Hydrodynamical models for semiconductor device simulation

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Abstract: The talk presents a review on hydrodynamical models for semiconductor devices, and on numerical simulations performed with these models. Hydrodynamical models for charge transposrt in semiconductors are derived starting from the Boltzmann equation for electron and holes, which provides a detailed semiclassical kinetic description of the carrier dynamics. Such description, although physically accurate up to submicron scale, is very expensive computationally. A simpler description can be obtained by considering the evolution of the moments of the distribution function, and closing the system by the use of maximum entropy principle. In this way the flux and the production terms are expressed as function of the moments, obtaining a closed set of equations. The parameters of the models have been computed for the two cases of Silicon and Gallium Arsenide. The models are described by a system that has the structure of hyperbolic system of balance laws with source terms, coupled with the Poisson equation, needed for the computation of the electric field. Only results for electron transport will be presented,and the treatment of bipolar devices is in progress. Such system has been integrated numerically by using second order shock capturing central schemes for systems with stiff source. Besides benchmark space homogeneous calculations, the n$\wedge+-n-n\wedge+$ diode (one dimensional geometry) and the MOSFET transistor (two dimensional geometry)have been simulated.