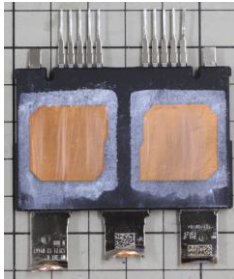
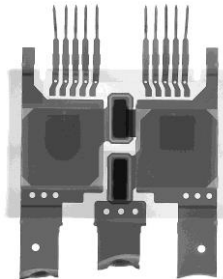


SiC MOSFET (650V): Denso (equipped in LEXUS "RZ450e") Inverter module SiC MOSFET Structure, Process analysis Reports.



Power card appearance



Power card X-ray view



SiC MOSFET die

Introduction

- Toyota Lexus has announced the new model "RZ", a fully electric battery EV (BEV) car model.
- The car adopts two motors (e-Axel), and the inverter of the rear unit is equipped with Denso's SiC MOSFET.

Product features

This transistor is the largest SiC MOSFET in production (~80mm²) today.

Estimated to be able to deliver 200A current at 650V rating, implemented in Denso's 2nd generation trench gate SiC MOSFET. (The first generation was adopted in the 2021 MIRAI FC converter).

- The SiC transistor integrates a current and a temperature sensor.
- Compared to other manufacturers, it uses a relatively thick gate oxide film and a large chip size. These are thought to be for reliability considerations.

Report content (Refer to Table of Contents in next pages)

(1) SiC MOSFET structural analysis report

- Package observation, chip observation
- SiC MOSFET plane analysis: Wiring connection, layout
- SiC MOSFET cross-sectional analysis: cell part, die edge part,
*including cell part cross-sectional TEM structural observation.

(2) Option analysis:

- SiC MOSFET cross-sectional SCM * + line analysis: channel, JFET, Epi layer, Buffer layer
(*) SCM: Scanning Capacitance Microscopy

(3) SiC MOSFET process analysis report

- Estimation of manufacturing process flow and consideration of critical processes
- Evaluation of electrical characteristics, relationship between electrical characteristics and device structure
- Comparison with MIRAI-equipped DENSO, ROHM, Wolfspeed, Infineon, SiC transistors.

Please contact us for report pricing.

(1) Structural analysis report

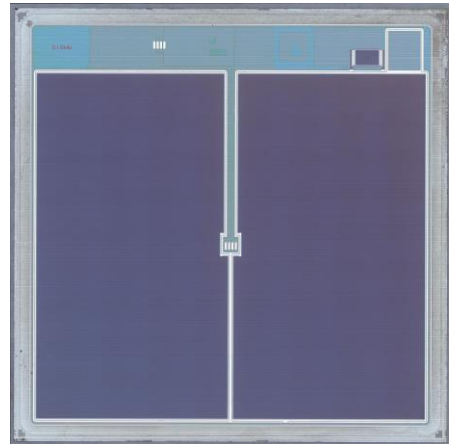
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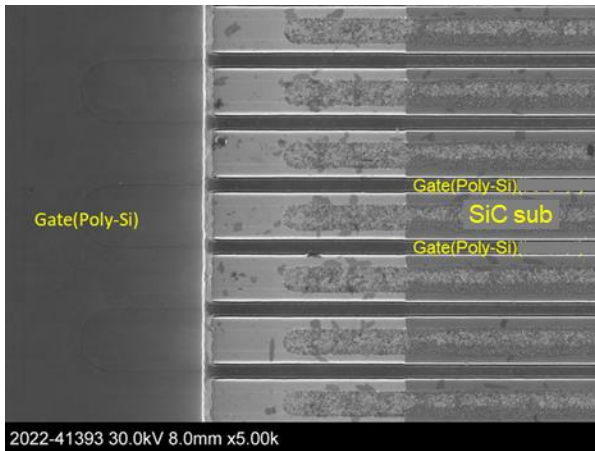
Excerpt from structure analysis report (1)



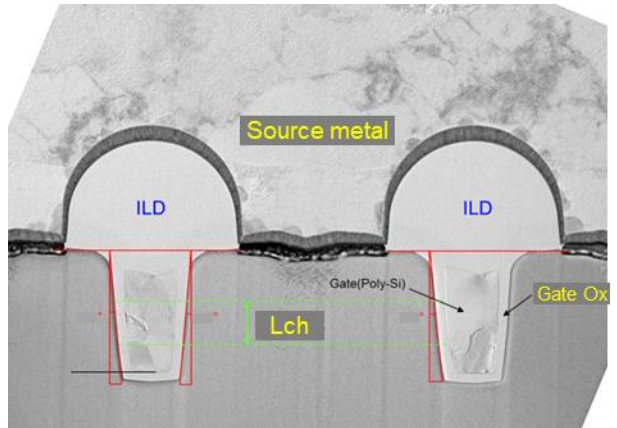
SiC MOSFET die (Top Metal layer)



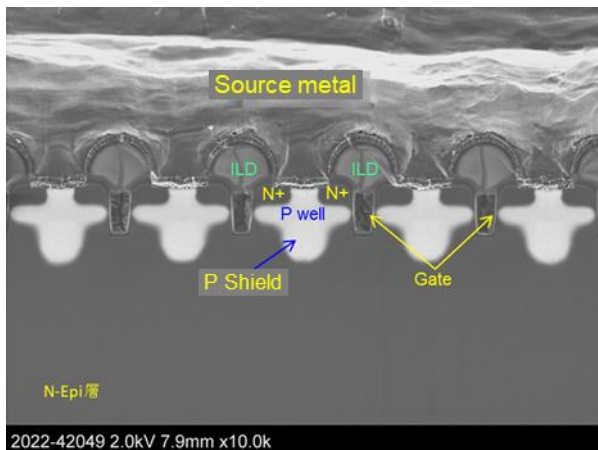
SiC MOSFET die (Poly-Si layer)



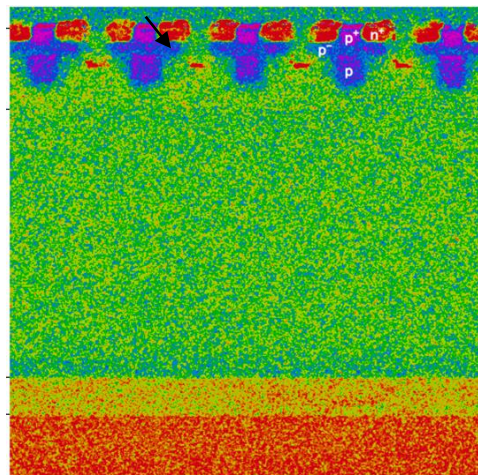
Cell array plane SEM image (Poly-Si layer)



Cell part cross-sectional TEM image



Cell array cross-sectional SEM image



Cell array SCM image (Option)

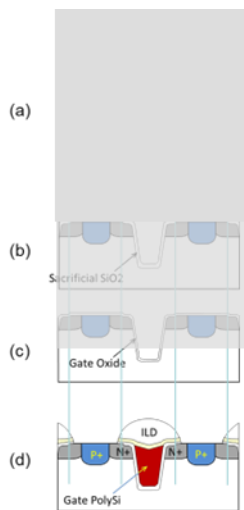
(2) Process analysis report

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Excerpt from process analysis report

1-1. Comparison of characteristics between DENSO's products and other companies' SiC-MOSFETs

Maker	Part no.	Process Gen	Production	Vdss [V]	RON [mΩ]	Die size [mm x mm]	Die area [mm ²]	Intrinsic RONxA [mΩ·mm ²]
ROHM	SCH2080KE	Gen 2	2012	1200	80			
ROHM	SCT3080KL/HR	Gen 3	2016	1200	80			
ROHM	SCT4062KR	Gen 4	2022	1200	62			
WOLFSPEED	C3M0075120K	Gen 3	2017	1200	75			
ON-SEMI	NVHL080N120SC1	Gen 1	2018	1200	80			
INFINEON	AIMW120R060M1H	Gen 1+	2020	1200	60			
TOSHIBA	TW070J120B	Gen 2 *	2020	1200	70			
TOSHIBA	TW060N120C	Gen 3 *	2022	1200	60			
DENSO	MIRAI FC Converter	Gen 1	2021					
DENSO	LEXUS Motor Inverter	Gen 2	2023					



SiC MOSFET Process flow sequence

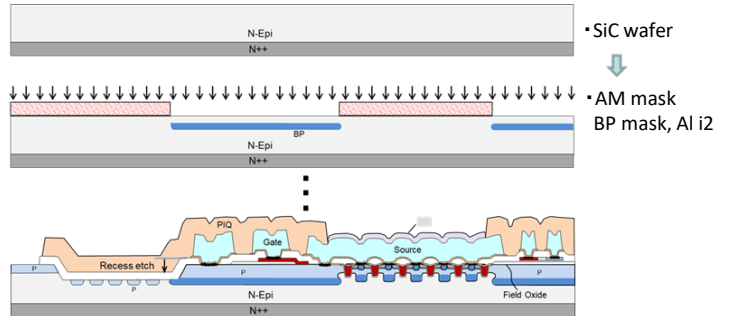
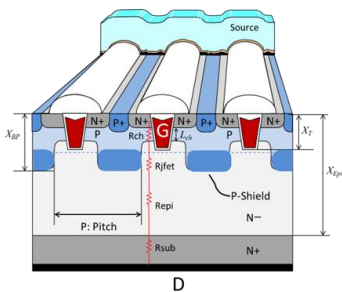


Fig. 2-2-1 Trench formation process flow



D

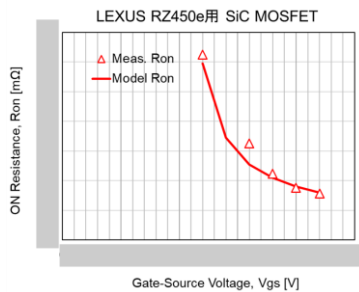


Fig.5-4-2: Measured (marked with a triangle) and model calculated RON dependence on Gate-source voltage V_{gs}.

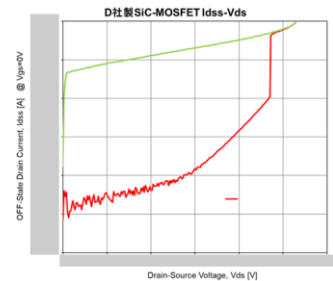


Fig.5-5-2 Measured I_{dss}-vs-Drain voltage (V_{ds}) and extracted breakdown voltage BV_{dss}