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Thermal Analysis of 4H-SiC power MOSFETs

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Abstract:

This paper presents the influence of doping density on temperature behavior between the 4H-SiC DMOSFETs and the 4H-SiC trench MOSFETs with p-shield (TP-MOS) by using the electro-thermal analysis method. As a results, the formation of hot-spot (the highest temperature) takes place at the junction between the p base and the n-drift region under gate oxide in the DMOS and next to the corner of the trench gate in the TP-MOS. This hot spot temperature increases with rising doping density of n-drift. Meanwhile, breakdown voltage of devices decreases with growing doping concentration in the drift region. When this dopant is lower than $5 \times 10^{15} \text{ cm}^{-3}$, BV of DMOS and TP-MOS are 1400 V and 1390 V, respectively. Additionally, resistance of the two proposed structures increases when climbing temperature from 300K to 523K. At 300K, resistance of the DMOS and the TP-MOS are $8.3 \text{ m}\Omega\cdot\text{cm}^2$ and $2.7 \text{ m}\Omega\cdot\text{cm}^2$, respectively. When the temperature up to 523K, the highest resistance of $20 \text{ m}\Omega\cdot\text{cm}^2$ belongs to DMOS compared to only $5.26 \text{ m}\Omega\cdot\text{cm}^2$ of TP-MOS.

Keywords

Thermal Analysis, 4H-SiC, MOSFET

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