Development and fabrication of electro-magnetic shock tube with high resolution spectrometer for stopping power measurement in atomic hydrogen gas

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Stopping power measurement in matter is very important for heavy-ion fusion and heavy-ion-driven high-energy density physics [1]. The database of the stopping power has been developed for many elements and compounds under a normal temperature and pressure [2, 3]. However, the stopping cross section can change due to a change of electronic state in the target such as excitation and ionization [4, 5]. Especially, there is few experimental results for the energy loss of charged particles in a dissociated target. Hydrogen is a suitable element to investigate the dissociation effect because it has only one valence electron.

An electro-magnetic shock tube [6, 7] was chosen as a driver to generate well-defined dissociated hydrogen. The electromagnetic force pushes the discharge current sheet and the filled hydrogen gas to the top end of the shock tube, and the shock front is formed in front of the compressed gas region, which can become the dissociated hydrogen. In this process, the uniformity of the discharge current sheet was important for the well-defined dissociated hydrogen target with a high shock velocity to dissociate the hydrogen gas completely [8].

In the previous experiments [7], a semiconductor detector was used for the energy loss measurement of the heavy ion beam. The energy resolution of the semiconductor detector was $\Delta E/E \sim 10\%$, which was not enough to measure the dissociation effect precisely. Therefore, we develop a high resolution spectrometer with $\Delta E/E \sim 1\%$. The high resolution spectrometer consists of a 90 degree bending magnet (Max. B: 1.13 T, Bending radius: 1 m) and position sensitive detectors.

In this presentation, we report the development and fabrication of the electro-magnetic shock tube with the high resolution spectrometer for stopping power measurement in the atomic hydrogen gas.

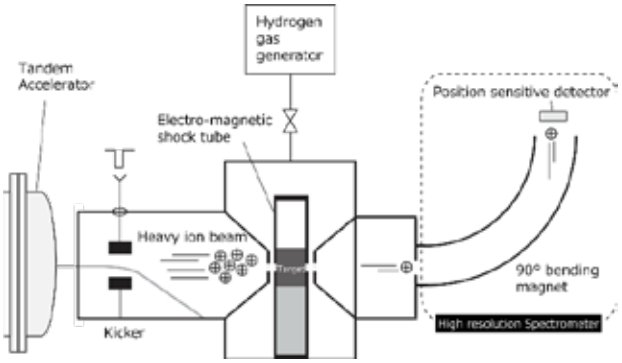

Figure 1. Schema of stopping power measurement in atomic hydrogen gas using the electro-magnetic shock tube with the high resolution spectrometer.

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