



重慶大學
CHONGQING UNIVERSITY

碳化硅电力电子实验室

-专注于碳化硅功率半导体芯片可靠性及其测评技术

隶属院系：电气工程学院电力电子系

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1. 实验室简介

碳化硅电力电子实验室专注于碳化硅（SiC）功率半导体芯片的可靠性及其测评技术研究，面向电力电子核心应用场景：电动汽车主电驱、固态变压器（SST）和柔直换流阀。实验室围绕器件物理、可靠性机理、测试评价方法和测评系统研发开展工作，致力于将基础研究与工程实践相结合。

学生将参与从器件到机理，再到测评和系统开发的完整科研链条，在实践中获得系统知识与综合能力。

2. 实验室定位

实验室通过碳化硅功率半导体器件可靠性及其测评技术研究培养学生，定位于：

- 理解电动汽车主电驱、固态变压器（SST）和柔直换流阀等典型电力电子应用场景对器件的需求
- 学习和理解器件物理原理及可靠性机理
- 掌握可靠性测评方法，并能够参与技术开发
- 参与器件测评系统和实验平台搭建，获得动手经验
- 培养兼具科研能力和工程实践能力的学生

实验室与以电路、拓扑或控制为主的团队不同，更加聚焦器件本体和测试评价问题，强调科学问题与工程实现的紧密结合，为学生提供可直接参与科研和平台研发的机会。

3. 研究方向

实验室总体研究方向为碳化硅功率半导体与电力电子技术，涵盖机理分析、可靠性测评及系统研发。

研究方向一：碳化硅器件物理与可靠性机理

- 研究器件在电、热、场等应力条件下的物理机制和失效演化
- 聚焦阈值漂移、参数离散、耐受能力变化等关键机理
- 学生参与后可掌握机理分析、实验设计及独立科研能力

研究方向二：碳化硅器件可靠性测评技术

- 开发动态阈值漂移、dv/dt 耐受、抗辐照能力等可靠性测试方法
- 构建可量化的评价指标体系，确保实验数据可靠性与可重复性
- 学生可在实验中获得系统测评能力

研究方向三：碳化硅器件与测评系统研发

- 设计器件、测试平台和测评系统
- 平台和系统涵盖驱动电路、控制程序、实验系统结构
- 学生可参与系统实现与调试，形成完整项目能力

进组后，将根据研究方向参与机理分析、测试评价和平台研发的具体任务，学生将在科研项目中逐步独立承担任务，形成从基础实验到系统研发的完整科研流程。

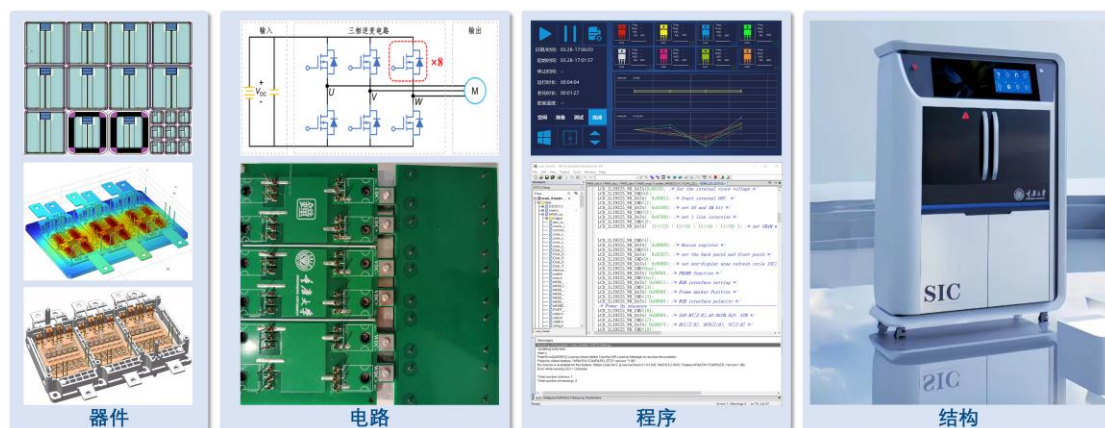
4. 学生培养

本实验室注重系统化培养，目标是让学生形成完整的知识与能力框架体系。

学生将通过器件、电路、程序和结构四类核心训练，不仅掌握单点技能，更能将其整合为完整体系。实验室训练涵盖从理论学习到实验操作、数据处理和平台开发全过程。

培养方向	掌握的知识	获得的能力
器件	SiC 功率器件物理、制造工艺、可靠性机理	功率芯片和封装的仿真与设计能力、器件可靠性分析能力
电路	电力电子电路与控制、功率半导体驱动电路、采样与控制电路	电路设计、焊接、组装和调试能力
程序	上位机/下位机程序、数据采集与处理方法	程序设计与调试能力、数据分析与处理能力
结构	测评系统、平台与装置结构、散热与温控系统	结构设计、整机组装与调试能力、独立完成平台/系统开发的能力

学生入组后，将先从基础实验和文献学习入手，逐步参与器件物理测试、可靠性评价实验、测评系统开发与调试等科研任务。通过阶段性实践，学生将形成贯通“器件—电路—程序—结构”的完整知识体系和能力框架，实现从问题分析到系统解决方案的独立科研能力。



5. 适合学生特质

本实验室欢迎具备以下特质的学生加入：

(1) 态度为首

- 对科研任务耐心且专注
- 遵循实验规范、严格记录数据
- 面对复杂问题，能够实事求是、循序渐进地分析与解决

(2) 性格稳重

- 不浮躁、不急功近利
- 尊重事实和数据

(3) 求知欲强

- 对器件物理、电力电子系统、可靠性测评充满兴趣
- 乐于钻研新技术、新方法，主动学习理论与实践知识

(4) 团队意识与沟通能力

- 能够与导师、同学和技术支持人员协作
- 思路清晰，精准回答问题

在本实验室，态度与性格是科研成长的首要因素，能力与技能可通过系统训练获得。具备认真、稳重、求真务实及强烈好奇心的学生，将在实验室获得完整的知识体系和实践能力。

6. 研究特色

- 聚焦核心应用：紧密围绕电动汽车主电驱、SST 和柔直换流阀
- 以可靠性为主线，兼顾机理研究、测评技术和系统研发
- 学术研究与工程实现结合，贯通器件—测评—系统
- 核心建设者兼具产业与学术背景，曾在中国中车和海外科研机构工作
- 学生在科研项目中可快速形成实践能力和知识框架

7. 研究条件

实验室场地约 108 平方米，配备器件测试平台、实验设备和测评系统。学生将在实验室中亲自操作实验、开发测试系统并分析数据，获得实操经验和系统研究能力。



8. 技术积累

实验室针对电动汽车主电驱、固态变压器（SST）和柔直换流阀三大典型电力电子应用场景，已建立下述完整技术基础体系，支撑三个研究方向，学生通过实践将掌握贯通知识与能力体系，形成独立解决科研问题的能力。

- 芯片设计与仿真

- 电路设计与仿真
- 程序开发与调试
- 平台/系统结构设计、组装与调试

9. 代表性成果

实验室针对电动汽车主电驱、固态变压器（SST）和柔直换流阀三大典型电力电子应用场景，在碳化硅功率半导体及可靠性研究方向取得了显著成果：

- 学术论文 70 余篇，其中期刊 40 余篇、会议 30 余篇
- 中国发明专利 30 余项（已授权 26 项）、英国专利 2 项
- 参与标准制定：第三代半导体联盟团体标准 1 项、JEDEC 标准 1 项
- 成果覆盖器件、可靠性机理、测评技术及测试平台开发

9.1. 代表性学术论文

[1] L. Tang, H. Jiang*, R. Liao, Y. Huang, X. Zhong, X. Qi, L. Liu and Q. Zhang, "Impact of the Threshold Dispersion Evolution on the Current Sharing of Parallel SiC MOSFETS," in *IEEE Transactions on Power Electronics*, vol. 39, no. 5, pp. 6312-6326, May 2024.

该工作主要针对并联 SiC MOSFET 在阈值离散性演化条件下的电流均流问题开展研究，揭示了阈值分散变化对器件并联一致性的影响规律。该成果属于“碳化硅器件物理与可靠性机理”方向，体现了实验室将器件参数演化机理与实际应用问题相结合的研究特色。

[2] H. Jiang*, X. Qi, G. Qiu, X. Zhong, L. Tang, H. Mao, Z. Wu, H. Chen and L. Ran, "A Physical Explanation of Threshold Voltage Drift of SiC MOSFET Induced by Gate Switching," in *IEEE Transactions on Power Electronics*, vol. 37, no. 8, pp. 8830-8834, Aug. 2022.

该工作主要针对 SiC MOSFET 在栅极开关过程中出现的阈值电压漂移现象，从器件物理角度给出了相应解释。该成果属于“碳化硅器件物理与可靠性机理”方向，体现了实验室围绕动态阈值漂移问题开展机理研究的特色。

[3] H. Mao, H. Jiang*, L. Ran, J. Hu, G. Qiu, J. Wei, H. Chen, X. Zhong, N. Xiao, L. Wang and M. Yang, "An Asymmetrical Power Module Design for Modular Multilevel Converter With Unidirectional Power Flow," in *IEEE Transactions on Power Electronics*, vol. 38, no. 1, pp. 1092-1103, Jan. 2023.

该工作主要针对单向功率流模块化多电平换流器中的功率模块设计问题，提出了相应的非对称功率模块结构方案。该成果体现了实验室在功率器件相关设计与工程实现方面的研究基础，也反映出实验室能够将器件研究与电力电子应用需求相联系。

9.2. 代表性发明专利

[1] 蒋华平,廖瑞金,钟笑寒,谢宇庭,汤磊,赵柯,肖念磊. 多工作模式电路的控制装置及其控制方法: CN116743138A [P],2023. (授权)

该专利主要面向多工作模式测试或实验电路中的控制实现问题,旨在提升测试过程中的功能切换与控制灵活性。该成果体现了实验室在测试平台控制装置与相关系统开发方面的能力。

[2] 蒋华平,廖瑞金,戚晓伟,钟笑寒,汤磊,赵柯,肖念磊. 绝缘栅型半导体器件的阈值电压恢复方法及相关产品: CN116743134A [P],2023. (授权)

该专利主要面向绝缘栅型半导体器件阈值电压测试与恢复过程中的关键问题,服务于相关可靠性评价和测试流程实现。该成果体现了实验室围绕阈值电压相关测评问题开展方法和装置研发的能力。

[3] 蒋华平,廖瑞金,赵柯. MOS 型半导体器件的栅极驱动电路和电力变换装置: CN116436450A [P],2023. (授权)

该专利主要面向 MOS 型半导体器件相关实验与应用中的栅极驱动问题,为器件测试与应用验证提供支撑。该成果体现了实验室在驱动电路设计及相关平台装置开发方面的技术基础。

9.3. 代表性器件与设备

[1] 车规级 1200V20m Ω 碳化硅 MOSFET 芯片

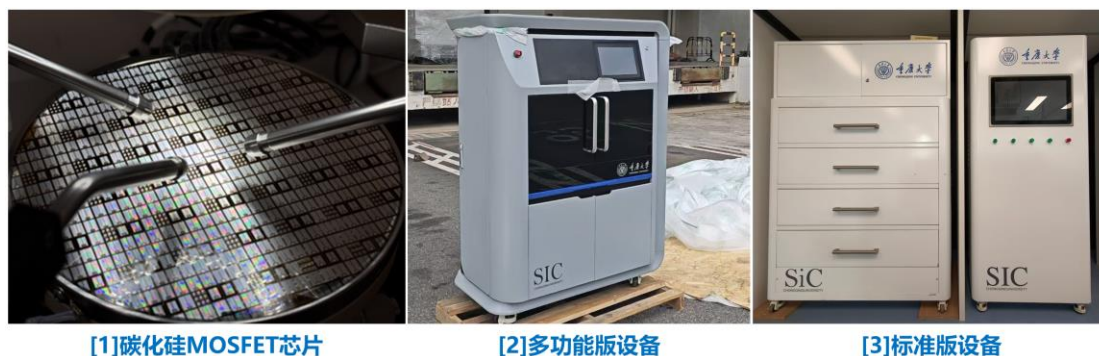
该芯片体现了实验室在碳化硅功率半导体芯片方向上的研究基础,可为器件特性、可靠性及相关应用研究提供对象支撑。该成果反映了实验室不仅关注测试评价,也重视器件本体相关研究。

[2] 动态阈值漂移 (DGS) 测试设备 (多功能版)

该设备面向碳化硅 MOSFET 动态阈值漂移问题开展测试与评价,可支持多种工作模式和更丰富的实验需求。该成果体现了实验室在可靠性测评技术与测试系统研发方面的系统实现能力。

[3] 动态阈值漂移 (DGS) 测试设备 (标准版)

该设备面向动态阈值漂移测试的标准化、规范化需求,适合开展针对性较强的测试与评价工作。该成果体现了实验室在测试平台工程化和测评技术落地方面的能力。



10. 团队情况

- 教师 2 名，行政助理 1 名，技术员 1 名
- 博士和硕士研究生十余名
- 兼具产业与学术背景，为学生提供理论与实践结合的指导
- 团队高效，学生将获得充分指导和实践机会

11. 毕业去向

本实验室的毕业生在学术和产业领域均取得了突出发展。毕业生不仅具备扎实的器件、测试与系统研发能力，还拥有完整知识框架和项目经验，在行业内具有较高竞争力，职业成长路径清晰，科研与工程岗位均可胜任。

【博士毕业生】

- 高校从事高水平科研工作
- 华为、国家电网等核心科研和技术岗位，承担关键技术研发任务

【硕士毕业生】

- 华为、汇川技术、禾望电气、长安汽车等新能源领域重点企业
- 就业岗位均为核心研发或技术岗位
- 年薪待遇优越：沿海地区约 35 - 42 万元/年，内地约 25 万元/年
- 多数学生入职第一年年终评定为优秀，显示快速的职业成长与认可

加入本实验室，学生不仅能获得系统科研训练，更能够在毕业后直接进入高质量、高发展潜力的岗位，实现职业快速成长。与多数高校电力电子方向毕业生相比，本实验室学生更易进入核心岗位，待遇优厚，职业成长快速。

12. 联系

欢迎硕士、博士及推免生申请或报考本实验室，了解具体研究方向及报考流程，并提交简历及成绩单。联系邮箱：Huaping.Jiang@cqu.edu.cn。

13. 附录

13.1. 期刊论文

- [1] H. Jiang*, Y. Li, X. Li, M. Qiu, N. Xiao, L. Tang, X. Zhong and R. Liao, "Dynamic Threshold Voltage Drift of Silicon Carbide MOSFET With Drain Stress," in *IEEE Transactions on Electron Devices*, vol. 72, no. 9, pp. 4802-4809, Sept. 2025. (二区)
- [2] L. Tang, H. Jiang*, X. Zhong, Y. Huang, N. Xiao, K. Zhao and R. Liao, "Influence of Mismatched Gate Loop Inductance on Threshold Dispersion Evolution and Current Sharing of Parallel SiC MOSFETs," in *IEEE Transactions on Power Electronics*, vol. 40, no. 5, pp. 6921-6932, 2025. (一区)
- [3] H. Jiang*, K. Zhao, R. Liao, X. Zhong and L. Tang, "Gate Drive Method for Reducing Threshold Voltage Drift of Silicon Carbide MOSFET," in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 12, no. 6, pp. 5864-5873, December 2024. (二区)
- [4] X. Zhong, C. Xu, H. Jiang*, R. Liao, L. Tang, Y. Huang, K. Zhao, N. Xiao, X. Qi, L. Liu and Q. Zhang, "Recovery Performance of the Dynamic Threshold Voltage Drift of Silicon Carbide MOSFETs," in *IEEE Transactions on Power Electronics*, vol. 39, no. 6, pp. 7620-7631, June 2024. (一区)
- [5] L. Tang, H. Jiang*, R. Liao, X. Zhong, K. Zhao, N. Xiao and Y. Huang, "Analyzing the Changes in the Third Quadrant Characteristics of SiC MOSFET Induced by Threshold Drift," in *IEEE Transactions on Electron Devices*, vol. 71, no. 4, pp. 2342-2348, April 2024. (二区)
- [6] L. Tang, H. Jiang*, R. Liao, Y. Huang, X. Zhong, X. Qi, L. Liu and Q. Zhang, "Impact of the Threshold Dispersion Evolution on the Current Sharing of Parallel SiC MOSFETs," in *IEEE Transactions on Power Electronics*, vol. 39, no. 5, pp. 6312-6326, May 2024. (一区)
- [7] L. Liu, L. Tang, H. Jiang*, F. Wei, Z. Li, C. Du, Q. Peng and G. Lu, "Reliability evaluation of IGBT power module on electric vehicle using big data," in *Journal of Semiconductors*, vol. 45, no. 5, pp. 52301, 2024. (四区)
- [8] 蒋华平,汤磊,钟笑寒等.碳化硅 MOSFET 动态阈值漂移综述[J].重庆大学学报.2024(录用)
- [9] 钟笑寒,游同生,蒋华平等.碳化硅 MOSFET 并联雪崩分流特性[J].重庆大学学报.2024(录用)
- [10] 汤磊,汪海兵,蒋华平等.阈值漂移对碳化硅 MOSFET 短路特性影响[J].重庆大学学报.2024(录用)
- [11] 赵柯,蒋华平,汤磊等.抑制碳化硅 MOSFET 阈值电压漂移的驱动电路[J/OL].重庆大学学报.2024(录用)
- [12] J. Wei, H. Jiang*, N. Xiao, Z. Wu, L. Wang and L. Ran, "Multiple Phase Change Materials Integrated into Power Module for Normal and High Current Reliability Enhancement," in *IEEE Transactions On Device and Materials Reliability*, vol. 23, no. 1, pp. 127-133, March 2023. (三区)
- [13] H. Mao, L. Ran, H. Chen, X. Zhou, H. Jiang*, "Avalanche capability degradation of the

- parallel-connected SiC MOSFETs," *Microelectronics Reliability*, 142: 114926, 2023. (四区)
- [14] L. Liu, Q. Peng, H. Jiang, L. Ran, Y. Wang, C. Du, J. Chen, H. Zhou, Y. Chen, Z. Peng, "BP neural network for non-invasive IGBT junction temperature online detection," *Microelectronics Reliability*, 141: 114882, 2023. (四区)
- [15] H. Mao, H. Jiang*, L. Ran, J. Hu, G. Qiu, J. Wei, H. Chen, X. Zhong, N. Xiao, L. Wang and M. Yang, "An Asymmetrical Power Module Design for Modular Multilevel Converter With Unidirectional Power Flow," in *IEEE Transactions on Power Electronics*, vol. 38, no. 1, pp. 1092-1103, Jan. 2023. (一区)
- [16] L. Tang, H. Jiang*, X. Zhong, G. Qiu, H. Mao, X. Jiang, X. Qi, C. Du, Q. Peng, L. Liu and L. Ran, "Investigation Into the Third Quadrant Characteristics of Silicon Carbide MOSFET," in *IEEE Transactions on Power Electronics*, vol. 38, no. 1, pp. 1155-1165, Jan. 2023. (一区)
- [17] H. Jiang*, X. Qi, G. Qiu, X. Zhong, L. Tang, H. Mao, Z. Wu, H. Chen and L. Ran, "A Physical Explanation of Threshold Voltage Drift of SiC MOSFET Induced by Gate Switching," in *IEEE Transactions on Power Electronics*, vol. 37, no. 8, pp. 8830-8834, Aug. 2022. (一区)
- [18] X. Zhong, H. Jiang*, L. Tang, X. Qi, P. Jiang and L. Ran, "Gate Stress Polarity Dependence of AC Bias Temperature Instability in Silicon Carbide MOSFETs," in *IEEE Transactions on Electron Devices*, vol. 69, no. 6, pp. 3328-3333, June 2022. (二区)
- [19] X. Zhong, H. Jiang*, G. Qiu, L. Tang, H. Mao, C. Xu, X. Jiang, J. Hu, X. Qi and L. Ran, "Bias Temperature Instability of Silicon Carbide Power MOSFET Under AC Gate Stresses," in *IEEE Transactions on Power Electronics*, vol. 37, no. 2, pp. 1998-2008, Feb. 2022. (一区)
- [20] H. Mao, G. Qiu, X. Jiang, H. Jiang*, X. Zhong, L. Tang, Y. Zhang, L. Ran and Y. Wu, "Investigation on the Degradations of Parallel-Connected 4H-SiC MOSFETs Under Repetitive UIS Stresses," in *IEEE Transactions on Electron Devices*, vol. 69, no. 2, pp. 650-657, Feb. 2022. (二区)
- [21] G. Qiu, L. Ran, H. Feng, H. Jiang*, T. Long, A. J. Forsyth, W. Shao and X. Hou, "A Fluxgate-Based Current Sensor for DC Bias Elimination in a Dual Active Bridge Converter," in *IEEE Transactions on Power Electronics*, vol. 37, no. 3, pp. 3233-3246, March 2022. (一区)
- [22] Z. Wu, H. Jiang*, Z. Zheng, X. Qi, H. Mao, L. Liu and L. Ran, "Dynamic dv/dt Control Strategy of SiC MOSFET for Switching Loss Reduction in the Operational Power Range," in *IEEE Transactions on Power Electronics*, vol. 37, no. 6, pp. 6237-6241, June 2022. (一区)
- [23] X. Jiang, H. Jiang*, X. Zhong, H. Mao, Z. Wu, L. Tang, H. Chen, J. Cheng and L. Ran, "Impact of Gate Resistance on Improving the Dynamic Overcurrent Stress of the Si/SiC Hybrid Switch," in *IEEE Transactions on Power Electronics*, vol. 37, no. 11, pp. 13319-13331, Nov. 2022. (一区)
- [24] L. Tang, H. Jiang*, J. Wei, Q. Hu, X. Zhong and X. Qi, "A comparative study of SiC MOSFETs with and without integrated SBD," in *Microelectronics Journal*, vol. 128, pp. 0026-2692, Oct. 2022. (二区)
- [25] H. Ren*, L. Ran, X. Liu, L. Liu, S. Djurović, H. Jiang*, M. Barnes and P. A. Mawby, "Quasi-Distributed Temperature Detection of Press-Pack IGBT Power Module Using FBG Sensing," in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 10, no. 5, pp. 4981-4992, Oct. 2022. (二区)
- [26] G. Qiu, L. Ran, H. Feng, H. Jiang, H. Mao and J. Wei, "A High-Precision Sensor Based on AC Flux Cancellation for DC Bias Detection in Dual Active Bridge Converters," in *IEEE Transactions on Power Electronics*, vol. 37, no. 11, pp. 13513-13524, Nov. 2022. (一区)

- [27] J. Yang, Y. Che, L. Ran, M. Du, H. Jiang and M. Xiao, "Monitoring Initial Solder Layer Degradation in a Multichip IGBT Module via Combined TSEPs," in *IEEE Transactions on Device and Materials Reliability*, vol. 22, no. 1, pp. 26-35, March 2022. (二区)
- [28] H. Jiang*, J. Wei, X. Fang, H. Ren, W. Shao and L. Ran, "A ΔT_j Reduced Power Module With Inbuilt Phase Change Material for Reliability Enhancement," in *IEEE Transactions on Electron Devices*, vol. 68, no. 9, pp. 4557-4564, Sept. 2021. (二区)
- [29] B. Hu, Z. Hu, L. Ran, C. Ng, C. Jia, P. McKeever, P. J. Tavner, C. Zhang, H. Jiang and P. A. Mawby, "Heat-Flux-Based Condition Monitoring of Multichip Power Modules Using a Two-Stage Neural Network," in *IEEE Transactions on Power Electronics*, vol. 36, no. 7, pp. 7489-7500, July 2021. (一区)
- [30] H. Ren, W. Shao, L. Ran, G. Hao, L. Zhou, P. Mawby and H. Jiang, "A Phase Change Material Integrated Press Pack Power Module With Enhanced Overcurrent Capability for Grid Support—A Study on FRD," in *IEEE Transactions on Industry Applications*, vol. 57, no. 4, pp. 3956-3968, July-Aug. 2021. (二区)
- [31] L. Liu, C. Du, Q. Peng, J. Chen, Y. Wang, Y. Chen, Z. Peng, H. Jiang and L. Ran, "An investigation on IGBT junction temperature estimation using online regression method," in *Microelectronics Reliability*, vol. 124, pp. 0026-2714, Sept. 2021. (二区)
- [32] H. Jiang*, X. Zhong, G. Qiu, L. Tang, X. Qi and L. Ran, "Dynamic Gate Stress Induced Threshold Voltage Drift of Silicon Carbide MOSFET," in *IEEE Electron Device Letters*, vol. 41, no. 9, pp. 1284-1287, Sept. 2020. (二区)
- [33] J. Yang, Y. Che, L. Ran and H. Jiang, "Evaluation of Frequency and Temperature Dependence of Power Losses Difference in Parallel IGBTs," in *IEEE Access*, vol. 8, pp. 104074-104084, 2020.
- [34] W. Shao, R. Wu, L. Ran, H. Jiang, P. A. Mawby, D. J. Rogers, T. C. Green, T. Coombs, K. Yardley, D. Kastha, P. Bajpai and L. Zhou, "A Power Module for Grid Inverter With In-Built Short-Circuit Fault Current Capability," in *IEEE Transactions on Power Electronics*, vol. 35, no. 10, pp. 10567-10579, Oct. 2020. (一区)
- [35] M. Zhang, J. Wei, X. Zhou, H. Jiang, B. Li and K. J. Chen, "Simulation Study of a Power MOSFET With Built-in Channel Diode for Enhanced Reverse Recovery Performance," in *IEEE Electron Device Letters*, vol. 40, no. 1, pp. 79-82, Jan. 2019. (二区)
- [36] J. Wei, M. Zhang, H. Jiang, X. Zhou, B. Li and K. J. Chen, "Superjunction MOSFET With Dual Built-In Schottky Diodes for Fast Reverse Recovery: A Numerical Simulation Study," in *IEEE Electron Device Letters*, vol. 40, no. 7, pp. 1155-1158, July 2019. (二区)
- [37] J. Wei, M. Zhang, H. Jiang, B. Li and K. J. Chen, "Gate Structure Design of SiC Trench IGBTs for Injection-Enhancement Effect," in *IEEE Transactions on Electron Devices*, vol. 66, no. 7, pp. 3034-3039, July 2019. (二区)
- [38] W. Shao, X. Li, H. Jiang, X. Guo, Z. Zheng, L. Ran and P. Mawby, "Power Loss Comparison in a BOOST PFC Circuit Considering the Reverse Recovery of the Forward Diode," in *Materials Science Forum*, vol. 963, pp. 873-877, July 2019.
- [39] T. Dai, C. Chan, X. Deng, H. Jiang, P. Gammon, M. M., Jennings and P. A. Mawby, "4H-SiC trench MOSFET with integrated fast recovery MPS diode," in *Electronics Letters*, vol. 54, no. 3, pp. 167-169, Feb. 2018.
- [40] Y. Sharma, H. Jiang, C. Zheng, X. Dai, Y. Wang and I. Deviny, "Impact of design and process variation on the fabrication of SiC diodes," in *Journal of Semiconductors*, vol. 39, no. 11, pp.

- 25-30, Nov. 2018.
- [41] Y.K Sharma, H. Jiang, C. Zheng, X. Dai and I. Deviny, "Effect of Design Variations and N2O Annealing on 1.7kV 4H-SiC Diodes," in *Materials Science Forum*, vol. 924, pp. 428-431, June 2018.
- [42] J. Wei, M. Zhang, H. Jiang, H. Wang and K. J. Chen, "Dynamic Degradation in SiC Trench MOSFET With a Floating p-Shield Revealed With Numerical Simulations," in *IEEE Transactions on Electron Devices*, vol. 64, no. 6, pp. 2592-2598, June 2017. (二区)
- [43] M. Zhang, J. Wei, H. Jiang, K. J. Chen and C. H. Cheng, "A New SiC Trench MOSFET Structure With Protruded p-Base for Low Oxide Field and Enhanced Switching Performance," in *IEEE Transactions on Device and Materials Reliability*, vol. 17, no. 2, pp. 432-437, June 2017. (二区)
- [44] M. Zhang, J. Wei, H. Jiang, K. J. Chen and C. Cheng, "SiC trench MOSFET with self-biased p-shield for low RON-SP and low OFF-state oxide field," in *IET Power Electronics*, vol. 10, no. 10, pp. 1208-1213, June 2017. (四区)
- [45] J. Wei, M. Zhang, H. Jiang, C. -H. Cheng and K. J. Chen, "Low ON-Resistance SiC Trench/Planar MOSFET With Reduced OFF-State Oxide Field and Low Gate Charges," in *IEEE Electron Device Letters*, vol. 37, no. 11, pp. 1458-1461, Nov. 2016. (二区)
- [46] H. Jiang, J. Wei, X. Dai, M. Ke, I. Deviny and P. Mawby, "SiC Trench MOSFET With Shielded Fin-Shaped Gate to Reduce Oxide Field and Switching Loss," in *IEEE Electron Device Letters*, vol. 37, no. 10, pp. 1324-1327, Oct. 2016. (二区)
- [47] J. Wei, H. Jiang, Q. Jiang and K. J. Chen, "Proposal of a GaN/SiC Hybrid Field-Effect Transistor for Power Switching Applications," in *IEEE Transactions on Electron Devices*, vol. 63, no. 6, pp. 2469-2473, June 2016. (二区)
- [48] H. Jiang, M. Ke, Y. Sharma, X. Dai, I. Deviny and C. Zheng, "Optimum Design of 4H-SiC Junction Barrier Schottky Diode with Consideration of the Anisotropic Impact Ionization," in *Materials Science Forum*, vol. 858, pp. 745-748, May 2016.
- [49] X. Deng, C. Rao, J. Wei, H. Jiang, M. Chen, X. Wang and B. Zhang, "High Voltage SiC JBS Diodes with Multiple Zone Junction Termination Extension Using Single Etching Step," in *Materials Science Forum*, vol. 778-780, pp. 808-811, Feb. 2014.
- [50] H. Jiang, B. Zhang, W. Chen, Z. Li, C. Liu, Z. Rao and B. Dong, "A Snapback Suppressed Reverse-Conducting IGBT With a Floating p-Region in Trench Collector," in *IEEE Electron Device Letters*, vol. 33, no. 3, pp. 417-419, March 2012, (二区)
- [51] H. Jiang, J. Wei, B. Zhang, W. Chen, M. Qiao and Z. Li, "Band-to-Band Tunneling Injection Insulated-Gate Bipolar Transistor with a Soft Reverse-Recovery Built-In Diode," in *IEEE Electron Device Letters*, vol. 33, no. 12, pp. 1684-1686, Dec. 2012. (二区)
- [52] H. Jiang, B. Zhang, C. Liu, W. Chen, Z. Rao and B. Dong, "Experimental study of the anode injection efficiency reduction of 3.3-kV-class NPT-IGBTs due to backside processes," in *Journal of Semiconductors*, vol. 33, no. 2, pp. 41-44, Feb. 2012. (三区)
- [53] H. Jiang, W. Chen, C. Liu, Z. Rao, B. Dong and B. Zhang, "Design and optimization of linearly graded-doping junction termination extension for 3.3-kV-class IGBTs," in *Journal of Semiconductors*, vol. 32, no. 12, pp. 72-75, Dec. 2011. (三区)
- [54] J. Fang, H. Jiang, M. Qiao, B. Zhang and Z. Li, "A Static-State Model of NPT-IGBTs with Localized Lifetime Control," in *Journal of Semiconductors*, vol. 27, pp. 857-863, May 2006. (三区)

13.2. 会议论文

- [1] X. Zhong, L. Tang, H. Jiang and Y. Xie, "Short-term Recovery of Silicon Carbide Power MOSFET Threshold Voltage," *2024 6th International Conference on Energy, Power and Grid (ICEPG)* pp. 1006-1009, 2024.
- [2] H. Mao, H. Jiang, L. Ran, H. Chen, Y. Xie and M. Yang, "Electrical and Thermal Performances of IGCT in High Voltage DC Circuit Breaker," *2022 2nd International Conference on Electrical Engineering and Control Science (IC2ECS)*, pp. 75-79, 2022.
- [3] H. Mao, H. Jiang, G. Qiu, Y. Zhang, X. Zhong, H. Feng and L. Ran, "Single-Pulse Avalanche Failure Characterization of Single and Paralleled SiC MOSFETs," *2021 IEEE Workshop on Wide Bandgap Power Devices and Applications in Asia (WiPDA Asia)*, pp. 467-471, 2021.
- [4] X. Jiang, H. Jiang, H. Yu, J. Jiang, H. Feng, H. Mao, L. Tang, X. Zhong and L. Ran, "Impact of Gate Resistances on Switching-on Behaviors of Si/SiC Hybrid Switch," *2021 IEEE Workshop on Wide Bandgap Power Devices and Applications in Asia (WiPDA Asia)*, pp. 478-482, 2021.
- [5] L. Tang, H. Jiang, H. Mao, Z. Wu, X. Zhong, X. Qi and L. Ran, "The Influence of Dynamic Threshold Voltage Drift on Third Quadrant Characteristics of SiC MOSFET," *2021 IEEE Workshop on Wide Bandgap Power Devices and Applications in Asia (WiPDA Asia)*, pp. 483-487, 2021.
- [6] Z. Wu, H. Jiang, X. Qi, H. Mao, S. Niu, S. Niu, L. Tang and L. Ran, "A dv/dt Control Strategy of SiC MOSFET for Turn-off Loss Reduction within Entire Operational Power Range," *2021 IEEE International Conference on Electrical Engineering and Mechatronics Technology (ICEEMT)*, pp. 424-428, 2021.
- [7] C. Xu, X. Zhong, H. Jiang, G. Qiu, L. Tang and L. Ran, "Impact of Duty Cycle and Junction Temperature on Dynamic Threshold Drift of SiC MOSFET," *2021 4th International Conference on Energy, Electrical and Power Engineering (CEEPE)*, pp. 347-350, 2021.
- [8] J. Hu, G. Qiu, W. Wang, L. Ran, K. Ma and H. Jiang, "An On-line Capacitor Condition Monitoring Method Based on Switching Frequencies For Modular Multilevel Converters," *2021 4th International Conference on Energy, Electrical and Power Engineering (CEEPE)*, pp. 183-187, 2021.
- [9] Z. Zheng, W. Shao, H. Jiang and L. Ran, "A Single-Phase Direct AC-AC Converter Using SiC Devices for Inherent Power Factor Correction Capability," *2021 IEEE 12th Energy Conversion Congress & Exposition - Asia (ECCE-Asia)*, pp. 1344-1349, 2021.
- [10] G. Qiu, L. Ran, H. Jiang, T. Long, A. Forsyth and W. Shao, "A Method for Detecting DC Bias in Transformer of Dual Active Bridge DC-DC Converter," *2021 IEEE 12th Energy Conversion Congress & Exposition - Asia (ECCE-Asia)*, pp. 714-719, 2021.
- [11] H. Mao, H. Jiang, J. Hu, L. Ran, Y. Wu, Z. Lv and D. Yang, "Asymmetrical Power Module for Modular Multilevel Converter with Lower Power Loss and Peak Junction Temperature," *2021 IEEE 12th Energy Conversion Congress & Exposition - Asia (ECCE-Asia)*, pp. 644-649, 2021.
- [12] X. Fang, H. Jiang, X. Wang, W. Shao, H. Ren, L. Ran and H. Mao, "Reliability Enhancement of Power Modules by Restricting Junction Temperature Fluctuation through Increased Transient Thermal Capacity," *2020 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 4024-4028, 2020.
- [13] H. Ren, G. Hao, W. Shao, L. Ran, L. Zhou, P. Mawby and H. Jiang, "Thermal Buffering Effect

- of Phase Change Material on Press-pack IGBT during Power Pulse," *2019 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 4937-4943, 2019.
- [14] W. Shao, R. Wu, L. Ran, H. Jiang, T. Coombs, K. Yardley, P. Mawby, D. Kastha and P. Bajpai, "Enhanced Over-current Capability and Extended SOA of Power Modules Utilizing Phase Change Material," *2019 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 5315-5320, 2019.
- [15] J. Wei, M. Zhang, H. Jiang, B. Li, Z. Zheng and K. J. Chen, "Investigations of p-Shielded SiC Trench IGBT with Considerations on IE Effect, Oxide Protection and Dynamic Degradation," *2019 31st International Symposium on Power Semiconductor Devices and ICs (ISPSD)*, pp. 199-202, 2019.
- [16] J. Wei, M. Zhang, H. Jiang, S. To, S. Kim, J. -Y. Kim and K. J. Chen, "SiC trench IGBT with diode-clamped p-shield for oxide protection and enhanced conductivity modulation," *2018 IEEE 30th International Symposium on Power Semiconductor Devices and ICs (ISPSD)*, pp. 411-414, 2018.
- [17] W. Shao, L. Ran, Z. Zeng, R. Wu, P. Mawby, H. Jiang, D. Kastha, P. Bajpai, "Power Module with Large Short Term Current Capability by Using Phase Change Material," *2018 14th IET International Conference on AC and DC Power Transmission (ACDC)*, pp. 3225-3229, 2018.
- [18] W. Shao, L. Ran, Z. Zeng, R. Wu, P. Mawby, H. Jiang, D. Kastha and P. Bajpai, "Power Modules for Pulsed Power Applications Using Phase Change Material," *2018 Second International Symposium on 3D Power Electronics Integration and Manufacturing (3D-PEIM)*, pp. 1-6, 2018.
- [19] X. Li, H. Jiang, B. Hu, H. Chen, Z. Zeng, L. Ran and P. Mawby, "Electro-Thermal Limited Switching Frequency for Parallel Diodes," *2018 IEEE Energy Conversion Congress and Exposition (ECCE)*, pp. 4692-4698, 2018.
- [20] H. Jiang, J. Wei, X. Dai, C. Zheng, M. Ke, X. Deng, Y. Sharma, I. Deviny and P. Mawby, "SiC MOSFET with built-in SBD for reduction of reverse recovery charge and switching loss in 10-kV applications," *2017 29th International Symposium on Power Semiconductor Devices and IC's (ISPSD)*, pp. 49-52, 2017.
- [21] J. Wei, Y. Wang, M. Zhang, H. Jiang and K. J. Chen, "High-speed power MOSFET with low reverse transfer capacitance using a trench/planar gate architecture," *2017 29th International Symposium on Power Semiconductor Devices and IC's (ISPSD)*, pp. 331-334, 2017.
- [22] J. Wei, M. Zhang, H. Jiang, H. Wang and K. J. Chen, "Charge storage effect in SiC trench MOSFET with a floating p-shield and its impact on dynamic performances," *2017 29th International Symposium on Power Semiconductor Devices and IC's (ISPSD)*, pp. 387-390, 2017.
- [23] X. Dai, H. Jiang, C. Zheng and M. Ke, "SiC Power MOSFET with Monolithically Integrated Schottky Barrier Diode for Improved Switching Performances," *PCIM Europe 2017; International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management*, pp. 1-4, 2017.
- [24] H. Jiang, J. Wei, X. Dai, M. Ke, C. Zheng and I. Deviny, "Silicon carbide split-gate MOSFET with merged Schottky barrier diode and reduced switching loss," *2016 28th International Symposium on Power Semiconductor Devices and ICs (ISPSD)*, pp. 59-62, 2016.
- [25] J. Wei, H. Jiang, Q. Jiang and K. J. Chen, "Proposal of a novel GaN/SiC hybrid FET (HyFET) with enhanced performance for high-voltage switching applications," *2016 28th International*

- Symposium on Power Semiconductor Devices and ICs (ISPSD)*, pp. 99-102, 2016.
- [26] M. Ke, D. Li, X. Dai, H. Jiang, I. Deviny, H. Luo and G. Liu, "Improved surge current capability of power diode with copper metallization and heavy copper wire bonding," *2016 18th European Conference on Power Electronics and Applications (EPE'16 ECCE Europe)*, pp. 1-6, 2016.
- [27] K. Mao, M. Qiao, L. Jiang, H. Jiang, Z. Li, W. Chen, Z. Li and B. Zhang, "A 0.35 μm 700 V BCD technology with self-isolated and non-isolated ultra-low specific on-resistance DB-nLDMOS," *2013 25th International Symposium on Power Semiconductor Devices & IC's (ISPSD)*, pp. 397-400, 2013.
- [28] W. Chen, J. Zhang, B. Zhang, H. Jiang and Z. Li, "The SuperJunction MOS-controlled thyristor (SJ-MCT) with low power loss for high-power switching applications," *2012 IEEE 11th International Conference on Solid-State and Integrated Circuit Technology*, pp. 1-3, 2012.
- [29] H. Jiang, B. Zhang, W. Chen, C. Liu, Z. Rao and B. Dong, "A Snapback Suppressed Reverse Conducting IGBT with Oxide Trench Collector," *2012 Asia-Pacific Power and Energy Engineering Conference*, pp. 1-4, 2012.
- [30] H. Jiang, B. Zhang, W. Chen, Z. Li, C. Zheng, C. Liu, Z. Rao and B. Dong, "A simple method to design the single-mask multi-zone junction termination extension for high-voltage IGBT," *2012 24th International Symposium on Power Semiconductor Devices and ICs*, pp. 173-176, 2012.
- [31] M. Qiao, Y. He, H. Wen, X. Zhou, L. Jiang, H. Jiang, X. Luo, Z. Li, B. Zhang, Z. Chen, Y. Su, Z. Xiao and C. Wang, "High-voltage thin layer SOI technology for negative power supply," *2012 24th International Symposium on Power Semiconductor Devices and ICs*, pp. 201-204, 2012.

13.3. 专利

- [1] 蒋华平,廖瑞金,肖念磊. 一种用于阈值电压稳定性评估的测试电路及其工作方法:CN118671541A [P],2024. (实审)
- [2] 蒋华平,廖瑞金,肖念磊. 一种测试电路及其工作方法: CN118655438A [P],2024. (实审)
- [3] 蒋华平,廖瑞金,汤磊.一种抑制并联器件阈值分散性增加的匹配方法: CN117316799A [P],2023. (实审)
- [4] 蒋华平,廖瑞金,赵柯.一种防止温漂的 MOS 器件栅极驱动方法及驱动电路: CN117200770A [P],2023. (实审)
- [5] 蒋华平,廖瑞金,胡浩伟,肖念磊.一种用于功率器件的 dv/dt 耐受能力测试电路及方法: CN116840648A [P],2023. (实审)
- [6] 蒋华平,廖瑞金,钟笑寒,谢宇庭,汤磊,赵柯,肖念磊. 多工作模式电路的控制装置及其控制方法: CN116743138A [P],2023. (授权)
- [7] 蒋华平,廖瑞金,戚晓伟,钟笑寒,汤磊,赵柯,肖念磊. 绝缘栅型半导体器件的阈值电压恢复方法及相关产品: CN116743134A [P],2023. (授权)
- [8] 蒋华平,廖瑞金,戚晓伟. MOS 型半导体器件的阈值电压稳定性测试方法、测试设备:CN116203370 A[P],2023. (实审)
- [9] 蒋华平,廖瑞金,赵柯. MOS 型半导体器件的栅极驱动电路和电力变换装置:CN 116436450A [P],2023. (授权)
- [10] 蒋华平,廖瑞金,肖念磊. MOS 型半导体器件阈值电压稳定测试方法和系统:CN 116359695A [P],2023. (授权)

- [11] 蒋华平,廖瑞金,汤磊. MOS 型半导体器件测试设备:CN 116520114A [P],2023. (实审)
- [12] 蒋华平,廖瑞金,胡浩伟,钟笑寒,汤磊,肖念磊,赵柯.一种通过调节栅极电压提高功率器件过载的栅极驱动电路:CN 116366044A [P],2023. (授权)
- [13] 蒋华平,廖瑞金,胡浩伟,钟笑寒,汤磊,肖念磊,赵柯.一种通过降低栅极电阻提高功率器件过载的栅极驱动电路:CN 116317480A [P],2023. (实审)
- [14] 蒋华平,廖瑞金,谢宇庭,钟笑寒,汤磊,赵柯,肖念磊.导通压降检测电路、设备和电力变换装置:CN 116718884A [P],2023. (授权)
- [15] 刘立,蒋华平,冉立.一种电机控制器寿命评估方法:CN 115600423B [P],2022. (授权)
- [16] 蒋华平,廖瑞金,肖念磊. MOS 型半导体器件的阈值电压稳定性测试方法、测试设备:CN 116068354A[P],2022. (授权)
- [17] 蒋华平,廖瑞金,黄诣涵.MOS 型半导体器件的阈值电压稳定性测试电路: CN116224003A[P],2022. (授权)
- [18] 蒋华平,冉立,廖瑞金,魏镜枫.一种基于衬底凹槽设计的高过载能力功率模块:CN 116230659A [P],2022. (实审)
- [19] 蒋华平,冉立,廖瑞金,魏镜枫.一种基于芯片顶部金属块设计的高过载能力功率模块:CN 115863279A [P],2022. (实审)
- [20] 蒋华平,吴泽兵,许超,刘立,冉立.一种基于器件开关电压变化率直接检测的动态调控电路及方法:CN115021739A[P],2022. (实审)
- [21] 蒋华平,许超,吴泽兵,刘立,戚晓伟.一种抑制过冲尖峰的 SiC MOSFET 驱动电路:CN115173676B[P],2022. (授权)
- [22] 毛嫄,蒋华平,冉立等.功率半导体结构及断路器转移支路组件:CN112968007A[P],2021. (授权)
- [23] 任海,冉立,刘立,蒋华平.一种压接型功率半导体结构及其内部压力在线测量方法:CN113834527A[P],2021. (实审)
- [24] 任海,冉立,蒋华平,刘立,王小勇.压接型功率半导体模块结构及其子单元和制作方法:CN113066785A[P],2021. (实审)
- [25] 刘立,冉立,蒋华平,王小勇.一种基于光纤光栅传感器的 IGBT 结温监测系统:CN112731095B[P],2020. (授权)
- [26] 周敬森,魏金萧,谢刚文,冉立,张友强,蒋华平等.基于数字孪生技术的交直流混合电网全域实时模拟方法:CN112531694B[P],2020. (授权)
- [27] 刘立,冉立,蒋华平,王小勇.基于光纤光栅传感器的电动汽车 IGBT 健康监测系统:CN112578255B[P],2020. (授权)
- [28] 蒋华平,冉立.功率半导体模块结构:CN110379787A[P],2019. (失效)
- [29] 高云斌,李诚瞻,赵艳黎,陈喜明,蒋华平等.碳化硅 MOSFET 器件及其制备方法:CN107275393A[P],2017. (失效)
- [30] 赵艳黎,李诚瞻,高云斌,蒋华平等.一种沟槽栅碳化硅 MOSFET 器件及其制造方法:CN109698237A[P],2017. (实审)
- [31] 陈万军,李震洋,蒋华平等.一种逆导型 MOS 栅控晶闸管及其制作方法:CN105679819B[P],2016. (授权)
- [32] 郑昌伟,蒋华平,戴小平.短沟道半导体功率器件及其制备方法:CN107799592B[P],2016. (授权)
- [33] H. Jiang, M. Ke, I. Deviny and J. Wei. A power MOSFET with an integrated Schottky diode:GB2569497B[P],2016. (PCT 有效期满)
- [34] H. Jiang, M. Ke, I. Deviny and J. Wei. A SiC trench transistor:GB2548126A[P],2016. (PCT

有效期满)

- [35] 赵艳黎,刘可安,李诚瞻,高云斌,蒋华平等.一种碳化硅 MOS 器件及其制造方法:CN104282765B[P],2015. (授权)
- [36] 李诚瞻,吴煜东,赵艳黎,蒋华平等.一种新型碳化硅 MOSFET 及其制造方法:CN104282766A[P],2015. (失效)
- [37] 赵艳黎,刘国友,李诚瞻,高云斌,蒋华平等.一种新型碳化硅 MOSFET 及其制造方法:CN104319292A[P],2015.
- [38] 吴佳,吴煜东,刘可安,李诚瞻,史晶晶,蒋华平等.半导体器件耐压终端结构及其应用于 SiC 器件的制造方法:CN104882357A[P],2015. (失效)
- [39] 李诚瞻,刘可安,吴煜东,杨勇雄,史晶晶,蒋华平等.肖特基势垒二极管及其制造方法:CN104576762B[P],2015. (授权)
- [40] 蒋华平,戴小平,郑昌伟.一种功率半导体器件及其制作方法:CN105514155A[P],2015. (实审)
- [41] 蒋华平,刘可安,吴煜东等.一种碳化硅功率器件结终端的制造方法:CN103824760B[P],2014. (授权)
- [42] 李诚瞻,吴煜东,刘可安,周正东,史晶晶,杨勇雄,吴佳,蒋华平等.一种大电流碳化硅 SBD/JBS 功率芯片结构及其制造方法: CN103579016B[P],2014. (授权)
- [43] 蒋华平,刘可安,吴煜东,李诚瞻,赵艳黎,吴佳,唐龙谷.一种功率器件结终端结构与制造方法:CN103824879B[P],2014. (授权)
- [44] 杨勇雄,吴煜东,何多昌,蒋华平等.一种碳化硅功率器件结终端结构及其制造方法:CN103824878B[P],2014. (授权)
- [45] 陈万军,蒋华平,章晋汉,张波.一种无 snapback 效应的逆导型绝缘栅双极晶体管:CN103022089A[P],2012. (实审)