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Transport of electrons through a long metallic microcapillary: characterization of the outgoing low-energy electron beam

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The guiding of charged particles – highly charged ions – by insulating nanocapillaries has been firstly reported in 2002 [1] and has been attracting a large attention since then, partly due to potential applications in ion transport [2]. The pioneering work on electron guiding through insulating capillaries has been reported recently [3,4] and the electron guiding phenomena has been discussed in detailed nowadays [5,6]. The aim of the present research is to investigate the electron transport by metallic high-aspect ratio capillaries and their potential use for a robust, spatially well-determined, low-energy electron source, which can be efficiently applied to study electron driven molecular processes under different environmental conditions.

In this work we have investigated transmission of 150 eV incident electrons through a single stainless steel microcapillary (0.9 mm diameter and 19.5 mm length – the aspect ratio of about 22). The intensity of the outgoing electron current has been measured as a function of both the incident beam angle with respect to the capillary axis (tilt angle) and the kinetic energy of outgoing electrons. The "quasi-monochromatic" incident electron beam produces a wide distribution of outgoing electrons, spanning down to practically 0 eV. At large tilt angles (when the direct beam is suppressed due to the close collision with the inner wall of the capillary) this distribution is determined by elastic electron scattering, inelastic processes and secondary electron production. It is, however, interesting that the dependence on the tilt angle changes with the outgoing kinetic energy, and low-energy electrons may dominate at larger tilt angles.

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