Guiding electron beam through parallel insulating plates in a wide current range

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Synopsis The guiding effect of electron beams transmitting through macro-insulating units has been investigated by following our previous study. It is very surprised that the guiding behaviors in a wide range of incident electron current (tens of pA/mm^2 to tens of nA/mm^2) were found to be very similar, which is quite different from that of ion beams.

In our previous work [1], using a pair of grooved SiO_2 parallel plates, we had obtained stably guided electron beams without energy loss in the incident energy range of 800-2000V. The very high-current (up to tens or hundreds of nA/mm^2) electron beams were adopted. A 128-strip electrode array with a 128-channel picoammeter system [2], combined with an electrostatic deflector were employed to monitor the transmitted electron beams. To better understand the guiding processes of electron beams passing through the insulting plates and investigate the dependence of guiding effect of electron beams on beam fluxes, a wide current range of tens of pA/mm^2 to tens of nA/mm^2 are used in present work.

As shown in Figure 1, when electron beams with different electron fluxes guiding through the grooved parallel plates, which are made of polymeric compound PEEK, the guiding behaviors are quite same. However, the experiment with lower electron current should be expected.

Our present results show that the self-organizing repulsive electric field played the dominant role to guide the electrons, by comparing with a pair of asymmetric parallel plates that were constructed by replacing one of the plates by a ground metal. This is similar to the case of SHCI beams. However, our results suggest that that the guiding effect of high-current electron beams by macro-insulating units may be due to the combined contributions of the individual atom scattering and the repulsive field on material surface.

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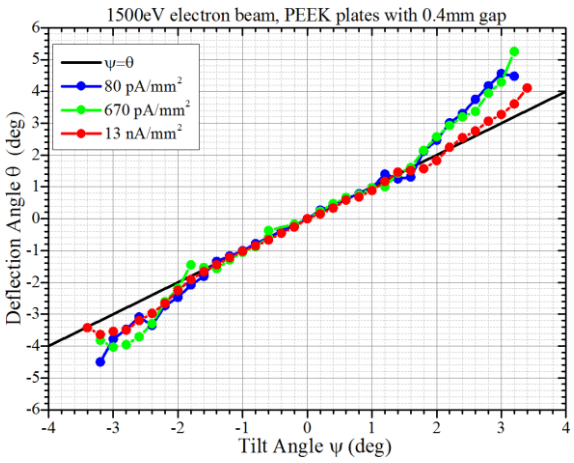

Figure 1. Deflection angle as functions of the tilt angle for 1500 eV electrons with different current, 80 pA/mm^2, 670 pA/mm^2, and 13 nA/mm^2, passing through parallel PEEK plates with 0.4 mm gap.

References

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