Electron transport in strongly confined nanostructures: modeling and simulation

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We present an effective mass model, derived in [1], describing the ballistic transport of electrons in ultra-scaled confined nanostructures. Due to the strong confinement, the crystal lattice is considered periodic only in the one dimensional transport direction and an atomistic description of the entire cross–section is given. The model consists of a sequence of 1D device dependent Schrödinger equations, one for each energy band, which retain the effects of the confinement and of the transversal crystal structure. In order to model field effect transistors, self-consistent computations include the resolution, in the whole 3D domain, of a Poisson equation. Simulations of the electron transport in semiconducting single-walled carbon nanotubes are presented, using a classical-quantum hybrid strategy. The ballistic effective mass model is used only in the active region, and it is coupled to a drift-diffusion model (derived for strongly confined nanostructures in [2]) in the source and drain regions. Appropriate current preserving interface conditions (as in [3]) are used.

1. N. Ben Abdallah, C. Jourdana, P. Pietra, *An effective mass model for the simulation of ultra-scaled confined devices.* to appear in Math. Models Methods Appl. Sci.

2. C. Jourdana, N. Vauchelet, 2011. *Analysis of a diffusive effective mass model for strongly confined nanowires* Kinet. Relat. Models **4**, 1121-1142.

3. M. Baro, N. Ben Abdallah, P. Degond, and A. El Ayyadi, 2005. *A 1d coupled Schrödinger drift-diffusion model including collisions* J. Comput. Phys. **203**, 129-153.