

Microbeam Production Using Straight and Tapered Glass Capillaries

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Introduction

- Micro- and nano-meter sized beams of charged particles have potential applications in nanotechnology [1] especially in biological applications [2].
- Straight and tapered glass capillaries with different dimensions were used to produce micrometer-sized beams [3, 4].
- In this work we compare the results of straight with tapered glass capillaries.

Experimental Technique

- The samples were mounted into an aluminum holder with the front side facing the incident beam.
- The outer surface of the capillaries was coated with a thin layer of graphite (straight) or silver paint (tapered) in order to carry away excess charges deposited on it. This also enabled reading the current on the sample.
- The samples were mounted into a goniometer to permit precise positioning with respect to the incident beam direction.
- The incident beam was obtained from the 6-MV tandem Van de Graaff accelerator at Western Michigan University.
- The beam was collimated to ~ 1.5 mm diameter and allowed to strike the samples inside the chamber which was at a pressure of $\sim 10^{-6}$ Torr.
- A movable silicon surface-barrier detector was used to count the transmitted ions. (See Fig. 1.)

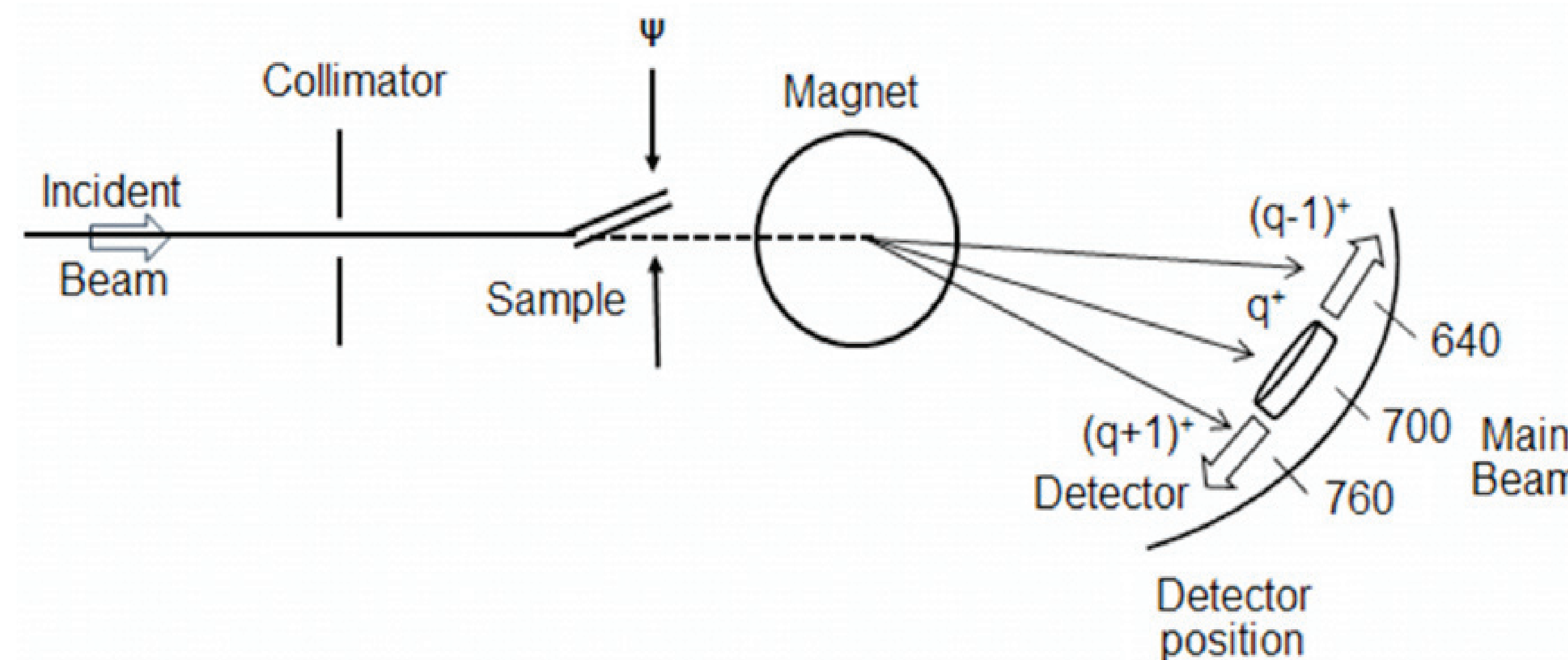


Figure 1. Schematic diagram of the experimental setup (top view).

Results

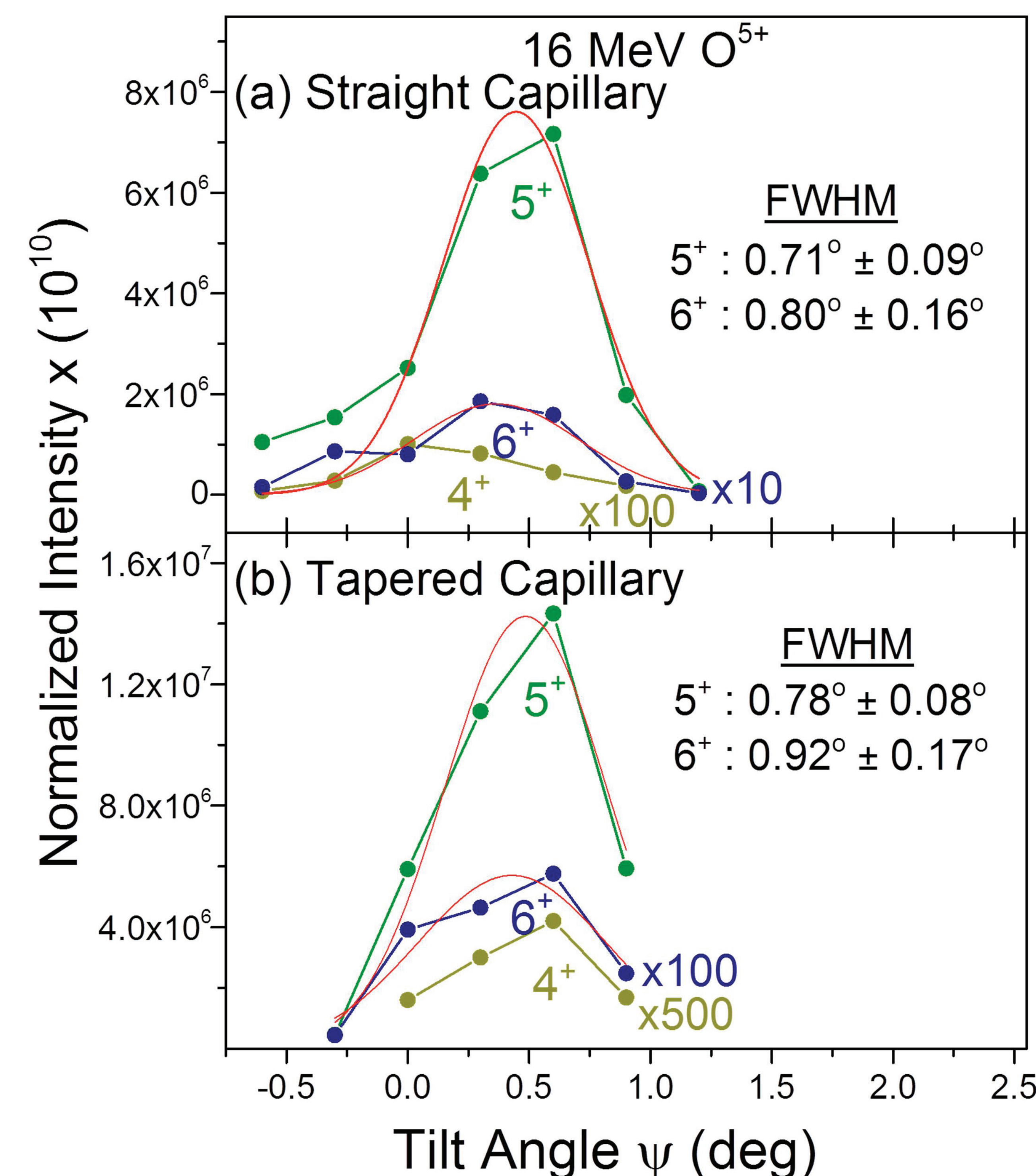
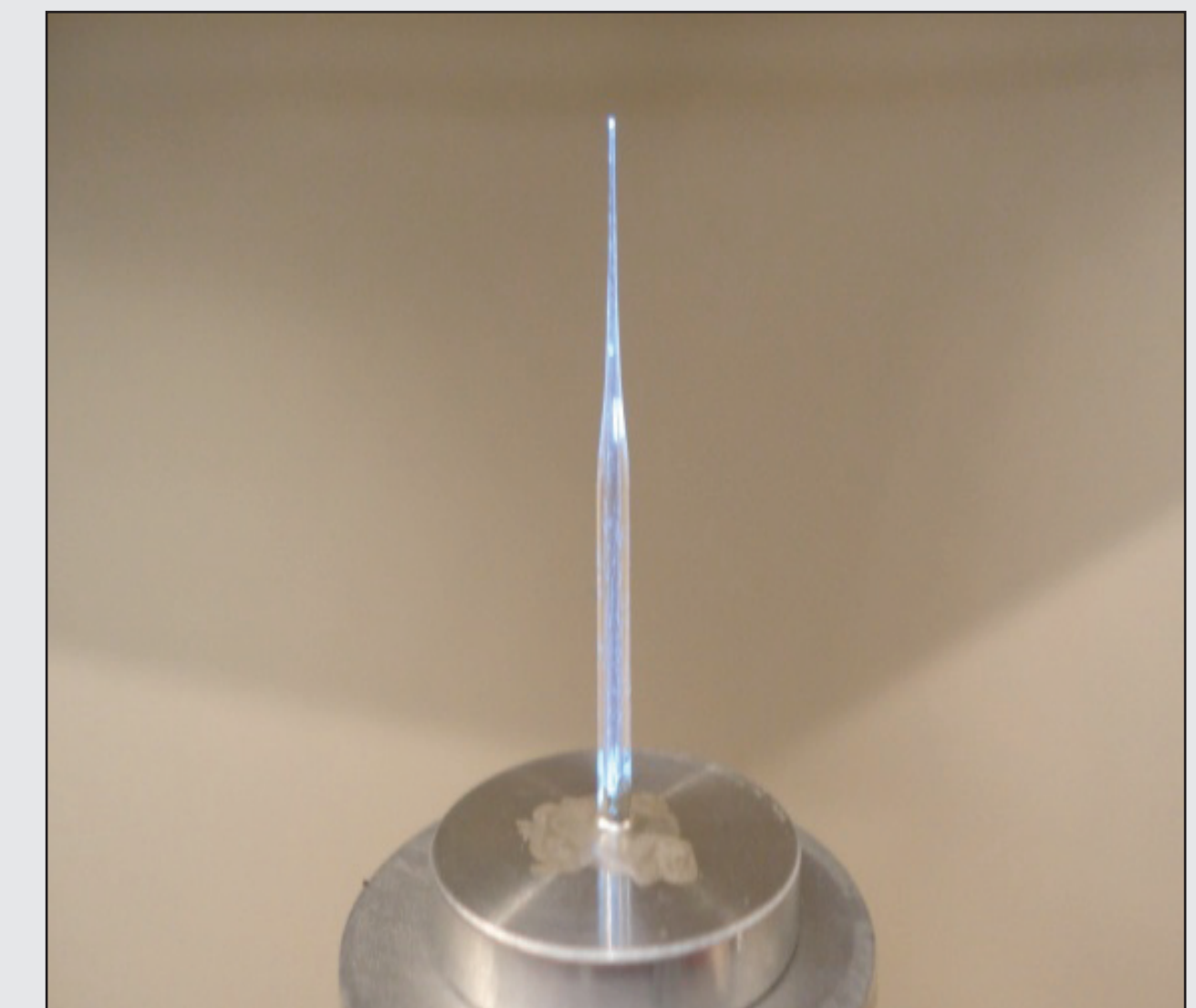


Figure 2. Normalized intensities of the transmitted 16 MeV/u O^{5+} ions as a function of sample tilt angle ψ (deg): (a) straight capillary and (b) tapered capillary.

Samples



Straight Glass Capillary
Diameter ~ 0.18 mm, length
 ~ 14.4 mm



Tapered Glass Capillary
Inlet diameter ~ 0.71 mm,
outlet diameter ~ 0.10 mm
and a length of ~ 28 mm

Conclusions

- The main charge state has the highest transmitted intensity as the sample is tilted.
- The majority of transmitted ions kept their initial charge state.
- The tapered capillary shows two times more transmitted intensity compared to the straight capillary.

Acknowledgment

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- Preparation of the tapered glass capillary was performed at the RIKEN laboratory, Tokyo.

References

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