Study of electron transmission through a metallic capillary

Journal of Physics: Conference Series **635** (2015) 062011 doi:10.1088/1742-6596/635/6/062011

Study of electron transmission through a metallic capillary

A. R. Milosavljević[1], M. Lj. Ranković[1*], D. Borka[2], J. B. Maljković[1], R. J. Bereczky[3], B. P. Marinković[1] and K. Tőkési[3]

[1]Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia
[2]Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia
[3]Institute for Nuclear Research, Hungarian Academy of Sciences, H-4001 Debrecen, Hungary

Synopsis In this work we study the transmission of charged particles through a single cylindrically shaped metallic capillary of microscopic dimensions with a large aspect ratio. We used electrons as projectiles. Our results suggest the existence of guiding of the electron beam by a metallic capillary.

In this work we investigate the guiding of electrons through straight and narrow metallic capillaries. The investigation of guiding of charged particles by metal capillaries is strongly motivated by the possibility of producing cheap alternatives to complex electron-optical tools.

We have performed both the measurements and the classical calculations of electrons guiding [1, 2, 3]. Since electrons cannot change their charge state, it is experimentally impossible to make a clear distinction between transmission of the primary and secondary electrons which correspond to elastic scattering. But using the classical simulation, we can identify and follow up all electron trajectories. We performed Monte Carlo simulation assuming that after each inelastic collision a secondary electron is generated with kinetic energy directly estimated from the energy transfer [2, 3]. The created secondary electron is treated as a primary electron and the trace of its path is followed in the successive simulation procedure.

Our experimental setup consisted of an electron gun, a straight cylindrical platinum capillary, an energy analyzer and a channeltron as a detector. Pressure inside the vacuum chamber was $7x10^{-7}$ mbar. An inner radius of the capillary was 3.3 mm, with 40.8 mm in length. Estimated electron beam width at the entrance of the capillary was 0.9 mm with 0.3° angle divergence. The initial electron energy was 200 eV. We found that a dominant fraction of electrons escaping from the capillary have energies smaller than the incident electron energy. Figure 1. shows the energy spectrum of electrons transmitted through a cylindrical platinum capillary.

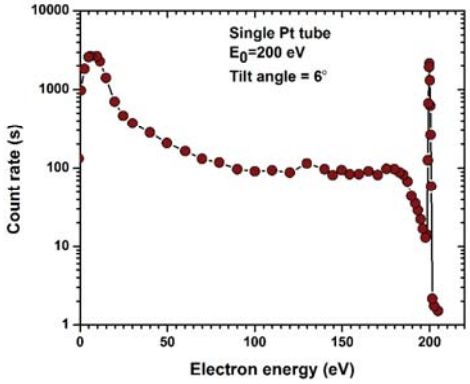

Figure 1. - Energy spectrum of electrons transmitted through platinum capillary [4].

This work was supported by the Ministry of education, science and technological development of Republic of Serbia under the Grants OI 171020 and III 45005, by the Hungarian SRF OTKA No. NN 103279, and by the Bilateral Cooperation Program between the Hungarian and Serbian Academies. This work was conducted within the framework of the COST Action CM1301 (CELINA).

References

[1] A.R. Milosavljević *et al. 2007 Phys. Rev. A* ***75*** *030901(R).*
[2] K. Schiessl, K. Tőkési, B. Solleder, C. Lemell, J. Burgdörfer *2009 Phys. Rev. Lett.* ***102*** *163201.*
[3] B.S. Dassanayake, R.J. Bereczky, S. Das, A. Ayyad, K. Tőkési, J.A. Tanis *2011 Phys. Rev. A* ***83*** *012707.*
[4] Milosavljevic et al, NIMB 2015

E-mail: mrankovic@ipb.ac.rs