The development of ionization for a large molecule with clusters by using pickup technique

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In nanotechnology, techniques to investigate molecule size and its structure are very important since these informations are indispensable for manufacturing nano size devices. In this context, the size of large molecules such as biological ones has been measured by matrix associated Laser desorption ionization (MARDI) and electron spray ionization (ESI) technique.

Recently we have suggested an another technique to measure the molecule size without any fragmentation process. This technique is so-called "pickup technique", in which the investigated molecule is attached to cluster and is ionized by soft X-ray. In this machine time, we have tried to confirm the feasibility of this technique by using Ar as the cluster source and benzene/toluene as the investigated molecules.

The experiment chamber is constructed from two rooms: source and main rooms. The Ar cluster was formed by expansion of Ar gas with a pressure of 8 atm through a nozzle. In this experimental condition, the mean size of Ar cluster is expected to be more than 10. At a 1cm downstream, a pickup nozzle was installed. A benzene or toluene molecule via this pickup nozzle was attached to the cluster at this point. After that, the center part of this molecule beam was selected by a 1 mm skimmer. In the main room, the soft X-ray was irradiated and ionized the cluster together with the molecule. The ions and electrons were extracted by the electric field and were detected by MCPs. The time-fo-flight (TOF) were measured by the difference of the arrival time of electrons and ions.

Figure 1 shows the TOF spectra of the ions when benzene molecule was attached. This figure shows that benzene was ionized without any breakup although the photon energy is enough to dissociate these ions.

This result clearly suggests that this technique might be applied to larger molecules such as biological ones.

Several mechanism can be considered as a ionization process. We will investigate these mechanism in the future experiment.

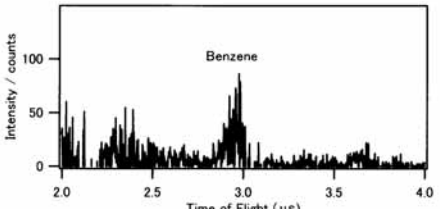

Figure 1. TOF spectrum of benzene when ionized with soft X-ray whose photon energy is 250 eV.

Electronic Structure Observation of O_2 molecules on Pt(111)

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Normally, SXE spectra of strongly bonding chemisorbed system have no dependence in excitation energy, because excited electron rapidly escapes from adsorbate molecule. This escape process should be connected to adsorbate-surface bonding, Thus, it is interesting to know how relaxation process of excited states is occur in weakly bonding system.

Soft x-ray emission (SXE) spectra of O_2 on Pt(111) adsorbates are successfully obtained using a high efficiency emission spectrometer and a 3rd generation synchrotron light source. Measurements were performed at SPring-8 BL27SU using high efficiency soft x-ray emission spectrometer system[i].

O_2 is adsorbed lying flat on the Pt(111) surface. Thus spectrums at the O K-edge reign were recorded in normal and grazing configuration to separate symmetry of a molecular orbital as shown in figure bellow. Spectrum of O_2 multilayer on Pt(111) have excitation energy dependence because O_2 is weakly bonding with van der Waals force. While chemisorbed O_2 monolayer on Pt(111) also small energy dependence. In case of chemisorbed SO_2 on Ni(111), there are only peak width differences. It means chemisorbed O_2 on Pt and SO_2 on Ni have a difference in bonding strength.

[i] T. Tokushima et al, Surface Review and Letters, Vol. 9, No.1 (2002) 503-508