Rotationally Resolved Pulsed Field Ionization Photoelectron Study of $O_2^+(B^2\Sigma_g^-,\ b^4\Sigma_g^-)$

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We have obtained rotationally resolved spectra of O_2 using pulsed field ionization zero electron kinetic energy photoelectron spectroscopy (PFI-ZEKE-PE) technique, covering the ionization transitions of $O_2^+(b^4\Sigma_g^-, v^+=0\sim4\ ,\ B^2\Sigma_g^-, v^+=0\sim3) \leftarrow O_2(X^3\Sigma_g^-, v''=0)$. PFI-ZEKE-PE technique is based on the detection of high-n-Rydberg electrons which have long lifetime and are ionized by electric pulse field. In this experiment, we have achieved 6.8cm^{-1} resolution using synchrotron radiation as the light source of vacuum-ultra-violet(V.U.V.) region.

The experiments were performed on beamline 20A. The synchrotron radiation was monochromized by 3-m normal incidence Eagle mounted scanning monochromator equipped with a 2400 lines/mm gold-coated grating. When the entrance and exit slit were set to 10 μm, the monochromator has resolusion (E/ΔE) of about 60,000.

The PF storage ring is capable of filling 312 electron buckets in a period of 624 ns. When the PF-Ring is operated in the multi-bunch mode, there are 500 ns width filled bunches and 124 ns width dark gap. The pulse field was applied to the ionization region to field ionize high-n Rydberg electrons and extract photo-electrons toward the detector. The time width of the pulse field is fixed for electron to be able to pass in the ionization region and the pulse height was about 0.8[V].

Figure 1 and 2 depict the ZEKE spectrum (upper line) for O_2 measured using monochromator entrance/exit slit of 15x15μm and the supersonic beam method to introduce O_2 into the ionization region. Where the lower curve is simulation spectrum characterized by a Maxwell-Boltzman distribution. According to the result of the simulation, in the case of the B state and the b state (v^+=4) the line width broader than the instrumental line width. These are caused by that the life time of the state becomes shorter by predissociation [1]. The dissociation life time obtained in the present experiment are significantly shorter than those of 75±25 ns reported in the previous PEPICO-TOF study [2]. In this way, our experiment has obtained high resolution spectra which are the same as used undulator (the Chemical Dynamics Beamline at the ALS)[1].

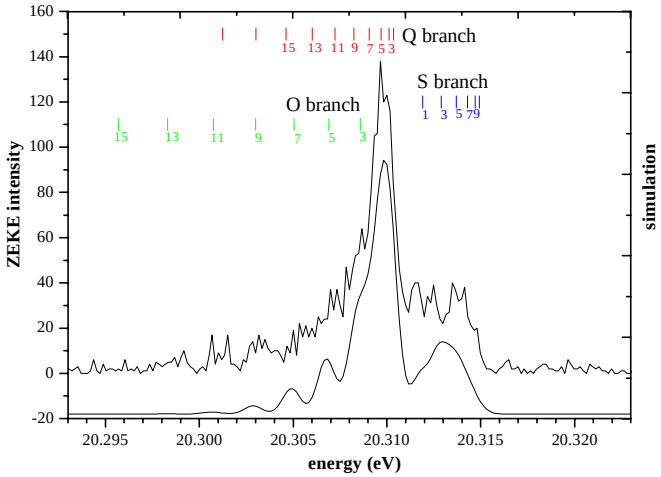

FIG.1 ZEKE spectra of O_2^+ ($B\ ^2\Sigma_g^-$, v^+=0)

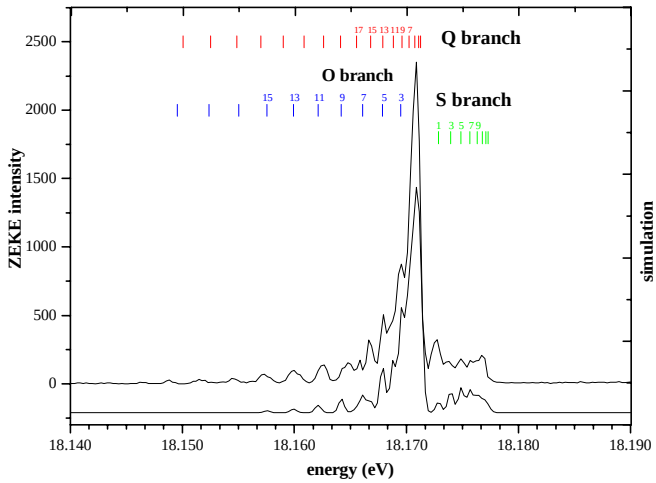

FIG.2 ZEKE spectra of O_2^+($b^2\Sigma_g^-$, v^+=0)

References
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