Remote-surface-roughness scattering-limited electron mobility in ultrathin high-k gate stacked MOSFETs

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Materials and Methods

Purpose

Importance of Remote scattering for direct contact MOSFETs

Remote scattering
- Remote Coulomb scattering
- Remote surface roughness scattering
- Remote phonon scattering

Aim
- Remote surface roughness (RSR) scattering effect on electron mobility in La2O3 gate stacked MOSFETs

Materials and Methods

Sample structure

W(50nm)/CoOx(xnm)/La2O3(xnm)

Model

RCS scattering model:
Scattering from fixed charges at the gate/high-k interface, and at the high-k/silicate interface

RSR scattering model:
Scattering from Roughness at the gate/high-k interface, and at the high-k/silicate interface

Calculation method
Scattering potential
< Relaxation time >
Carrier mobility
Parameters

Roughness, roughness correlation length, roughness distribution

Results

SRR-limited electron mobility extracted by Matthiessen’s rule, and the result is compared with simulation result.

Conclusion

For CeOx/La2O3 gate dielectric structure, the remote-Coulomb scattering play dominant role when the physical thickness of the La2O3 is larger than 2.2nm.

When the interfacial layer too close (the distance is less than 1.7nm) to the channel, the remote surface roughness scattering take dominant role.

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