as well as IRMPD in an ion trap.

We have shown that the ν(OH) stretch mode region is a good signature of the chiral recognition process[1,2]. In addition, it often shows a complicated spectroscopic pattern due to combination bands with low-frequency modes, as we have already observed for other jet-cooled hydrogen-bonded complexes[3].



Heterochiral complex



Homochiral complex

References

[1] A. Zehnacker, M. A. Suhm, Angewandte Chemie-International Edition **47**, 6970, 2008.

[2] D.Scuderi, K.Le Barbu-Debus, A. Zehnacker Physical Chemistry Chemical Physics **13**, 17916, 2011.

[3] N. Seurre, K. Le Barbu-Debus, F. Lahmani, A. Zehnacker-Rentien, J. Sepiol Chemical Physics **21**, 295, 2003.