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ASIA
电能驱动新未来
28 – 30 August 2024
Hall 11, Shenzhen World Exhibition & Convention Center, Shenzhen, China

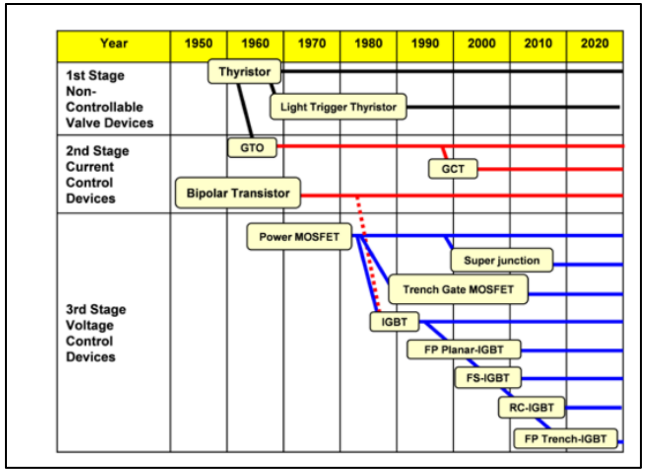
PCIM Conference Record

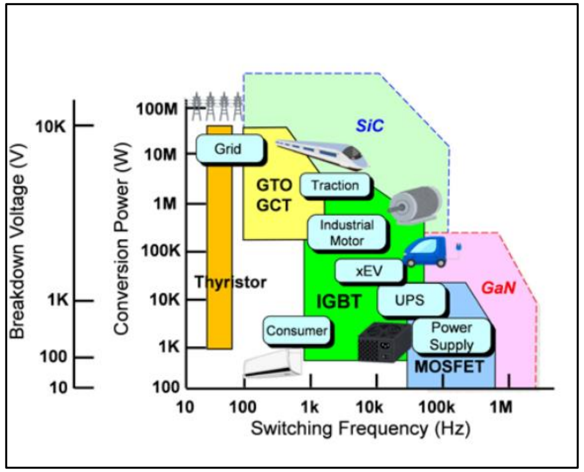
Wenjie Xu

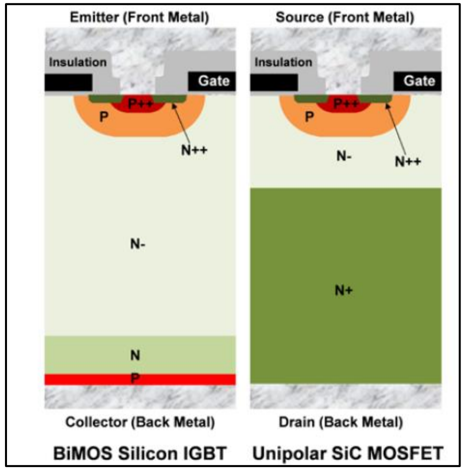
09/2024

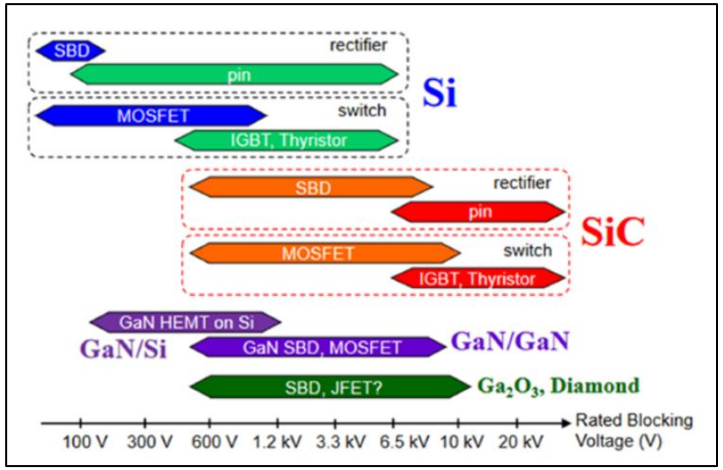
The Hong Kong Polytechnic University
香港理工大學

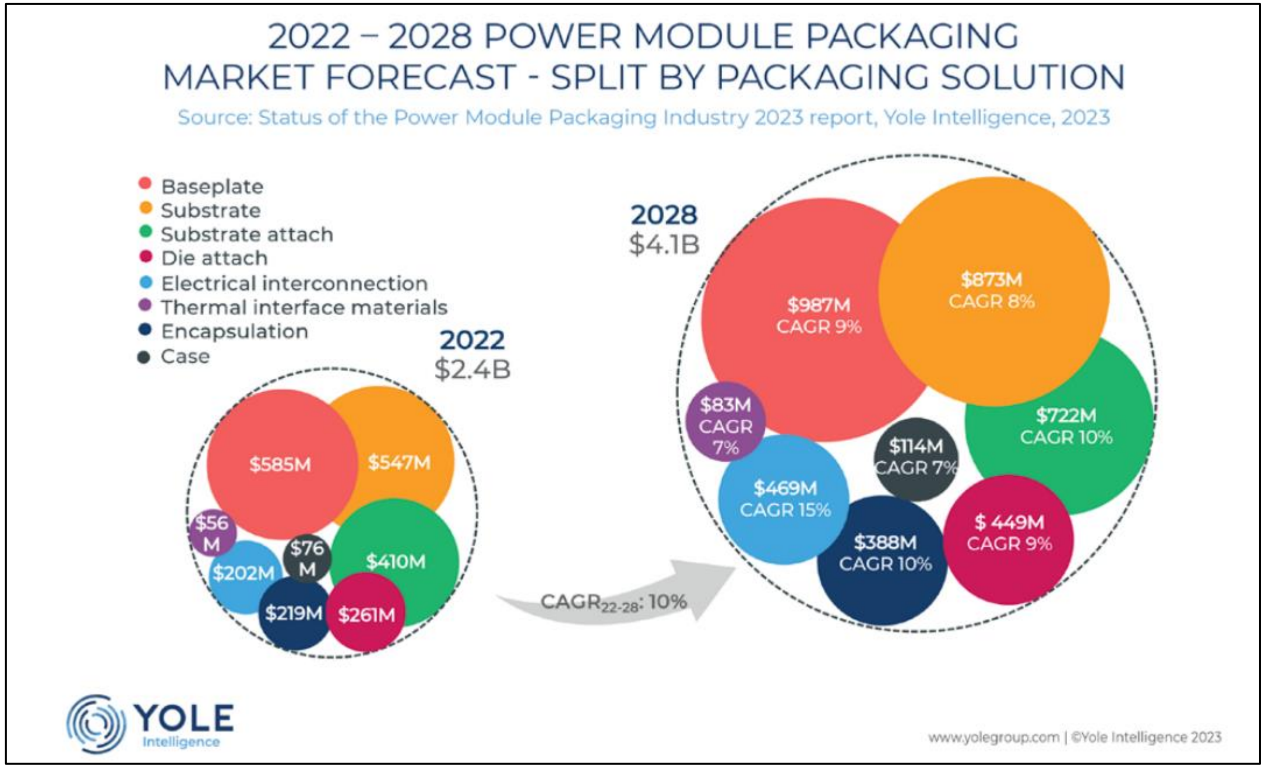
“Power semiconductors for an energy-wise society” IEC 白皮书

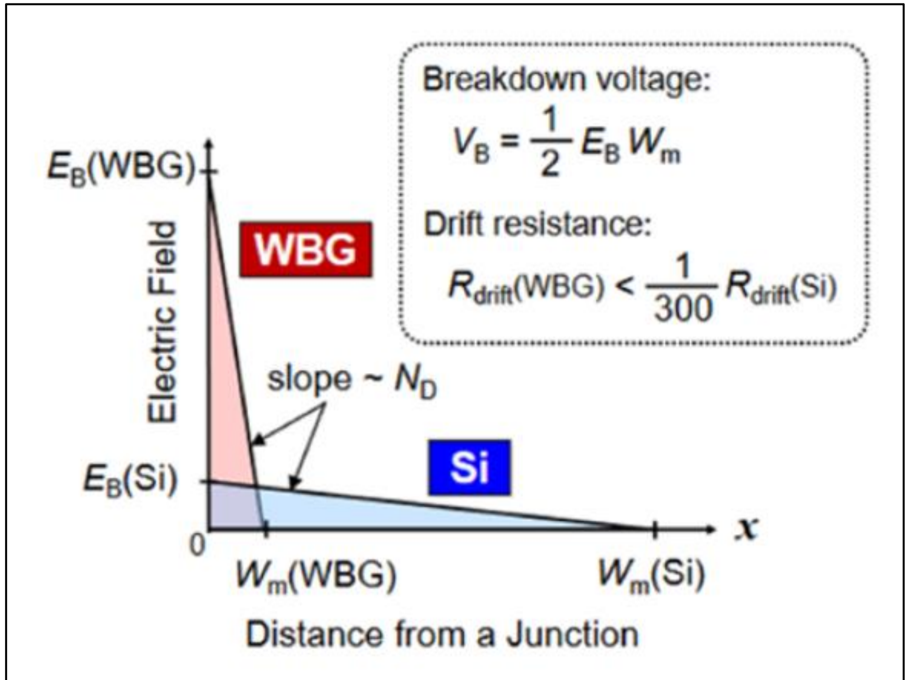












WBG Semiconductor

iec_wp_power_semiconducto

Power Brain – AI tool: Design automation for power converters

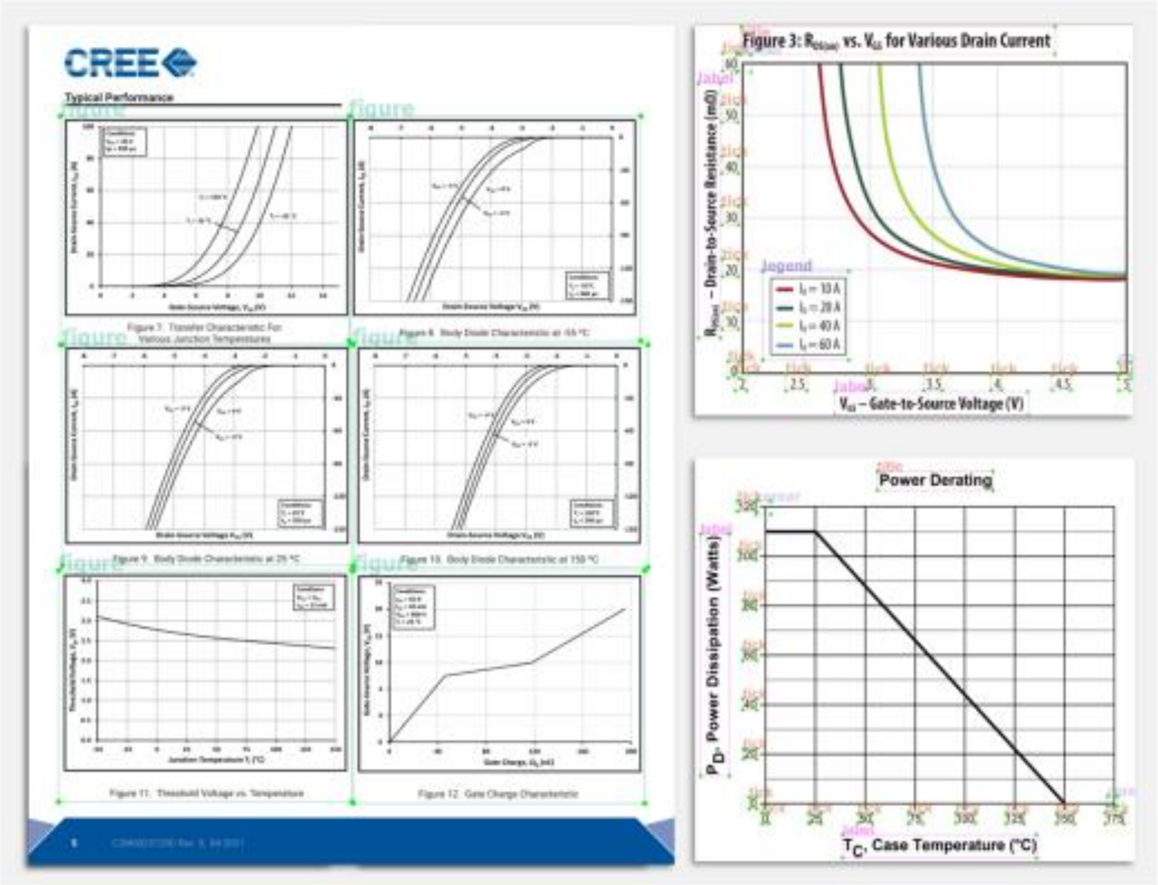


Fig. 2: Examples of the annoated PDF page and figures for object detection algorithm.

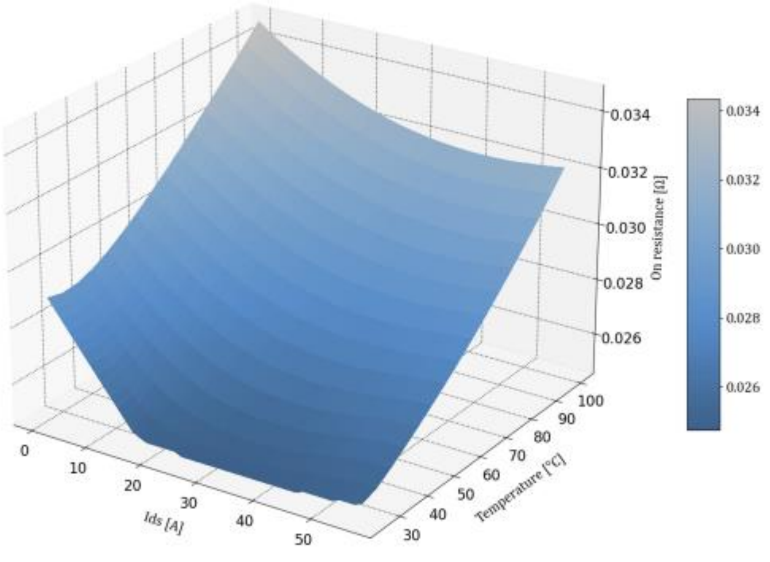


Fig. 7: An interpolation map of on-resistance.

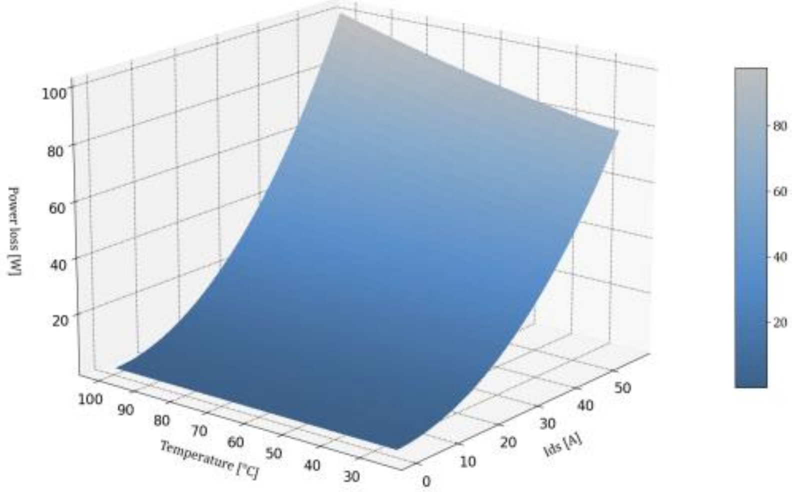


Fig. 8: An look-up table on conduction losses.

KU LEUVEN

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University Scientist Award
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14360 IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 38, NO. 11, NOVEMBER 2023

Magnetically Controlled Transformer With Variable Turns Ratio and Low Series Inductance: Analysis and Implementation Toward Its Application in SMPS

Camilo Suarez Buitrago, Diego Bernal Cobaleda, *Student Member, IEEE*, and Wilmar Martinez, *Senior Member, IEEE*

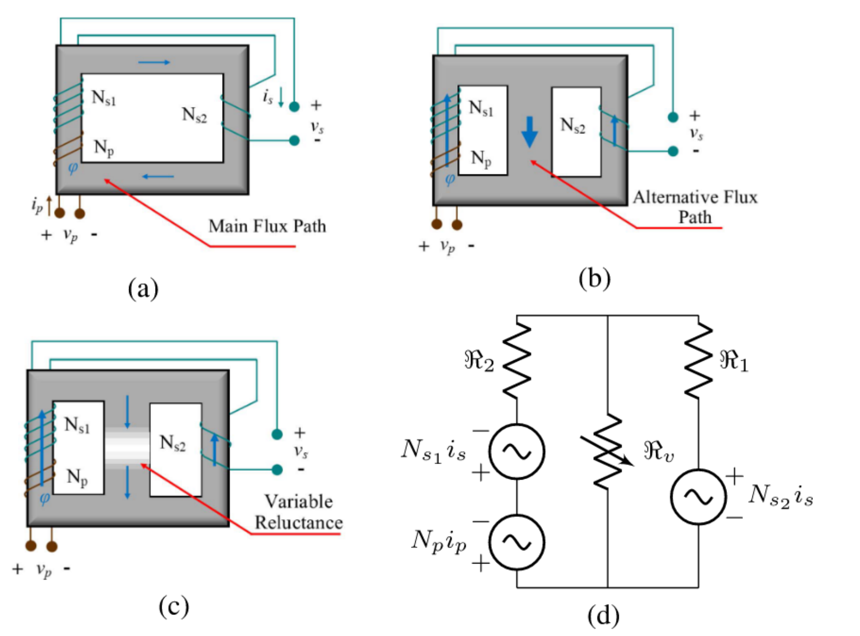
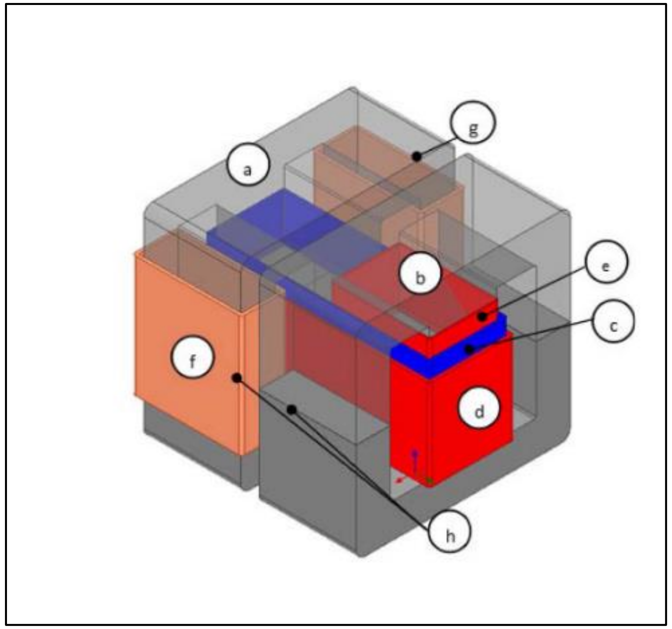
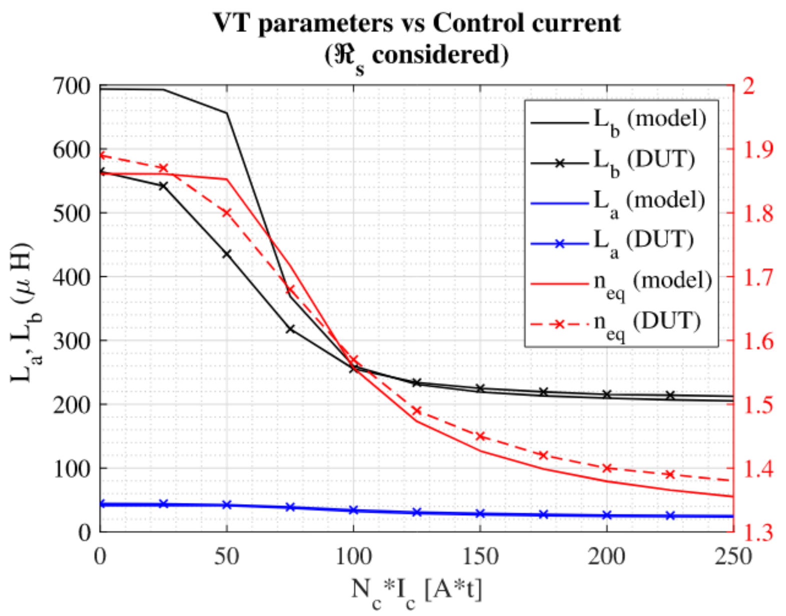
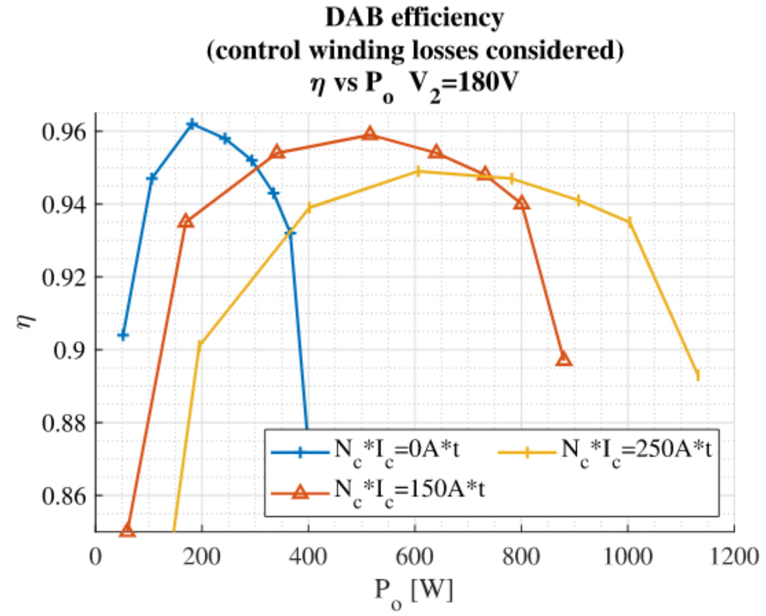


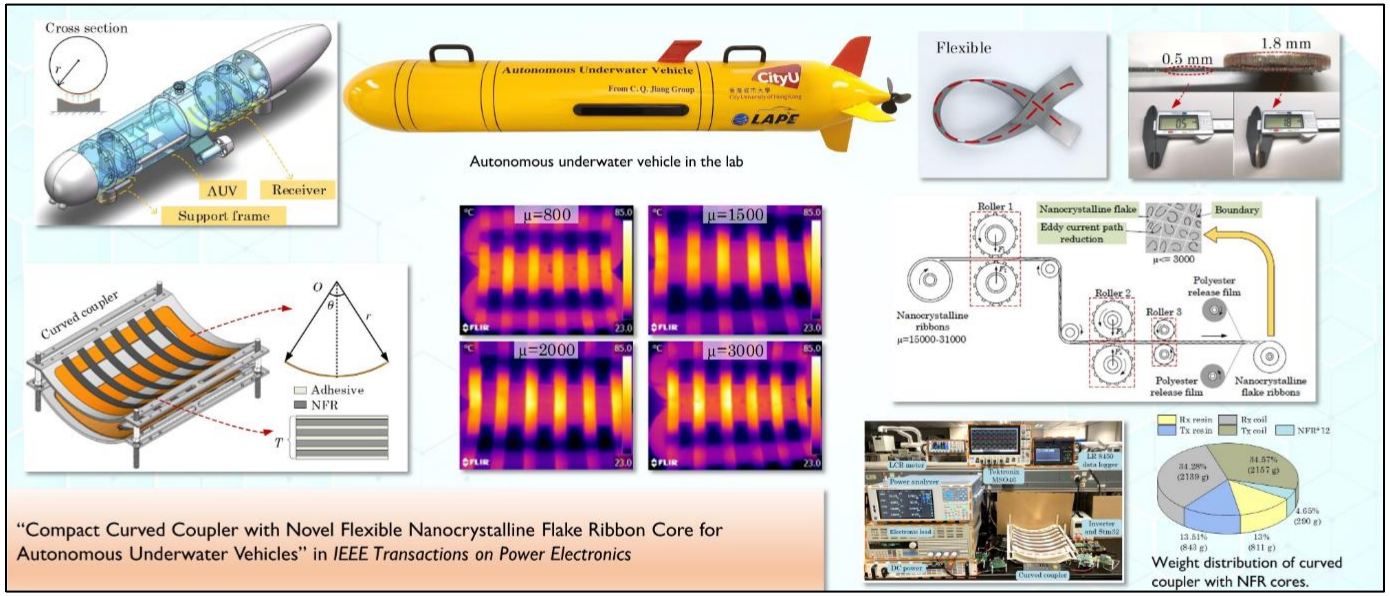
Fig. 1. VT principle of operation. (a) Transformer $N_p : (N_{s1} - N_{s2})$. (b) Transformer $N_p : N_{s1}$. (c) Variable reluctance. (d) Magnetic circuit.

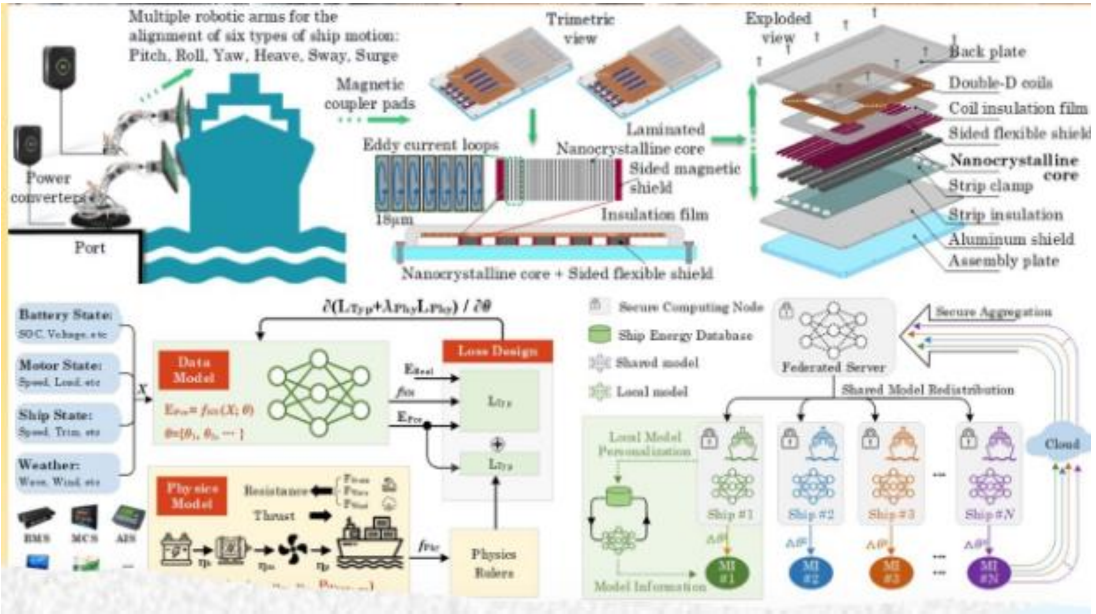


Double E–E core VT structure isometric view.

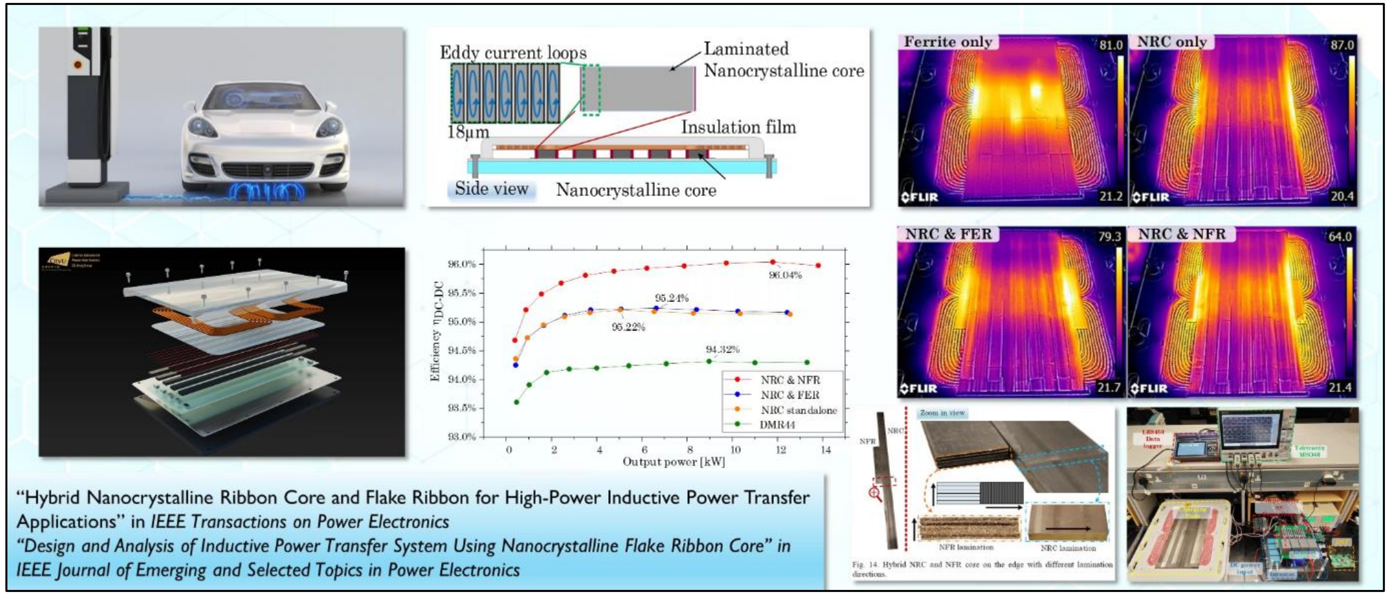








水下机车的柔性纳米晶片状带芯，IET



高功率无线充电的混合纳米晶代芯分析

PC: C. Jiang (CityU)

Power electronics, transport electrification

Trained HKU, Cambridge U

2 book chapters, 60 papers, 15 patents

- Winner of Acorn Blue Sky Research, Cambridge University
- Silver Award in Youth Innovation
- Gold Medal in Asia Exhibition

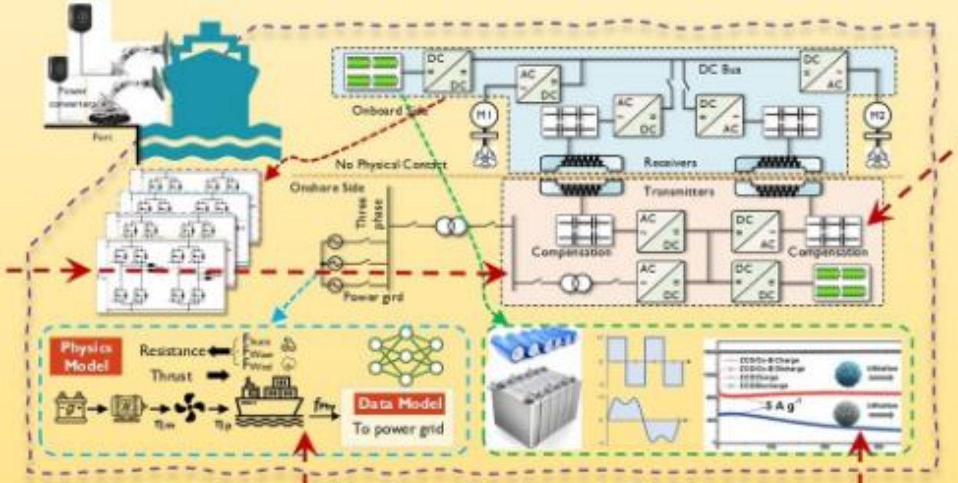
Co-PI: C. Tse (CityU)

Nonlinear circuits and systems, smart grid

Associate Vice-President, Innovation & Enterprise

Director, CityU Academy of Innovation

- IEEE CASS Charles A. Desoer Technical Achievement Award
- Grand Prize & Gold Medal, Silicon Valley International Invention Festival
- Best Paper Awards in IEEE Trans.



Multi-port Wireless Dock and Charge System

Co-PI: Y. Wang (HKU)

Energy forecasting, multi-energy systems

Trained Tsinghua U, ETH Zürich

2 books, 100 papers

- HKU Scholar in Top 1%
- IEEE IAS Ralph Lee Prize Paper Award
- IEEE Trans. on Smart Grid Best Paper (1st)

Co-PI: X. Yu (PolyU)

Electrochemical energy storage, lithium battery

Trained Tsinghua U, Japan National Institute

- Best Presentation in Graphene Forum
- Excellent Oral Presentation in Tsinghua

香港城市大學
City University of Hong Kong
Professional · Creative For The World

CRF 2023/24 Yong Collaborative Research Grant （4.7 Million HKD）

清华大学-直流研究中心

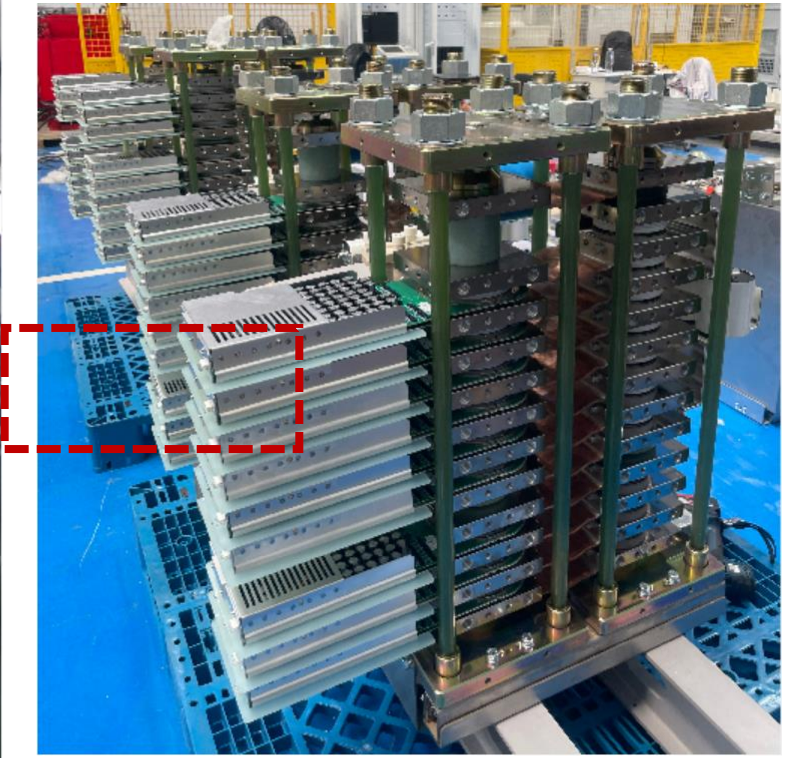
直流研究中心
DC Research Center

8000V/5500A
双向阻断 IGCT-Plus 器件

关键参数		
V_{DRM}/V_{RRM}	8000	V
I_{TGQM}	5500	A
I_{TSM}	40	kA
V_{TO}	1.23	V
r_T	0.27	mΩ

IGCT(集成门极换流晶闸管)

IGCT-MMC阀塔



IGCT-串联ANPC模块

清华大学支直流研究中心：
定制化IGCT器件技术，支流开端技术，功率变换技术，系统分析和控保技术

IGCT技术优势：
大容量，高可靠，高效率，低成本，高密度

Validating 1% safe operation of overvoltage for GaN HEMTs*

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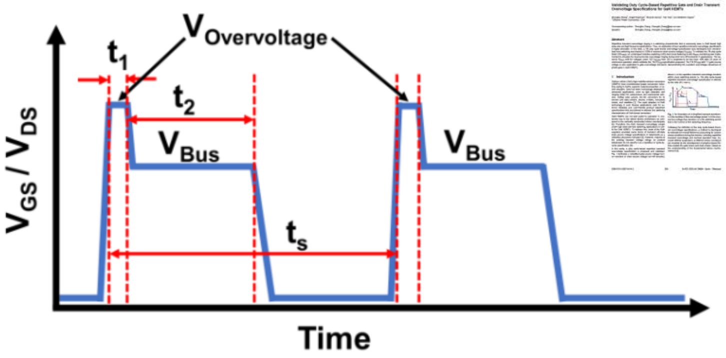
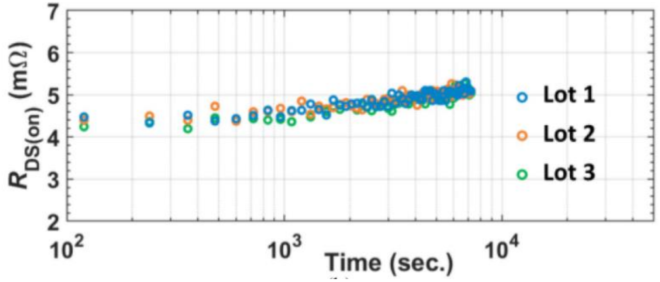




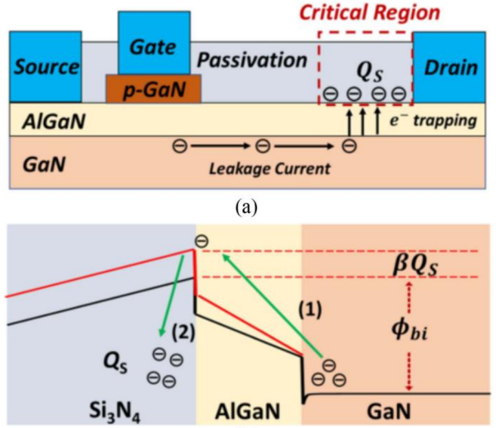


Fig. 5. (a) Illustration of the trapping process in the DUT; the interface electron trapping occurs mainly in the critical high-field region near the drain contact. (b) Illustration of the 1-D trapping model in the vertical direction near the drain. The energy barrier is lifted up when additional electrons get trapped.

Repetitive transient overvoltage ringing

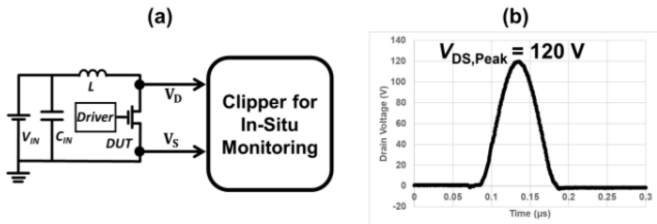


Fig. 4. (a) Schematics of the unclamped inductive switching circuit with *in-situ* $R_{DS(on)}$ monitoring; (b) the measured drain overvoltage waveform with a $V_{DS,Peak}$ of 120 V.

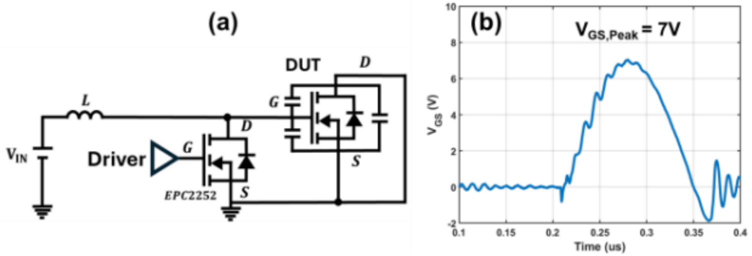


Fig. 8. (a) Schematics of the gate UIS test circuit; (b) the measured gate overvoltage waveform with a $V_{GS,Peak}$ of 7 V.

Fig. 9 and 10 show the excellent overvoltage robustness of the pGaN gate in GaN HEMTs, which also validates the applicability of the 1% duty cycle-based repetitive transient overvoltage specification for the gate.

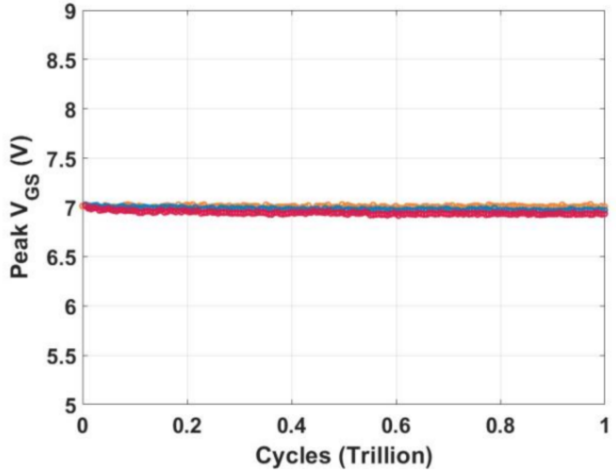


Fig. 9. *In-situ* 7 $V_{DS,Peak}$ monitoring during 1 trillion overvoltage pulses of three EPC2057 GaN transistors, where no measurable $V_{GS,Peak}$ degradation is seen.

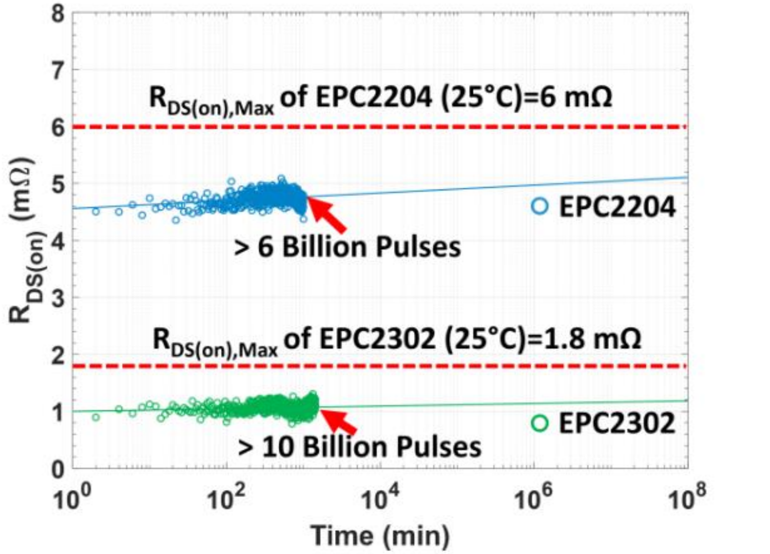


Fig. 6. Evolution of $R_{DS(on)}$ shift of a representative EPC2204 and EPC2302 DUTs under 120 $V_{DS,Peak}$ UIS testing.

IGBT discrete thermal resistance network Tvj

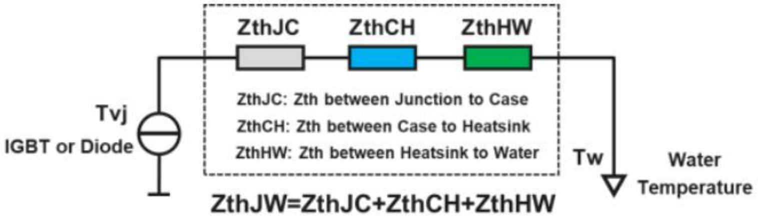


Fig.1 Typical Thermal Network of ZthJW

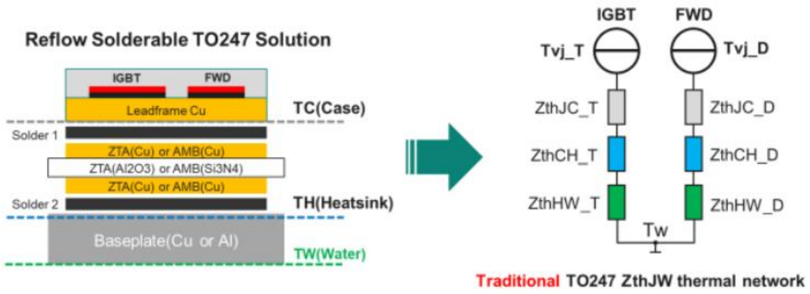


Fig.3. Traditional TO247 ZthJW Thermal Network

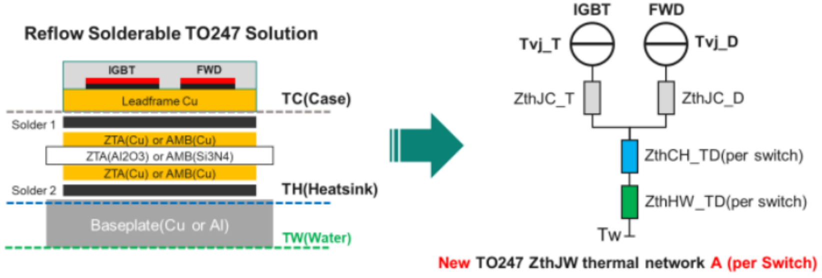


Fig.6. New TO247 ZthJW Thermal Network A (per switch)

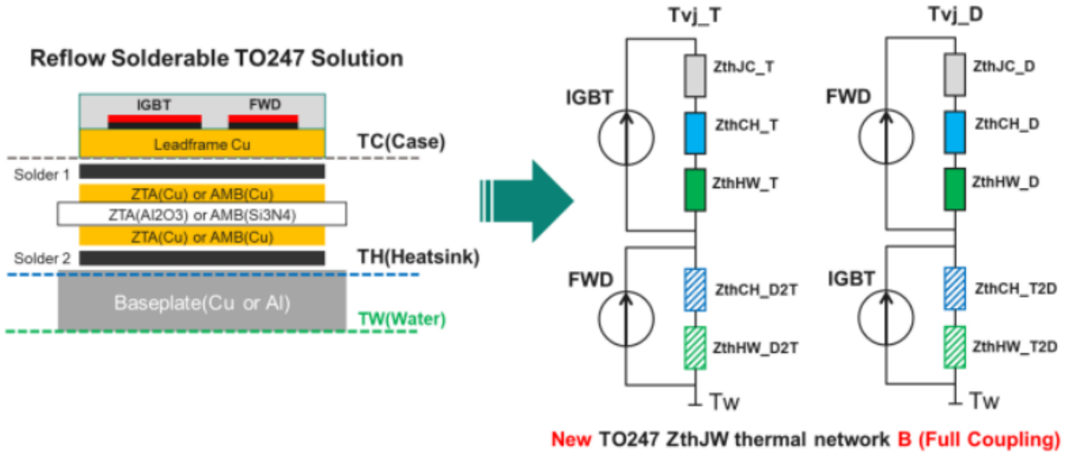
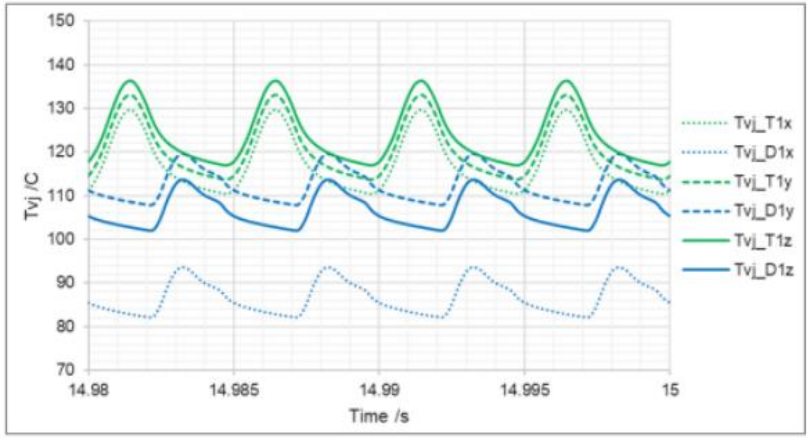


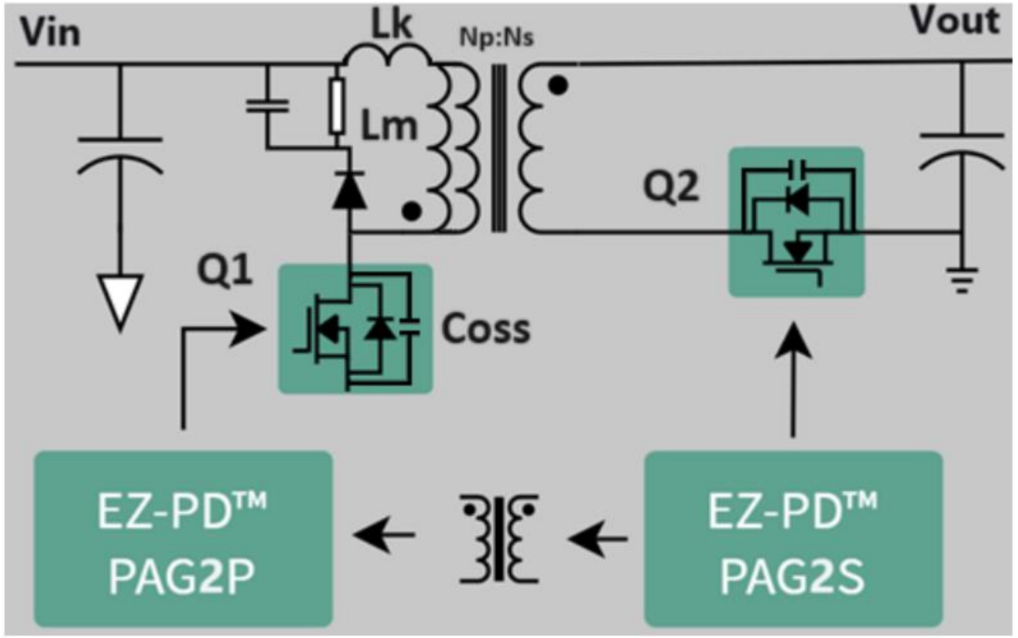
Fig.7. New TO247 ZthJW Thermal Network B (full coupling)

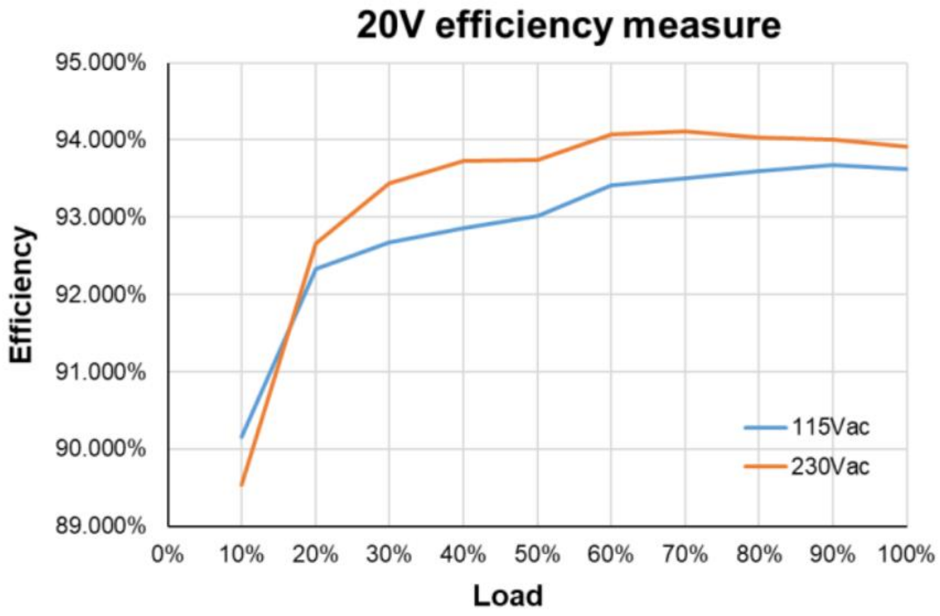
- **Condition 1**
- Vdc=480Vdc
- Fsw=8kHz
- Fout=200Hz
- Modi=0.9
- **PF= +0.85**
- Io=160Arms
- Rg=5Ohm
- Tw=65C

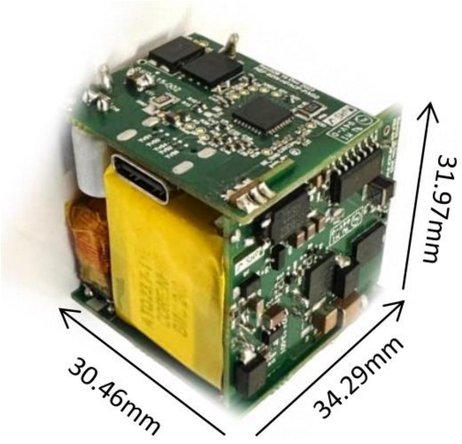


比较分析了不同热阻模型的准确度

High Power Density ZVS Flyback Converter (GaN) *







USB-PD 66W,
1.89kW/L
Efficiency = 93%

- AC input voltage: 90~264Vac
- USB PD output:
  - 5V3A,9V3A,15V3A,20V3.25A PDO,
  - 3.3~21V3.25A PPS
- Transformer
  - Core: ECW23.7F/12.8 DMR96
  - Inductance Lm: 210uH
  - Np: 18T 0.1*20
  - Ns: 3T 0.1*80
  - Lk: 3uH
- Q1: CoolGaN IGLD60R190D1AUMA1
  - Vds:600V
  - Rdson: 190mΩ
  - Coss: 32.5pF
  - Qg: 3.2nC
- Q2: OptiMOS™ 5 BSC050N10NS5
  - Vds:100V
  - Rdson: 5mΩ
  - Coss: 490pF
  - Qg: 49nC
- Controller: CYPAP212A1, CYPAS211A1

High Power Density ZVS Flyback Converter

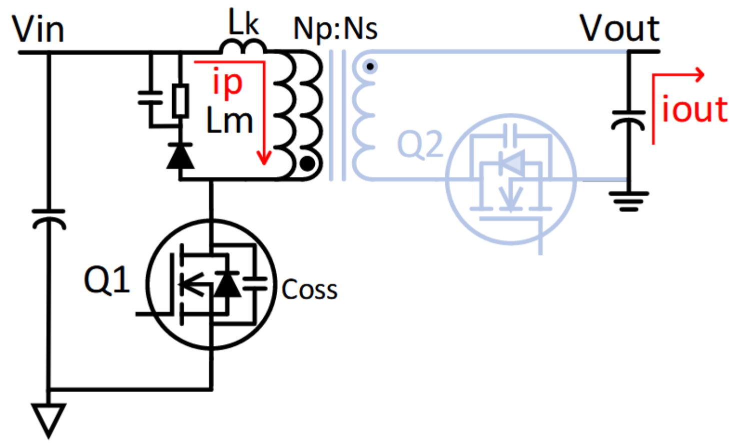


Fig. 3. Equivalent circuit in Primary Energy Storage Stage

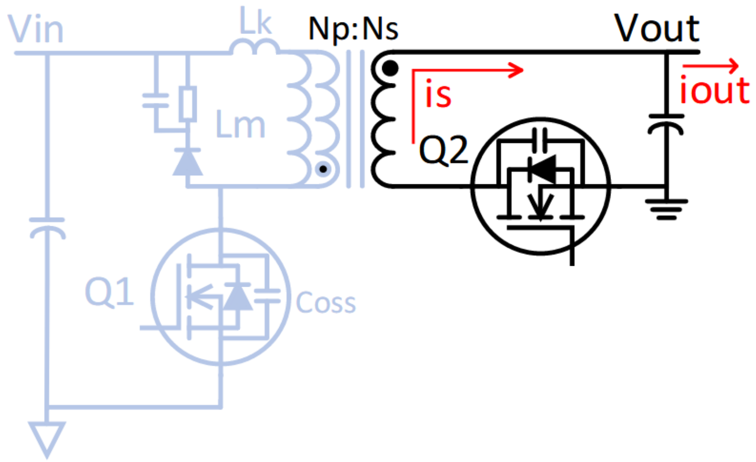
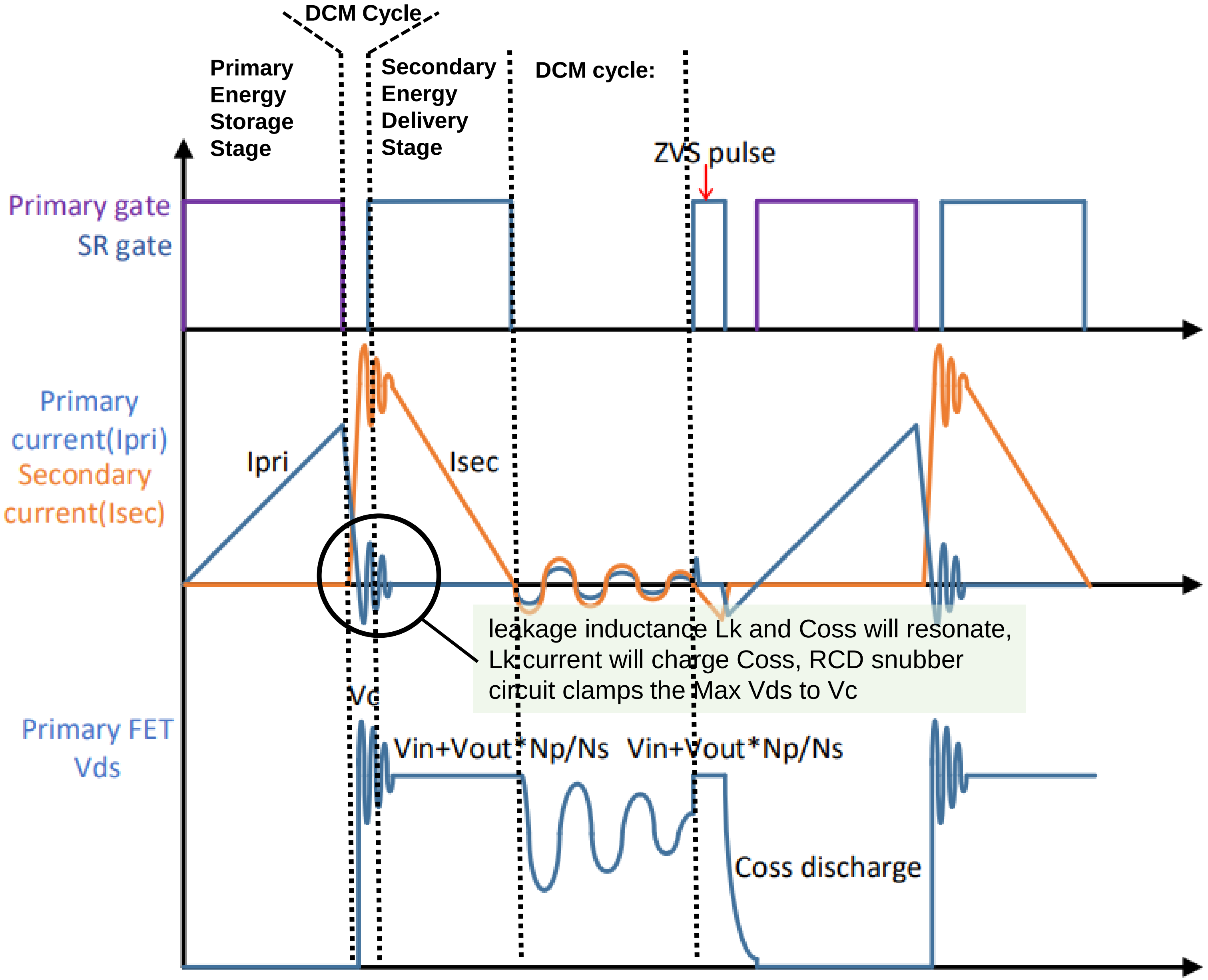


Fig. 5. Equivalent circuit in Secondary Energy Delivery Stage



High Power Density ZVS Flyback Converter

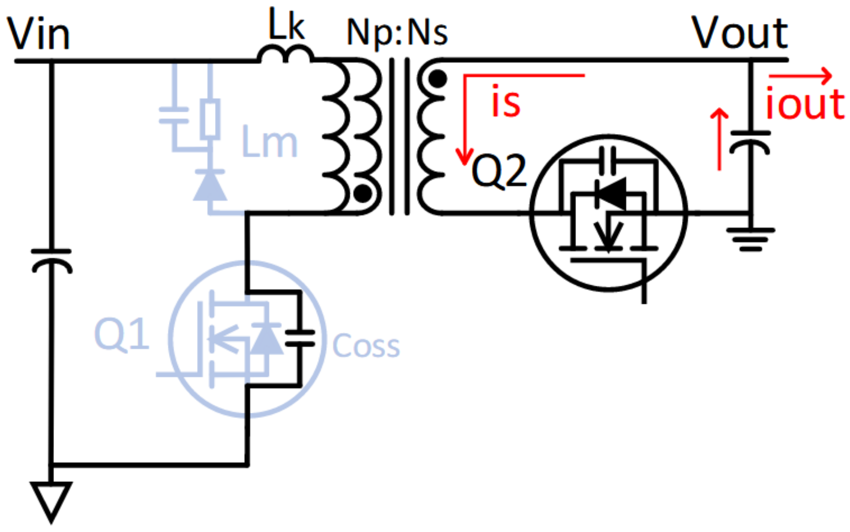


Fig. 8. Equivalent circuit in ZVS pulse

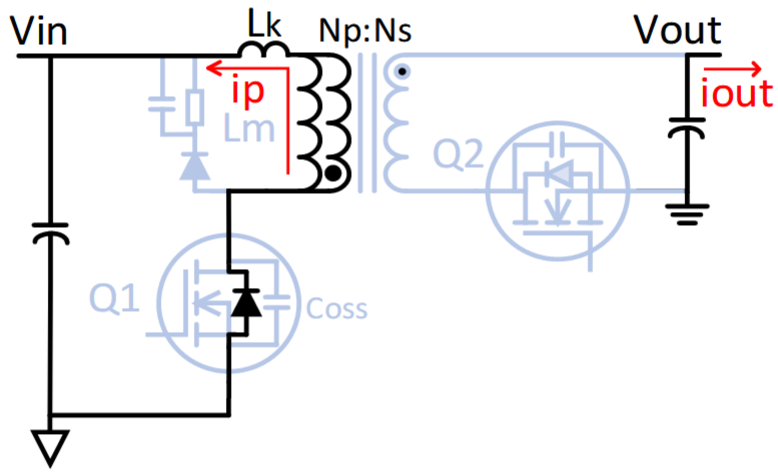
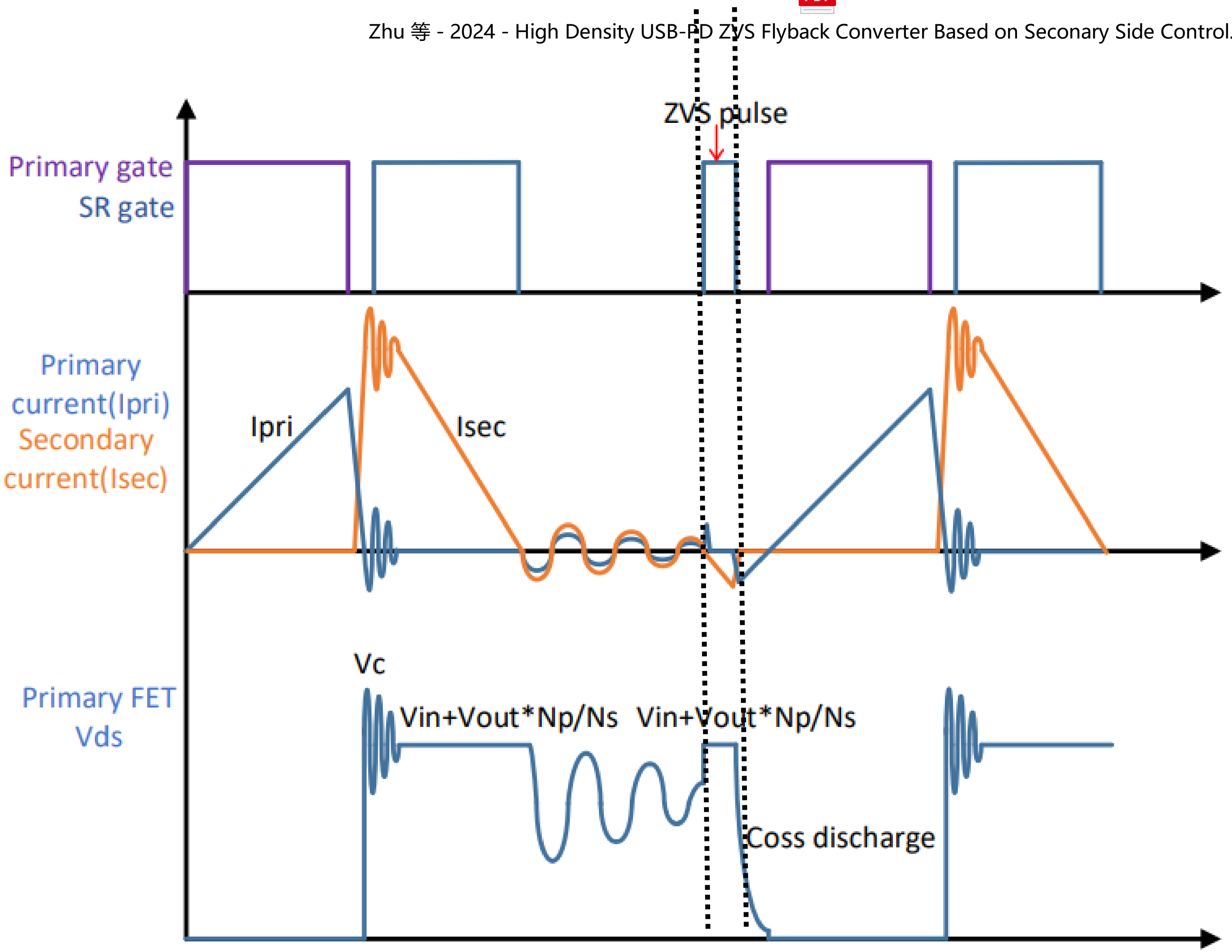


Fig. 10. Equivalent circuit in primary ZVS implementation stage

Zhu 等 - 2024 - High Density USB-PD ZVS Flyback Converter Based on Seconary Side Control.pdf



Cold spray : Cooling of Devices with hybrid Al&Cu

Fig. 1. Cold sprayed hybrid-heat sinks.

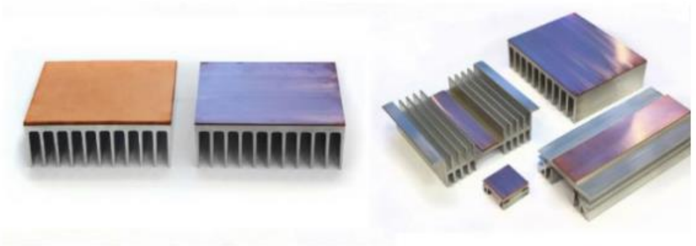


Fig. 2. Cold sprayed hybrid-heat sinks.

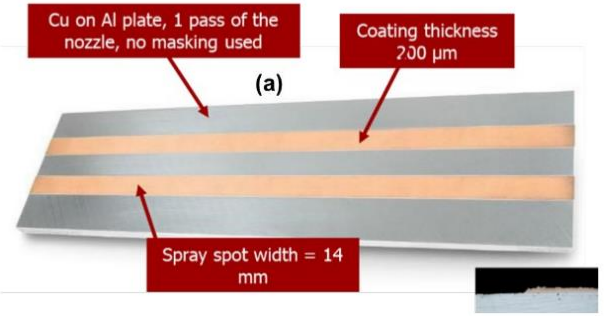
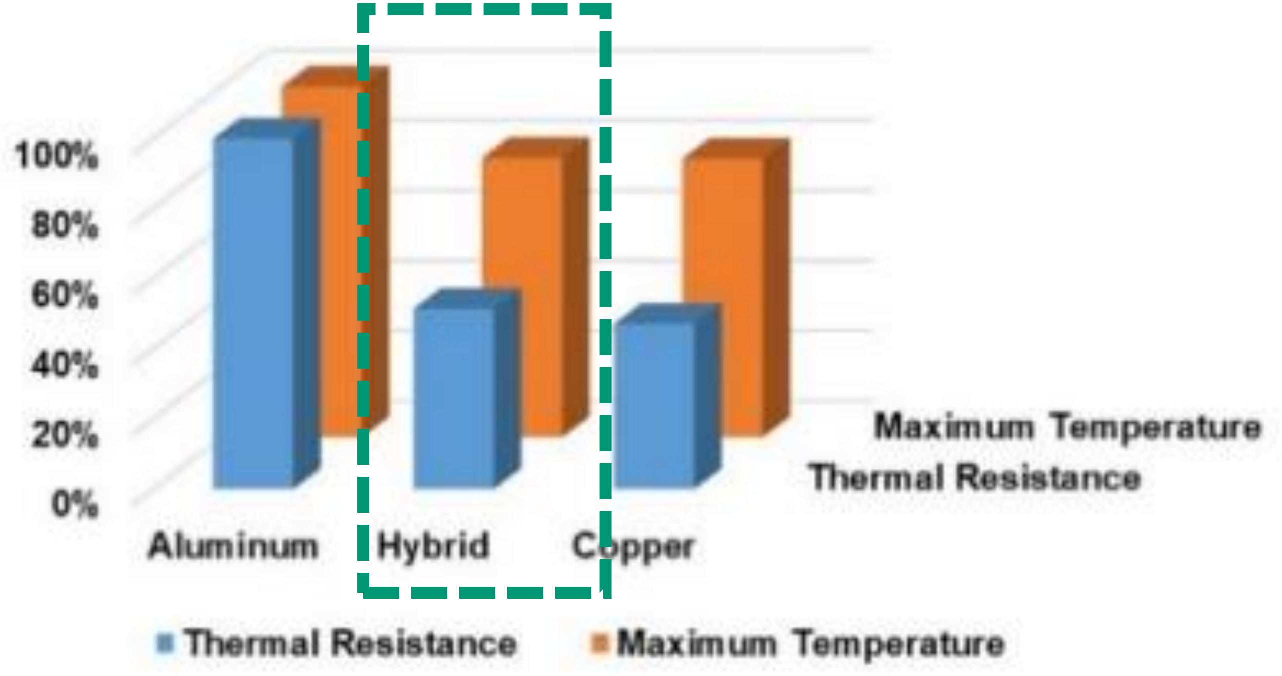


Fig. 2 (a) Cold Spray deposited Cu contact tracks on Aluminum



The results illustrate that the properties of **cold-sprayed Cu** in the as-sprayed state are comparable with bulk-Cu with **98% IACS electrical conductivity** and thermal conductivity of **368 W/mK**. Perfectly gas-tight Cu-deposits with a He-leakage rate smaller than **1×10-7 mbar-l/s** have been produced.

Thanks

09/2024

Reference：

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學