The Monte Carlo simulation of electron transmission through Al_2O_3 nanocapillary

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Synopsis The detailed simulation was conducted to study the 900 eV electron transmission through insulating nanocapillaries and to identify the transmission probability and guiding effect. We get, the uneven negative and positive charge distributed on the inner wall of the capillary made the transmission probability fall off rapidly and slightly effected the guiding effect.

The study of electron through nanocapillary and tapered capillary have attracted many attentions. Electron do not change their state in capillary and second electron production depend on the energy, angle of primaries, material of capillary. In Ref. [1], simulation results get charge up of surface plays only a minor role in guiding process in Mylar. And for Al_2O_3 [2], the transmission of electron decrease as a function of time, in which charging-up attract the trajectories.

In this paper, the detailed simulation was conducted to study the 900 eV electron transmission through insulating nanocapillaries and to identify the transmission probability and guiding effect. The diameter of Al_2O_3 nanocapillary was 60 nm and the current of incident electron was 4.0 pA/mm. In simulation, the secondary electron production and trajectories were considered.

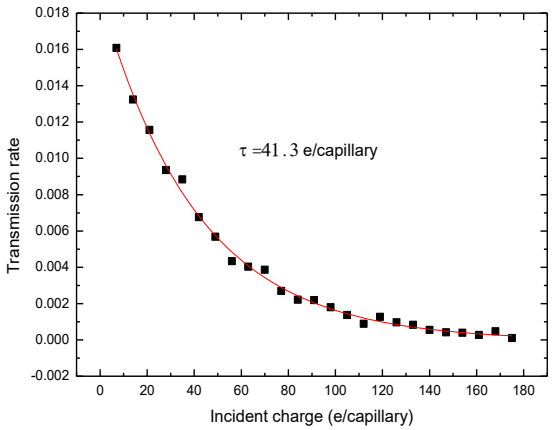


Figure 1. The transmission rate change with incident charge for 0.2 deg.

The transmission of electron decreases as exponential decay. In capillary, the negative and positive charge are both exist. The negative charges are low energy secondary electron from opposite wall and positive charges produce from secondary production.

For incident angle of 0.2 deg., the positive charge distribution is uneven, which makes the transmission fall off rapidly. For different incident angle, the transmission angles out of the capillary were slightly attracted to the incident side by the stronger positive charge patch. Our results were also consistent with the experiments of our laboratory (not present).

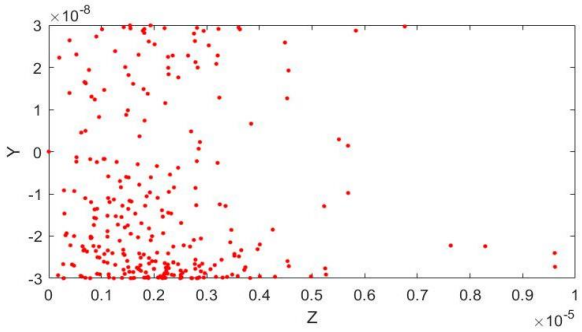
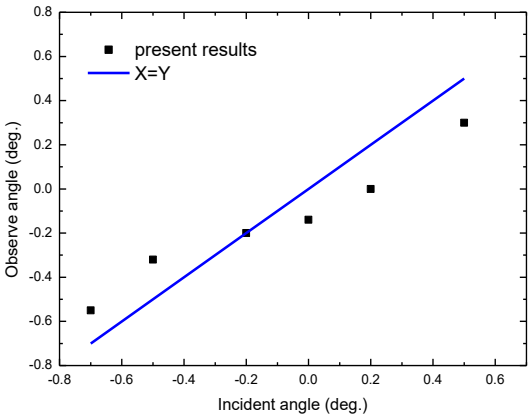


Figure 2. Positive charge distribution in the capillary for incident 0.2 deg.



References

[1] K. Schiessl *et al.* 2009 *Phy. Rev. Lett.* **102** 163201

[2] A. R. Milosavljevic *et al. Nucl. Instr. Meth, Phys. B 279, 190*

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