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 ~10^-6 Torr.
- A movable silicon surface-barrier detector was used to count the transmitted ions. (See Fig. 1.)

Results

![Figure 1. Schematic diagram of the experimental setup (top view).](image)

![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.](image)

- 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

- R. J. Bereczky of the ATOMKI laboratory in Debrecen, Hungary is gratefully acknowledged for preparation of the straight glass capillary.
- Preparation of the tapered glass capillary was performed at the RIKEN laboratory, Tokyo.

References