Contribution ID: **33** Type: **Poster presentation**

Cryogenic detector for mass spectrometric identification of neutral molecules towards atomic and molecular collision experiments

Tuesday, 12 September 2017 18:00 (1 hour)

To explore the quantum collision dynamics of the stored molecular ions by the merging experiments with a beam of the neutral atoms, we are developing a new technique of mass spectroscopy for the neutral molecular fragments from the collisions using an array of superconducting transition-edge-sensor (TES) microcalorimeters at a brand-new cryogenic electrostatic ion storage ring in RIKEN (Wako, Japan).

In the cosmic space, more than 100 kinds of various molecules exist despite low temperature and low density which is disadvantageous environment to the molecule formations. It remains still unknown how to be generated even for the simple molecules. We have recently developed a cryogenic low-temperature ion storage ring to reproduce such chemical reactions at a temperature of outer space. A molecular ion beam with a vibration-rotation energy (temperature) of ~4 Kelvin is stored in this storage ring; and we conduct experiments by an interflow collision with neutral molecular beam having the same direction and velocity as the stored ion beam, where low-energy collisions at the center-of-mass system are realized.

It is important to identify the products by measuring those molecule masses after the collision to study the reaction mechanism. In the case of neutral fragments, however, it is difficult to apply the ordinary mass spectrometry without ionization for the neutral fragments. In our storage ring, the neutral products after the collision have almost the same velocity as initial ions / neutral molecules; thus mass identification can be realized by a measurement of the translational energy. However, the energy resolution of Micro Channel Plate (MCP) detector commonly utilized so far is not enough to identify the mass of molecular fragments.

We aim a direct detection of neutral molecules and molecular fragments (less than 15 keV) generated after the chemical reactions reproduced using an array of TES microcalorimeters developed by NIST. By a measurement of the kinetic energy, we perform the mass spectrometric identification of those neutral fragments and aim comprehensive understanding of the chemical reactions from the initial to final stages.

TES is operated at the superconducting critical temperature of less than 100 mK; thus we usually install radiation shields in front of the TES sensors to avoid infrared background from heat radiation which deteriorates the energy resolution. Unlike x-rays, the low energy molecules (~10 keV) easily stop at the radiation shields even for 100-nm-thick aluminum sheet; thus we need to remove the radiation shield window. One of key issue towards this TES application is how to operate TES system against the radiation background although our storage ring is at 4 K. We just started the study at RIKEN from this spring.

In this presentation we will give an overview of this project and the recent progress.

Primary author: Dr OKADA, Shinji (RIKEN)

Co-authors: Dr REINTSEMA, Carl D. (NIST); Dr SCHMIDT, Daniel R. (NIST); Dr SWETZ, Daniel S. (NIST); Dr BENNETT, Douglas Alan (NIST); Dr O'NEIL, Galen C. (NIST); Prof. HILTON, Gene (NIST); Dr TATSUNO, Hideyuki (Lund Univ.); Dr NODA, Hirohumi (Tohoku Univ.); Dr HAYS-WEHLE, James (NIST); Prof. ULLOM, Joel N. (NIST); Dr FOWLER, Joseph W. (NIST); Mr HAYAKAWA, Ryota (TMU); Dr YAMADA, Shinya (TMU); Dr UEDA, Shutaro (JAXA); Dr KUMA, Susumu (RIKEN); Dr HASHIMOTO, Tadashi (JAEA); Dr NAKANO, Toshio (RIKEN); Prof. AZUMA, Toshiyuki (RIKEN); Dr DORIESE, William Bertrand (NIST); Prof. ISHISAKI, Yoshitaka (TMU); Prof. NAKANO, Yuji (Rikkyo Univ.); Dr ICHINOHE, Yuto (TMU)

Presenter: Dr OKADA, Shinji (RIKEN)

Session Classification: Poster

Track Classification: Future facilities and instrumentation