High-temperature excess current and quantum suppression of electronic backscattering in a 1-D system.

L. Gorelik [1], G. Sonne[2], R.Shekhter[2] and M.Jonson[2]

[1]Chalmers University of Technology, Department of Applied Physics, SE-412 96 , Gothenburg, Sweden
[2] Gothenburg University, Department of Physics, SE-412 96 Gothenburg, Sweden

We consider the electronic current through a one-dimensional conductor in the ballistic transport regime and show that the inelastic backscattering on a weakly pinned target results in a measurable temperature- and bias-voltage independent excess current at large bias voltages. This is a genuine quantum effect on transport that derives from an exponential reduction of electron backscattering in the elastic channel due to quantum delocalization of the scatterer and from a suppression of low-energy inelastic electron reflection caused by the Pauli Exclusion Principle. We apply our analysis to the particular case of a weakly pinned molecule encapsulated by a single-wall carbon nanotube and show that both the quantum vibration frequency and the molecule mass of the pined molecule can be measured by studying the excess current and the differential conductance of the nanotube.