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Electrons transmitted through a plate capillary

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Synopsis 1.5 keV electrons passed through a plated capillary were studied. We observed that the electrons were transmitted the capillary along its axis for smaller tilt angle, while for larger tilt angle, the electrons emerged from the capillary neither along the capillary axis nor along the beam incident direction, but kept their initial energy.

In 2002, N. Stolterfoht *et al* found the guiding effect of 3 keV Ne^{7+} ions passing through an insulating PET nanocapillaries [1]. Thereafter, considerable work [2] has been done to investigate slow highly charged ions (HCIs) interacting with inner surfaces of various insulating capillaries, showing that the guiding effect is prevalent in the transmission of slow HCIs.

Similar guiding phenomena were also observed for electrons transmitted through capillaries (see, e.g., [3-5]). However, the experiments showed that transmission efficiency of electrons was significantly lower than that of HCIs. Moreover, it revealed that portion of the transmitted electrons suffered significant energy-loss.

We investigated the transmission of 1.5 keV electrons through a plate capillary with a gap of 0.4 mm and a length of 20 mm. The capillary consists of a pair of high pure (99.999%) quartz glass plates of 120 mm long, 20 mm wide and 15 mm thick. The front and back ends of the capillary are grounded. The electron beam was produce by an electron gun with a cathode of LaB_6.

Figure 1 shows the dependence of the deflection angle on the capillary tilt angle. Contrast to previous results with slow HCIs [1, 2] or electrons at similar energy [3-5], we observed that the electrons were transmitted the capillary along its axis for smaller tilt angle. However, with the tilt angle increasing further, the deflection angle remained unchanged at first, then increased quickly and followed by a slightly slow increasing. We also observed that the transmitted electron fraction was higher than that of direct transmission. In addition, transmitted electrons kept their initial energy.

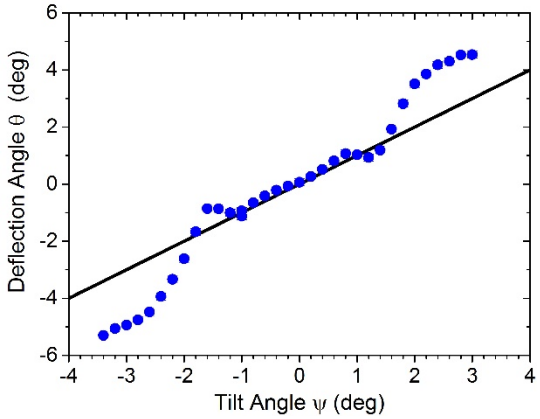

Figure 1. The dependence of the deflection angle on the capillary tilt angle for 1.5keV electrons passing through a plate capillary. The solid line represents $\psi=\theta$.

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