Discussion

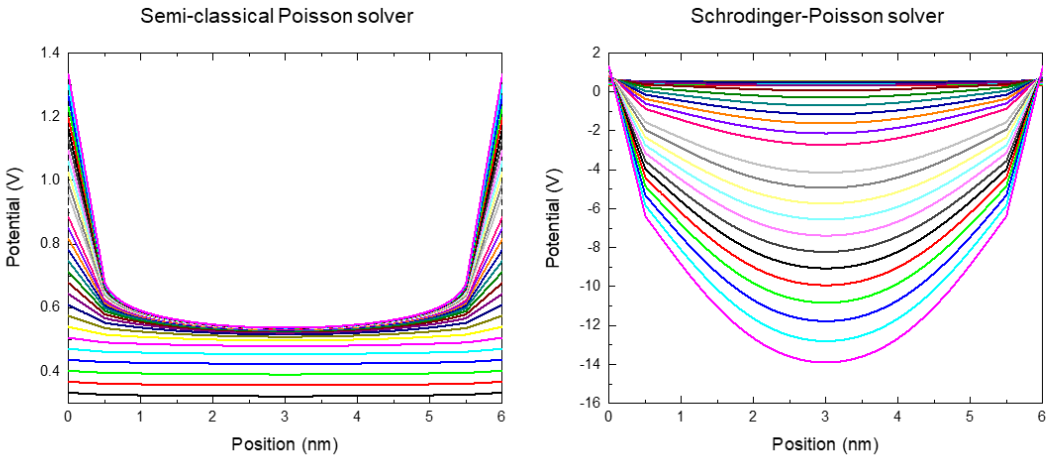

Figure 1 Electrostatic potential calculation in double gate structure by using Semi-classical Poisson solver (left) and Schrodinger-Poisson solver (right).

We calculated the electrostatic potential and electron density of SiO (0.5 nm)/Si (5 nm)/SiO (0.5 nm) double gate structure by using semi-classical Poisson (SCP) solver and Schrodinger-Poisson (SP) solver. We observed the clearly difference of electrostatic potential between two different solvers as shown Fig.1. Interestingly, the potential calculated by SCP solver is not below the zero, on the contrary, that calculated by SP solver has large negative potential when gate voltage increases. This distinctive difference is due to the description of electron density. In case of SCP solver, the electron density is given by $n_i e^{\frac{q\phi}{k_B T}}$ which is the semi-classical interpretation. On the other hands, the electron density is modified by Poisson solver which involve the quantum calculation.

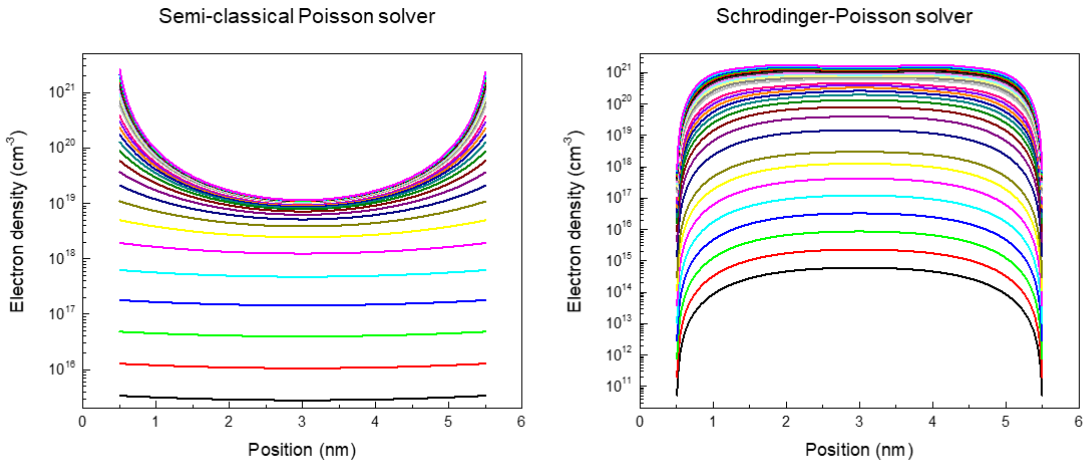

Figure 2 Electron density calculation in double gate structure by using Semi-classical Poisson solver (left) and Schrodinger-Poisson solver (right).

We also observed the different electron density according to solvers. The electron density calculated by SCP solver seems like a U-shape as shown Fig. 2. It can be explained by the semi-classical electron density $n_i e^{\frac{q\phi}{k_B T}}$. Because electrostatic potential is minimum at the center, electron density is also minimum at the center. However, SP solver does not use semi-classical electron density, the shape of electron density is different from SCP solver. Because sub-band electron number is maximum when n = 1, the electron density is inverse U-shape. This difference is affected to integrated electron density as shown Fig. 3. The tendency for electron density increase is similar to both solvers, however, order is clearly different each other.

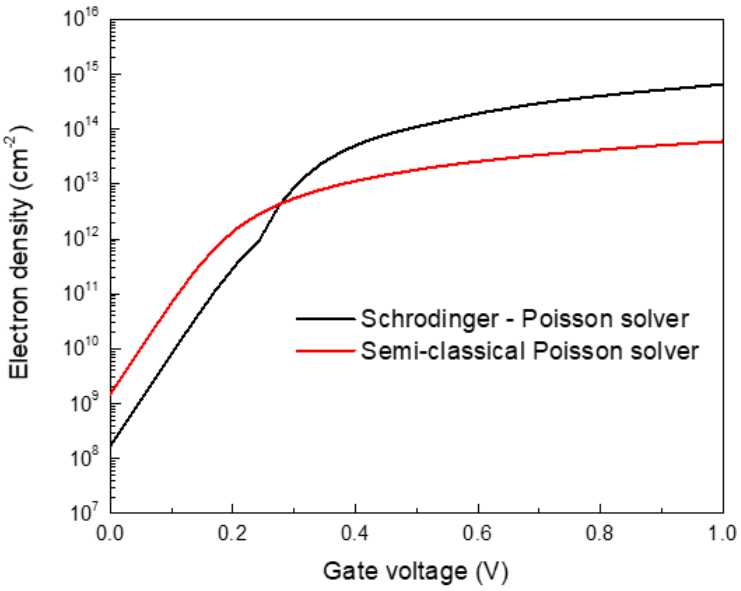

Figure 3 Integrated electron density comparison between two different solver.