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Reduction of noise in CSDG MOSFET with HfO2

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Abstract content
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The cylindrical surrounding double-gate (CSDG) MOSFET is an extended version (rotated across one gate) of double-gate MOSFET. It is a hollow cylindrical structure having gate on the external and internal peripheral. With the scaling of device, the gate size and dielectric thickness reduces which clues to large gate-current leakage because of quantum mechanical tunneling of carriers through the thin gate oxide. In the application of traditional MOSFET as switch, various noises are available (such as thermal noise and flicker noise). In the CSDG MOSFET a high dielectric HfO2 has been used for the oxide.

The CSDG MOSFET has two resistive channels each under external and internal gate. Since the channels (from drain to source) has resistance Ron1 and Ron2, which exhibits thermal noise (source of noise) in the small-signal equivalent circuit. This increase in thermal noise may be attributed to hot electrons in short-channel (nanotechnology) devices. This effect can be minimized using the HfO2 (band gap 6.0 eV) compared to SiO2 (8.9 eV).

Also, with the use of HfO2, just below the oxide layer, a resistance creates from source to drain which will be in parallel combination with other oxide resistances. The combination of overall resistance reduces due to parallel combination. Since the noise is proportional to the resistances, hence, the noise with the use of HfO2 will reduces.

The CSDG MOSFET conduct current near the surface, where surface states act as traps that capture and release current carriers, which generates the flicker noise. Since the flicker noise is inversely proportional to the gate oxide capacitance, and with the use of HfO2, the CSDG MOSEFET can achieve higher gate oxide capacitance due to higher value of ε.

In conclusion these noises are lowers in CSDG MOSFET, for use in nanotechnology devices.

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