Mixed-mode simulation을 이용한 4H-SiC DMOSFETs의
채널 길이에 따른 transient 특성 분석
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Mixed-mode simulation of transient characteristics of 4H-SiC DMOSFETs
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Abstract : Silicon Carbide (SiC) is a material with a wide bandgap (3.26eV), a high critical electric field (~2.3MV/cm), and a high bulk electron mobility (~900cm²/Vs). These electronic properties allow high breakdown voltage, high-speed switching capability, and high temperature operation compared to Si devices. Although various SiC DMOSFET structures have been reported so far for optimizing performances, the effect of channel dimension on the switching performance of SiC DMOSFETs has not been extensively examined.

This paper studies different channel dimensions (L: 0.5µm, 1µm, 1.5µm) and their effect on the device transient characteristics. The key design parameters for SiC DMOSFETs have been optimized and a physics-based two-dimensional (2-D) mixed device and circuit simulator by Silvaco Inc. has been used to understand the relationship with the switching characteristics. To investigate transient characteristic of the device, mixed-mode simulation has been performed, where the solution of the basic transport equations for the 2-D device structures is directly embedded into the solution procedure for the circuit equations. We observe an increase in the turn-on and turn-off time with increasing the channel length. The switching time in 4H-SiC DMOSFETs have been found to be seriously affected by the various intrinsic parasitic components, such as gate-source capacitance and channel resistance. The intrinsic parasitic components relate to the delay time required for the carrier transit from source to drain. Therefore, improvement of switching speed in 4H-SiC DMOSFETs is essential to reduce the gate-source capacitance and channel resistance.

Key Words : Silicon carbide, transient, Switching, 4H-SiC DMOSFET

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