SPECTROSCOPY AND EXCITED STATE DYNAMICS OF Ne-NO COMPLEX

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The spectroscopy and excited state dynamics of rare gas-NO complexes have been studied using resonance enhanced multiphoton ionization (REMPI) techniques combined with a time-of-flight (TOF) mass spectrometry [1]. The Rydberg-valence interactions of bare NO in the excited states are well analyzed: For example, the interaction between the Rydberg $C^2\Pi$ and valence $B^2\Pi$ states of NO are strongly dependent of the vibrational quantum numbers. The complex formation with rare gas effects on the interaction strength, and the intermolecular potential surfaces between NO and rare gas varies largely with the excited states and rare gases selected. The excited state dynamics is thus controlled by the selection of these factors.

The complex of Ne-NO was prepared in a molecular beam. We pumped first the complex to the excited state, the potential surfaces of which and the reaction dynamics on which were further probed by using the photoionization. In the analogy of Ar-NO, the initial Ne-NO $X^2\Pi$ ($\tilde{X}$ state) and final Ne-$NO^+(X^1\Sigma)$ complexes are estimated to be of T-shape, and the intermediate states, Ne-NO^*, of interest are therefore prepared near a T-shaped Franck-Condon region. The potential well of the lowest Rydberg state, Ne-NO $A^2\Sigma^+$ ($\tilde{A}$ state), is presumably not deep enough to have the zeroth vibrational level, because the Ne-NO^+ ions could not be detect by REMPI via the $\tilde{A}$ state. The binding energy of Ne-NO in the ground state was determined to be 40 cm^{-1}, which is comparable to that of Ne-Ar van der Waals complex (D_0=38 cm^{-1}).

Our another objective is to explore the excited state dynamics of the floppy complex. We present the examples of predissociation of the complex evident in the excited states of $\tilde{B}$ and $\tilde{C}$. The electronic state and vibrational quantum number of the NO moiety as well as the kind of rare gas control the rates through the radiationless transitions to near lying excited states.

[1] K. Tsuji, K. Shibuya, and K. Obi; J. Chem. Phys. 100, 5441 (1994); Laser Chem. 15, 157 (1995); Chem. Phys. 231, 279 (1998).