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Transport in Nanostructured Materials

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In nanostructured materials spatial confinement effects lead to structure-dependent modifications of the bulk transport properties. In part, such modifications can be accounted for by a classical master equation approach for the transport of the different charge carrier species. The rather large quantity of parameters, which enter such an approach, can more or less easily be adjusted to the dimensional characteristics and the electronic settings of the system as well as to temperature effects. On the other hand, a microscopically more detailed and mostly parameter-free picture is obtained from a quantum-mechanical treatment on the basis of the density-functional theory. An extension by a Green's function formalism allows the determination and analysis of electronic transport through contacted nanostructures. Examples will be given to demonstrate the applicability of the different approaches for dissipative and hopping transport through a regular array of nanostructures, for a mechanically triggered metal-insulator transition in nanowires, and for the enhanced conductivity at multiferroic domain walls.