



## Low Barrier Height Resurf Structure For Efficient Power Diodes

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### BACKGROUND

Efficient power conversion relies on the use of power devices designed to minimize power consumption. Conventional power diodes exhibit a forward voltage drop in the forward bias and a reverse leakage current in the reverse bias, resulting in power dissipation during both operating states. PN-junction diodes typically have low reverse leakage current but exhibit a substantially higher turn-on voltage. Schottky barrier diodes (SBD) are unipolar devices that have a metal-semiconductor interface. They offer a lower turn-on voltage than PN-junction diodes, reducing the forward voltage drop. SBDs are also generally better at working at high frequency switching which can potentially reduce system complexities of power converters. However, conventional SBDs often exhibit significantly increased reverse leakage currents due to an enhanced electric field at the metal semiconductor junction leading to thermionic field emission.

### DESCRIPTION

Researchers at the University of California, Santa Barbara have designed a trench Schottky barrier diode featuring a high-k dielectric RESURF (reduced surface field) and a low work-function metal contact. By utilizing the trench geometry, the electric field at the metal/semiconductor junction is reduced and pushed deeper into the fin bottom. Incorporating the high-k dielectric enables the deposition of thicker dielectric material, enhancing the breakdown voltage while simultaneously reducing dielectric leakage, all without compromising the impact of RESURF. The decreased electric field at the metal/semiconductor junction allows for the use of a low work-function metal, reducing the turn-on voltage and consequently reducing the forward voltage drop. The high-k trench SBD has the potential to be employed in power converters capable of achieving very high-power efficiency by simultaneously reducing the forward voltage drop and reverse leakage current. The high-k trench SBD offers several key advantages including improved power efficiency, due to a reduction in both the forward voltage drop and reverse leakage current; faster switching, making it a viable alternative to traditional pn junction diodes for high-voltage high frequency switching applications; versatility and efficiency, leading to opportunities for a wide-range of applications; and reduced heat generation.

### ADVANTAGES

- ▶ Enhanced power efficiency, leading to lower energy loss and extended battery life
- ▶ Reduced heat generation, reducing the need for additional cooling mechanisms leading to lighter and potentially more cost-effective products
- ▶ Enhanced switching speed that facilitates the development of more efficient power converters
- ▶ Wide range of applications including power converters and voltage regulators

### APPLICATIONS

- ▶ Electronics
  - Power converters
  - Voltage regulators
  - Green tech

### PATENT STATUS

Patent Pending

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### OTHER INFORMATION

#### KEYWORDS

power conversion, power diode, semiconductors, voltage

#### CATEGORIZED AS

- ▶ **Semiconductors**
- ▶ Other

#### RELATED CASES

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