VARIABLE CHANNEL DOPING IN VERTICAL TRANSISTOR

A method for growing vertical power transistors with gradual doping, allowing for simultaneous reduction in resistance (Ron) and increase in breakdown voltage (BV) that can improve the performance of power electronic circuits by 2-4 X without additional costs or modifications.

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IP Position:
Patent Pending

Development Status:
TRL 3: Concept demonstrated on lab platform - analytical models to support lab design

Opportunity
Partners sought for development and prototype testing.

Category(s):
Power Electronics, Semiconductor Devices, Power Conversion, Energy Efficiency, Electrical Power Systems

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Inventor(s):
Hiu Yung Wong

Contact Information:
Sandeep Mukkamala
Intellectual Property Specialist
Sandeep.Mukkamala@sjsu.edu
408-924-5462

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Technology Overview

This technology involves the implementation of gradual doping in vertical power transistors to significantly improve the performance of power electronic circuits without requiring additional cost or complex modifications. Variable channel doping in vertical transistors, such as in a gradual channel doping Silicon Carbide (SiC) MOSFET, reduces reduction in resistance (Ron) and increases breakdown voltage (BV) of the transistors at the same time. High BV is desired for reliability/safety and the lower on-state current is for reducing the conduction energy loss. The variation in doping is achieved using multiple implantations or in-situ doping during epitaxial growth.

Overall, the invention offers a practical and efficient solution for enhancing the performance of power transistors, which are crucial components in power converters and other critical power circuits.

Key Features & Benefits

- Improved performance by 2-4 X without significant additional cost or complex modifications.
- Variable doping is achieved through dopant precursor gas flow adjustment during epitaxial growth, providing a cost-effective solution without additional process modifications.
- Compatibility with existing technology allows for easy implementation by power electronic device companies and foundries.

Potential Applications

- Power electronic converters in electrical vehicles, power grids, data centers, and cell phone chargers.
- Integration into various power circuits for efficient energy processing.
- Wide adoption in industries where power transistors are used extensively, such as semiconductor foundries and power circuit companies.
- Suitable for vertical SiC trench MOSFET devices.

Fig 1.

Computer simulations show that using gradual channel doping SiC MOSFET/FinFET, the transistor current can increase by 2-4 times for the same BV