CeO_2/ La_2O_3 MOSFETにおけるリモートクーロン散乱の移動度に及ぼす影響

Remote Coulomb Scattering Limited Mobility in MOSFET with CeO_2/ La_2O_3 Gate Stacks

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Introduction: The problem of mobility degradation of high-k MOSFETs has been well modeled and as a result, the main reason has been regarded as Remote Coulomb Scattering (RCS). In high-k/SiO_2 MOSFETs, SiO_2 layer play important role do improve mobility. By the Scaling of transistor size, the SiO_2 interfacial layer should be removed. Recently, it has been demonstrated that a direct contact structure between La_2O_3, and Si substrate can be obtained by forming La-silicate. Forming a higher k value silicate is advantageous for gate dielectric scaling, but the mobility degradation due to RCS still remains as one of the major concern. In this report, we studied RCS limited mobility in CeO_2 capped La_2O_3 high-k MOSFETs.

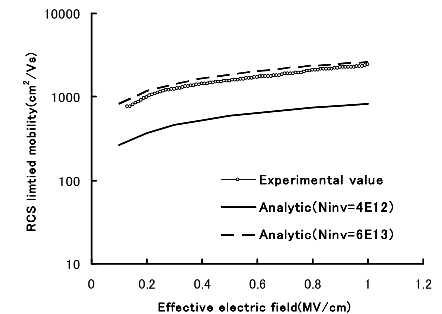

Fig. RCS limited mobility

Numerical Calculation: We used the relaxation time approximation to calculate the RCS-limited mobility. The relaxation time is averaged by the kinetic energy, and found by the well-known Fermi golden rule.

Experiment: nMOSFET was fabricated on a S/D preformed Si (100) substrate with the annealing condition of forming gas ambient at 500 ℃ for 30 min. The effective mobility of electrons was measured for both La_2O_3 single and CeO_2 / La_2O_3 stacked MOSFETs.

Result: Our result shows that, in CeO_2 / La_2O_3 high-k direct contacted to substrate MOSFETs, the fixed charge in the gate stack might be main reason for mobility degradation, and possible to improve the RCS limited mobility by introducing multivalent material to reduce fixed charge density in the gate stack.