一种 100 V 分离栅沟槽 MOSFET 的优化设计

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摘 要：把多个侧壁阶梯氧化层应用于分离栅沟槽 MOSFET（Split-Gate Trench MOSFET，SGT 结构），并把改进的结构称为多阶梯侧壁氧化层分离栅沟槽 MOSFET（Multi-Step Sidewall Oxides Split-Gate Trench MOSFET，MSO 结构），之后介绍了 MSO 结构的器件结构和制备工艺，重点借助 TCAD 仿真软件对 MSO 结构的外延层掺杂浓度、顶部侧氧厚度与底部侧氧厚度进行优化，最终仿真得到击穿电压为 126 V，特征导通电阻为 30.76 mΩ・mm^2和特征栅漏电荷为 0.351 nC・mm^{-2}的 MSO 结构.在近似相等的击穿电压下，与传统 SGT 结构相比，MSO 结构的特征导通电阻及特征栅漏电荷均有所降低，这两项参数综合反映器件的优值（$FOM=Q_{gd,sp}\times R_{on}A$）降低了 39.6%.

关键词：分离栅；MSO 结构；特征导通电阻；特征栅漏电荷

Optimized Design and Research of A 100V Split Gate Trench MOSFET

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Abstract：In this paper, multi-step sidewall oxide layers are applied to split-gate trench MOSFET (Split-Gate Trench MOSFET, SGT structure), and the improved structure is called a multi-step sidewall oxide layers split-gate trench MOSFET (Multi-Step Sidewall Oxides Split-Gate Trench MOSFET, MSO structure). Then the device structure and manufacturing process of the MSO structure are introduced. The epitaxial layer doping concentration, the thickness of the top and bottom of the sidewall oxide layer of the MSO structure are optimized by TCAD simulation software. Finally, the simulation results show that the MSO structure with the breakdown voltage is 126 V, a specific on-resistance of 30.76 mΩ・mm^2 and a specific gate drain charge of 0.351n C・mm^{-2}. At approximately the same breakdown voltage, specific on-resistance and specific gate-drain charge of the MSO structure are lower than those of the conventional SGT structure. These two parameters show that the figure of merit ($FOM= Q_{gd,sp}\times R_{on}A$) of the device is decreased by 39.6%.

Key words：split-gate; MSO structure; specific on-resistance; specific gate-drain charge

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