Ultra-low-loss of Electric Power in 4H-SiC Double-epitaxial MOS Transistor

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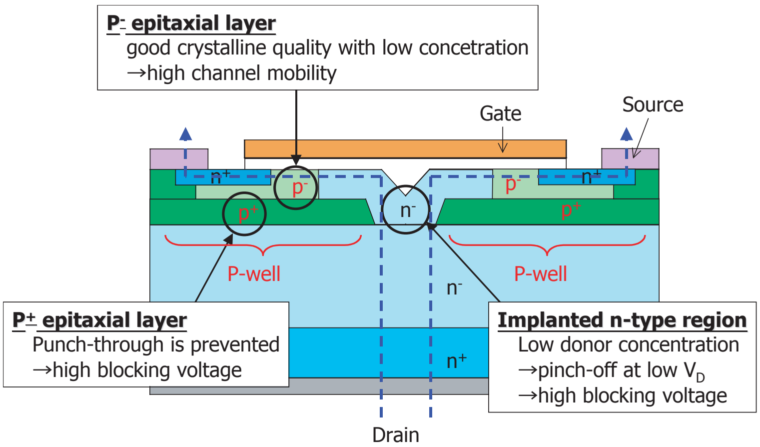
Electric power consumption seems to increase continuously for long term in the future. Consequently, effective use of electric power becomes very important issue. The key technology for this issue is conversion of the electric power using power semiconductor devices. However, performance of existing silicon (Si) based device is approaching to its theoretical limit. Silicon carbide (4H-SiC) based vertical MOS transistor (MOSFET) is one of promising candidates for high-power unipolar switching device because 4H-SiC has superior physical and electrical properties. However, vertical MOSFETs on 4H-SiC showed high on-resistance due to the poor channel mobility on the implanted rough surface. In this study, we developed a novel 4H-SiC vertical MOSFET employing two epitaxially grown layers as a MOS channel region. We named it double-epitaxial MOSFET (DEMOSFET). Fabricated device exhibits a ultra-low specific on-resistance (Rons) of 7.7 mΩcm^2 with a blocking voltage of 600 V. This is the first Rons lower than 10 mΩcm^2.



Schematic cross-section of double epitaxial MOSFET

Bandgap Modified Transparent Conducting Films using ZnMgO

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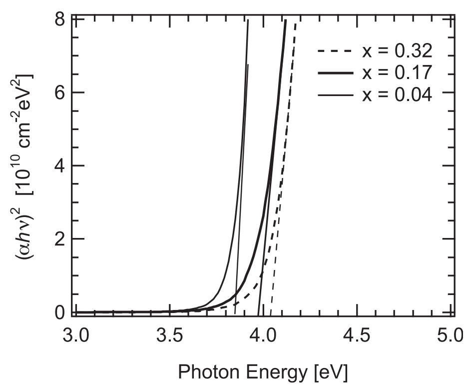
Bandgap modified transparent conducting films were proposed and demonstrated with Al-doped $Zn_{1-x}Mg_xO$ films deposited on glass substrates by a pulsed laser deposition system. The bandgap energy of these films could be widened up to about 4 eV with increasing Mg content in the films. The maximum bandgap values of the film with an electrical resistivity of less than 1×10^{-3} Ωcm was 3.97 eV. Bandgap of the transparent conducting films was varied from 3.5 eV to about 4.0 eV, keeping the resistivity of less than 1×10^{-3} Ωcm. These films can be used not only as an UV transparent conducting film but also to control the band lineup of the multilayered semiconductor structures.



$(\alpha h\nu)^2$ plots of Al-doped $Zn_{1-x}Mg_xO$ films with different x