

# 非对称超结场效应晶体管设计和仿真

张广银<sup>1</sup>, 沈千行<sup>2</sup>, 喻巧群<sup>1</sup>, 卢烁今<sup>1</sup>, 朱阳军<sup>2</sup>

(1 中国科学院 微电子研究所, 北京 100029; 2. 江苏物联网研究发展中心, 江苏 无锡 214135)

**摘要:** 为了克服传统功率 MOSFET 通态电阻和击穿电压之间的矛盾, 引入了超级结 (SJ) 器件, 通过引入横向电场来提高击穿电压. 针对工艺中非对称 pillar 的设计需求, 建立了非对称的研究分析模型, 通过引入影响设计的非对称因子  $k$ , 分析了  $k$  的物理意义和修正了不同 pillar 比例下的  $k$  值来设计相关参数, 推导出超结的设计解析表达式. 为了验证设计的准确性, 以沟槽栅 SJ-MOSFET 为器件, 进行了仿真验证和比较, 理论与仿真结果符合良好, 可以用于超结 MOSFET 的设计指导.

**关键词:** SJ-MOSFET; 非对称; 漂移区; 横向电场

## Design and Simulation of Asymmetric SJ-MOSFET

ZHANG Guang-yin<sup>1</sup>, SHEN Qian-xing<sup>2</sup>, YU qiao-qun<sup>1</sup>, LU Shuo-jin<sup>1</sup>, ZHU Yang-jun<sup>2</sup>

(1 Institute of Microelectronics, Chinese Academy of Sciences, Beijing 100029, China;  
2 Jiangsu R&D Center for Internet of Things, Wuxi 214135, China)

**Abstract:** In order to overcome the traditional power MOSFET contradiction between on-state resistance and breakdown voltage, the super junction (SJ) device is introduced, so that it improves the breakdown voltage through the transverse electric field. In asymmetric pillar design requirements, establishing the asymmetry analysis model, introducing asymmetric factor  $k$ , analyzing the physical meaning of  $k$  and modifying the  $k$  value for pillar in different proportions, analytical expression of super junction is derived. In order to verify the accuracy of the design, basing on trench gate SJ-MOS device, simulation verification and comparison are carried out., theoretical and simulation results are in good agreement, the theory can be used as a guide for the design of super junction MOSFET.

**Key words:** SJ-MOSFET; asymmetric; drift region; transverse electric field

**作者简介:**

张广银 男, (1989-), 硕士研究生. 研究方向为 SJ 器件研究.

[[BP]] E-mail: zhangguangyin@ime.ac.cn. [[BP]]

朱阳军(通讯作者) 男, (1980-), 研究员, 硕士生导师. 研究方向为 IGBT/FRD 等电力电子器件芯片开发与产业化以及测试可靠性.

E-mail: zhuyangjun@ime.ac.cn.