第一回複合創造領域シンポジウム

Diameter-dependent injection velocity of ballistic Si nanowire MOSFETs

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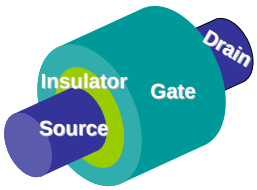
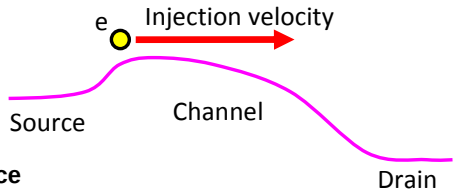
Introduction



The Si nanowire MOSFET is one of the most promising devices, which yield further performance improvement without scaling

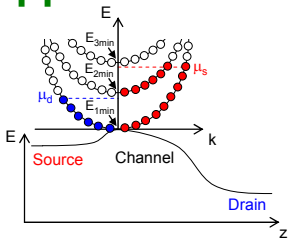
Diameter-dependent injection velocity is focused on

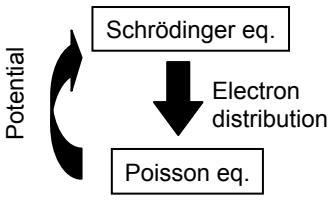


Degenerate electrons have high kinetic energy

The electron degeneracy has diameter dependence because of diameter-dependent density of states and gate oxide capacitance

Approach



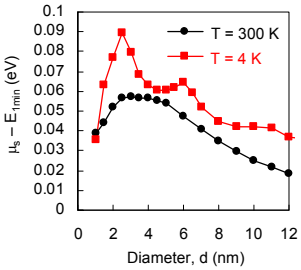


Semiclassical ballistic transport model

Self consistent solution of Schrödinger and Poisson

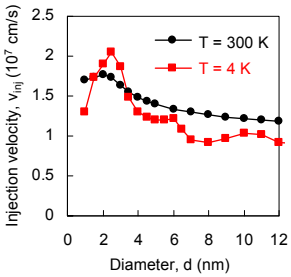
Using these approaches, we calculate electrostatics and electron states at the top of the barrier

Results and discussion



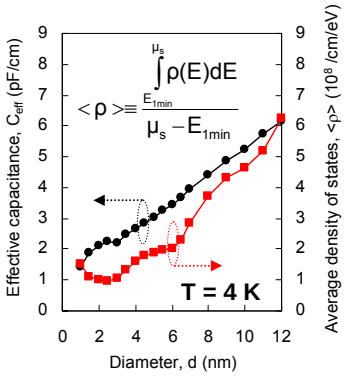
There is the highest ($\mu_s - E_{1min}$) at a certain diameter

We regard the ($\mu_s - E_{1min}$) as electron degeneracy

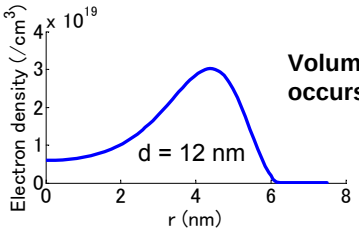


There is the highest injection velocity

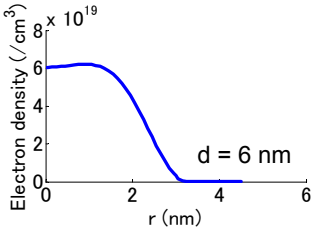
Peak injection velocity corresponds to peak electron degeneracy

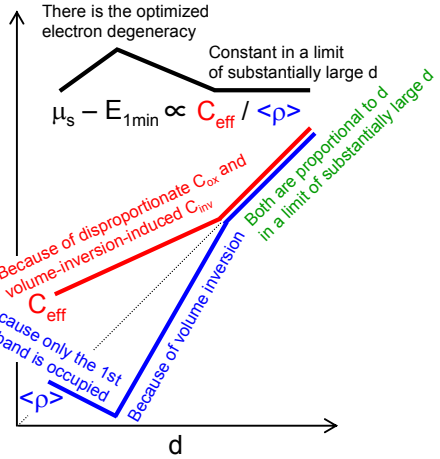


Volume inversion causes disproportionate <ρ> and C_{eff}



Volume inversion occurs





Conclusion

Because of disproportionate density of states and effective capacitance, there was optimized electron degeneracy

We revealed there was the optimum diameter with the highest injection velocity