Guiding a 15 keV Ar^{6+} ion beam by a cylindrical glass channel

Ryohei Takahashi[1], Yuya Kazamatsuri[2], Tomoaki Seki[2] and Kenji Motohashi[1, 2]

[1]Graduate School of Science and Engineering, Toyo University
[2]Department of Biomedical Engineering, Toyo University

In recent years, attention has been focused on the guide effect [1] of some slow multiply charged ion beams caused by charge up due to interaction between ions and insulator surfaces. The phenomenon is being applied to research for various ion beam technologies, such as the secondary ion mass spectrometry (SIMS), the ion implantation, the particle induced X-ray emission (PIXE), the heavy particle cancer therapy, and so on. However, since most studies have conducted for focusing and deflecting ion beams by thin capillaries, influence of inner wall geometry and surface conditions to the guide effect have not been well understood. Furthermore, since kinetic energy of guided ion beam has never been measured, the process is not elucidated in detail.

One purpose of this study is to verify whether the ion beam guides an energetic ion beam even by not a capillary but by a channel, and another purpose is to verify whether kinetic energy of the transmitted ion beam retains the initial energy. Therefore, we developed the cylindrical glass channel (CGC) [2] consists of two cylindrical glass lenses facing each other with a narrow gap between them. Kinetic energy distribution (KED) of transmitted Ar^{6+} ions was measured for a 15 keV-Ar^{6+} ion beam injected into the CGC by measuring the time of flight and the displacement due to an uniform electric field in the parallel plates, simultaneously.

Figure 1 shows the KED for each angle θ when the CGC is tilted with respect to the incident ion beam axis. The shaded area shows apparent spectra due to not guided but scattered Ar^{5+} to Ar^{3+} ions on the inner wall. However, the Ar^{6+} ions maintained the incident kinetic energy of 15 keV at all tilt angles. Furthermore, deflection of the ion beams up to 0.18° was observed by tilting the CGC.

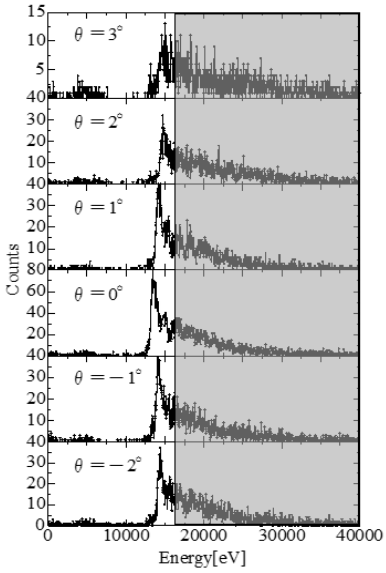

Figure 1. Kinetic energy distributions of transmitted Ar^{6+} ions after injection into the CGC.

References:

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