SIMULATION OF ULSI PROCESSES AND DEVICES. Hans Kosina, Karl Wimmer, Claus Fischer, and Siegfried Selberherr, Technical University Vienna, Institute for Microelectronics, Gußhausstraße 27–29, A-1040 Wien, Austria.

Devices with feature sizes less than a micrometer are required for monolithic ULSI circuits. These devices can only be efficiently developed with the aid of computer simulation. Our contribution is intended to review the state of the art in process and device simulation for these ULSI devices.

In the development of the technology for submicron devices, the demand for models capable of predicting the various processing steps is growing dramatically due to the tight coupling of electrical device effects with the doping profile. Process simulation offers the ability to predict doping profiles and wafer topologies for all practically applied steps in silicon processing. The existing models enable the simulation with sufficient accuracy in a wide area of applications, although the involved processes are not always understood on an atomic scale. We try to sketch the basic assumptions of the involved models and methods as well as to convey an idea of what can be expected from process simulation. ULSI devices demand shallow junctions. Therefore accurate models for the ion implantation process including channeling effects are required. Additionally a desired process goal is to anneal point defects without redistributing the dopant profiles. Increasing interest in the use of rapid thermal annealing can be found. Pair diffusion models are necessary to describe the associated transient enhanced diffusion.

During the last decade, device simulation based on the self-consistent solution of the basic semiconductor equations has been widely used and is still of remarkable importance for industrial purposes. When the device size shrinks below one micron, the current relations become frequently subject of discussions. In this situation the drift-diffusion approach begins to fail, while the Monte Carlo Method is able to describe the occurring effects. In terms of computation, however, the solution of the drift diffusion approach is very efficient compared to Monte Carlo simulations. Therefore a coupling of drift diffusion and Monte Carlo methods which is rigorous in a physical sense and cheap in terms of demands on computational resources looks promising. Currently efforts are made to include quantum effects at the boundary regions into the transport models. Numerous new device structures take advantage of these effects.

Hans Kosina
TU Vienna, Institute for Microelectronics, Gußhausstraße 27–29, A-1040 Wien, Austria
Tel: *43/1/58801/3701, FAX: *43/1/5059224