SCHRED Exercises

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Consider a simple MOS capacitor structure with aluminum gate. The thickness of the oxide region equals 4 nm and the substrate is p-type with doping NA that varies between 10^{16} cm-3 and 10^{19} cm-3. Using SCHRED consider two cases for the charge description in the semiconductor: semiclassical with Fermi-Dirac statistics and quantum-mechanical model. Follow these steps to arrive at a plot that gives you the shift in the threshold voltage versus NA due to quantum-mechanical charge description:

(1) For a representative number of doping densities of your choice run SCHRED using first semiclassical and then quantum mechanical model for the charge in the depletion/inversion layer.
(2) For both cases plot the electron sheet density vs. applied gate bias. Assume that the threshold voltage equals the gate voltage VG for which the sheet electron density equals 10^{12} cm-2. Register the VG values for both quantum and classical model. Subtract VG(classical) from VG(quantum).
(3) Plot this difference versus doping density. Comment on the results and compare with experimental data.