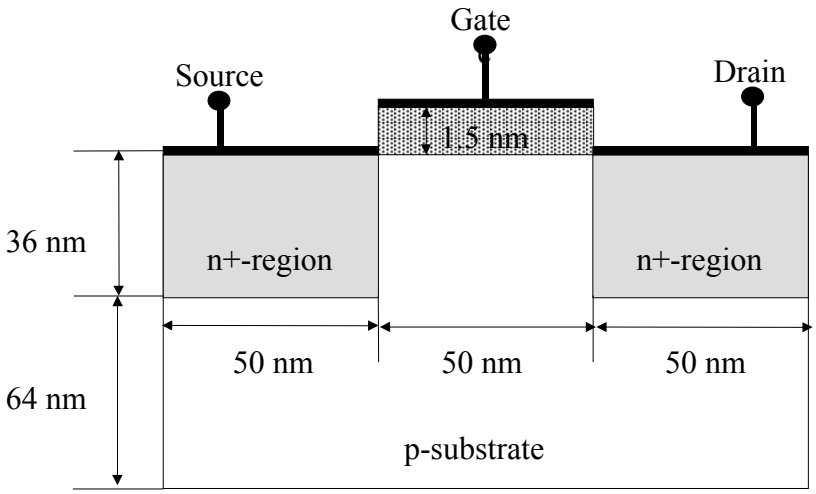
Simulation exercise using SILVACO software

Write a set of Silvaco ATLAS commands for modeling a MOSFET device structure, schematically shown in the figure below. In your calculations use the appropriate model for low field mobility description in silicon inversion layers, Shockley-Read-Hall generation-recombination process (not that relevant for MOSFET operation), velocity saturation effect and impact ionization model due to Selberherr. The oxide thickness of the device being simulated equals 1.5 nm. For the substrate doping assume 10^{19} cm^{-3}. The junction depth is 36 nm and the total device depth, measured from the $Si\text{-}SiO_2$ interface, is 0.1 μm. For the doping of the source and drain regions assume, in one case 10^{19} cm^{-3}, and in the second case 10^{20} cm^{-3}. Vary the gate voltage from 0.8 V to 1.4 V, in 0.2 V increments. For each gate voltage value, do a drain voltage sweep from 0 V to 1.4 V. Perform the following set of simulation runs:

- Exclude the impact ionization process and use the two different values for the source and drain doping densities (10^{19} and 10^{20} cm^{-3}). This will demonstrate the role of the series resistance effects on the device output characteristics. Also, discuss the role of the DIBL effect in the device output characteristics.

- Investigate the role of the impact ionization process on the device performance, by including the Selberherr's model for impact ionization. In these simulation runs assume that the doping of the source and drain regions equals 10^{20} cm^{-3}.



NOTE: For the 2002 Summer School we obtained a temporary license for the code S-PISCES, a drift-diffusion simulator included in the ATLAS TCAD package distributed by Silvaco. Since this is a commercial package, on-line access to the simulator was only possible on a limited basis to school participants. The software can be purchased by contacting:

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