Guiding of Electrons through a Paired Parallel Glass Plates

J.L. Liu*, D.Y. Yu*, Y.L.Xue*, and X.H. Cai*

* Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, 730000, Gansu, China

Synopsis We investigate transmission of low-energy electrons (800 eV) through a paired parallel glass plates. The measurements were focused on the angular distributions of electrons transmitted through capillary. The present results indicate that the observation angle $\varphi$ is larger than the tilted angle $\psi$.

Interaction between charged particles and insulating capillary has become more and more important in the fundamental study of ion-surface collision processes. What’s more, it also provides a possible new method to produce micro/nano meter sized beams, which may be widely used in nanotechnology. Particular attention has been paid to the transmission of HCIs though insulating capillaries [1-5]. However, in contrast to the case of HCIs, study of transmission of electrons through insulating capillaries is still deficient.

In the present work, the transmission of 800 eV electrons through a paired parallel glass plates was investigated. The glass plate used in this study was 21 mm in length, 30 mm in width and 4 mm in thickness, which was made of soda lime glass. The gap in the paired plates was set to 0.6 mm. To avoid macroscopic charge-up of the entrance surfaces of the glass, they were covered by the sample holder. The measurements were focused on the angular distributions of electrons transmitted through capillary.

The intensity and angular distribution of the transmitted electrons for various tilt angles were measured using a one-dimensional position sensitive detector. Fig.1 shows the observation angle $\varphi$ of the transmitted beam as a function of capillary tilt angle $\psi$ with respect to the beam direction. In the figure, the observation angle $\varphi$ is the center of the transmitted electrons profile and the solid line represents the observation angle being equal to the tilt angle. According to Fig. 1, the observation angle $\varphi$ is larger than the tilted angle $\psi$ when increasing the tilt angle of the capillary. This behavior has not been observed in the previous studies.

Figure 1. Observation angle $\varphi$ of the transmitted beam as a function of capillary tilt angle $\psi$. The solid line represents a direction of $\varphi=\psi$.

The present results indicate the existence of guiding effect and the guiding effect is observed to be enhanced at lower incident energies. Moreover, when the capillary was tilted with respect to the direction of the incident beam, a unique phenomenon that the observation angle $\varphi$ related to the center of the transmitted electrons profile was larger than the tilted angle $\psi$ is observed.

References

1 E-mail: caixh@impcas.ac.cn