MINIMOS NT - a Hydrodynamic Simulator for High Electron Mobility Transistors

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In recent times, the HEMT (high electron mobility transistor) has become a widely used supplement to the spectrum of industrial semiconductor devices and especially pseudomorphic submicron HEMT's have conquered a broad field of application because of their high-frequency performance. Due to the complex structure of these devices, several requirements have to be met to make numerical simulations of HEMT's feasible.

A consistent discretization of the material interfaces at the heterojunctions requires doubly-valued points at the heterointerface, where two separate values describe the situation at both sides of the interface. These values are connected by arbitrary functional relations. Coupled solution of all quantities in all regions of the device is necessary, since the mutual influence of the regions is very strong.

The partial differential equations which describe the current transport phenomena have to be extended to inhomogeneous density of states and band edge offset energies. This is necessary to study structures consisting of arbitrary materials, given as a general material description. Graded junctions and compound materials can thereby be consistently treated.

The small dimensions of heterojunction devices in connection with the typical materials used in these devices require a hydrodynamic set of equations, including a carrier temperature equation. This allows to describe carrier heating in the channel correctly, which is the major limiting effect determining current transport in the normal operation regime.