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Simultaneous Measurements of Mass and Kinetic-Energy Distribution of Ions Using a Miniature Cylindrical Mirror Analyzer (CMA) and Synchrotron Radiation under the Single-Bunch Mode Operation –Application for H^+ Desorption Induced by Core-Level Excitations of Condensed Ammonia-

Eiichi KOBAYASHI[1, *], Koji K. OKUDAIRA[2], Kazuhiko MASE[1, 3]
[1]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan
[2] Chiba Univ., Yayoi-cyo, Inage-ku 263-8522, Japan
[3] PRESTO, Japan Science and Technology Agency, Sanbancho, Chiyoda-ku, Tokyo 102-0075, Japan

Introduction

When a core electron energy level of a surface molecule is ionized, an ion can be desorbed by the following three-step process: 1) a core-electron emission, 2) an Auger transition leaving two valence holes, 3) ion desorption due to hole-hole Coulomb repulsion and electron missing from valence orbitals (Auger stimulated ion desorption (ASID) mechanism) [1]. To clarify the last step of the ASID mechanism measurements of ion kinetic energy (KE) are required, because they provide information on the steepness of the repulsive potential curve responsible for the ion desorption.

Recently, we have developed a miniature cylindrical mirror analyzer (CMA) mounted on a 70-mm-diameter conflat flange for measurements of kinetic energy distribution of ions desorbed in the polar angles of 24-28° from the surface normal [2]. We applied the CMA for simultaneous measurements of mass and kinetic-energy distribution of desorbed ions [3].

Results and conclusion

Figure 1 shows the CMA that we have developed [2]. Using the CMA and synchrotron radiation under the single-bunch mode operation we measured time-of-flight spectra of desorbed ions at $4a_1 \leftarrow$ N 1s resonant transition of condensed NH_3 at BL-13C (Fig. 2). For KE > 4 eV only one peak was observed, that was assigned to H^+. The ion kinetic energy distribution obtained from data in Fig. 2 is shown in Fig. 3. The result is in consistent with the previous one [2]. These results show that our approach is useful for simultaneous measurements of mass and kinetic-energy distribution of desorbed ions.

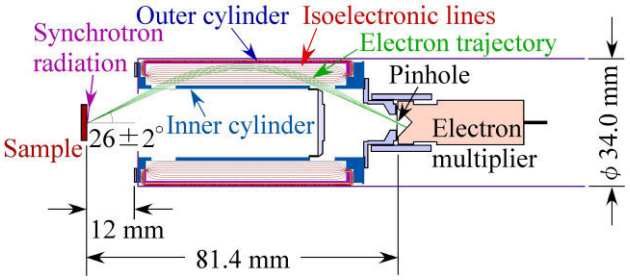

Figure 1. Miniature CMA mounted on a conflat flange with an outer diameter of 70 mm. The trajectories of ions from a pointed source for polar angles of 24°~28° with 1° step are shown based on the simulation with the SIMION 3D version 7.0 (http://www.simion.com/) [2].

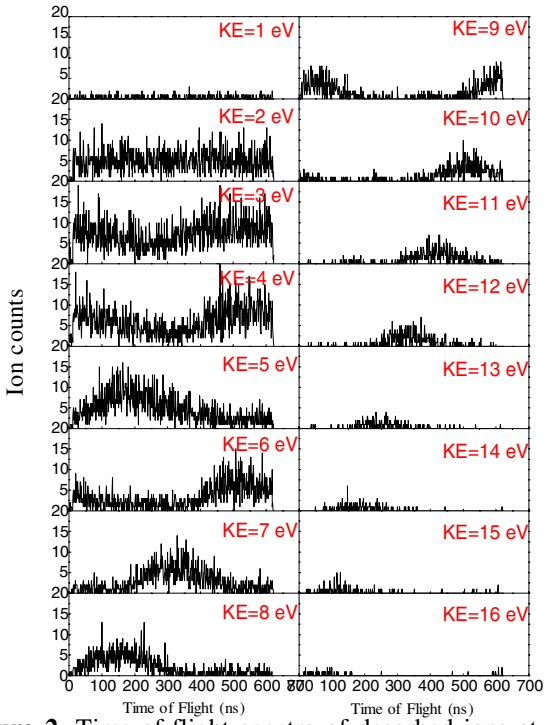

Figure 2. Time-of-flight spectra of desorbed ions at $4a_1 \leftarrow$ N 1s resonant transition of condensed NH_3 [3].

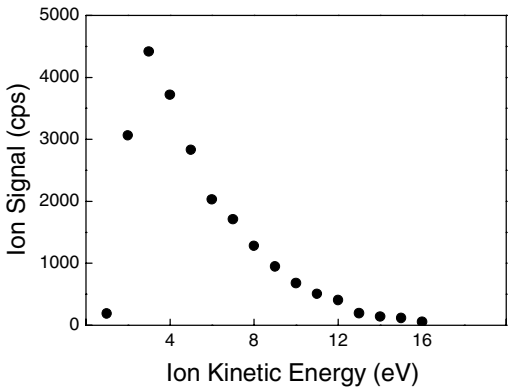

Figure 3. Ion kinetic energy distribution at $4a_1 \leftarrow$ N 1s resonant transition of condensed NH_3 [3].

References

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*kobayashi@saga-ls.jp