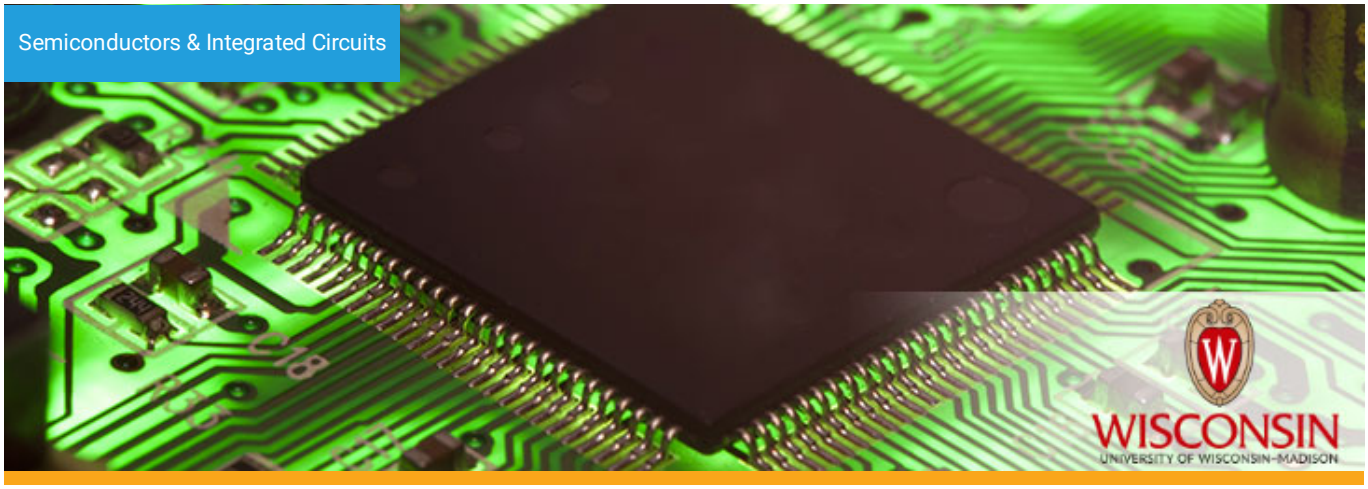
Semiconductors & Integrated Circuits



Boron-Doped Diamond for Next Generation Power Electronics

View U.S. Patent No. 9,605,359 in PDF format.

WARF: P140384US01

Inventors: Zhenqiang Ma, Jung-Hun Seo

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a new thermal diffusion method for doping diamond.

Overview

Diamond is considered a good material candidate for power electronics, offering reliability, low weight and power switching efficiency. Single-crystalline diamond (SCD) has the best overall properties and is expected to revolutionize electronics in the future.

Turning SCD into useful semiconductors requires doping, but conventional substitutional techniques (e.g., in situ doping and ion implantation) require very high temperatures and other processing challenges.

Another method, called thermal diffusion doping, is the easiest way to dope semiconductors. Applying the method to diamond has been considered impossible due to the difficulty of breaking carbon-carbon bonds, until now.

The Invention

UW–Madison researchers have developed a method to make boron-doped diamond via low-temperature thermal diffusion. The diamond material may be single crystalline, natural or type IIa.

In the process, an ultrathin boron-doped silicon nanomembrane is bonded to the surface of the diamond and annealed at a temperature around 800 degrees Celsius. Given enough time, the boron atoms from the nanomembrane diffuse into the diamond layer to form a doped region.

Applications

- Thermal diffusion doping of diamond
- Power electronics
- Potential to create PIN diodes on diamond with excellent thermal dissipation properties

Key Benefits

- Easy to implement
- Much milder temperatures than other doping methods
- High dopant concentration
- Silicon nanomembranes can be routinely made or purchased.
- Bonding is strong and tight.
- Enables effective, uniform and selective doping
- No graphitization of the underlying diamond surface

Stage of Development

The researchers have successfully demonstrated boron diffusion from a silicon nanomembrane into single-crystalline diamond. They have created high performance P-I diamond diodes and rectifiers.

Additional Information

For More Information About the Inventors

- Zhenqiang Ma

Related Technologies

- WARF reference number P06047US describes a method for fabricating semiconductor devices on single-crystal membranes and transferring the membranes to different substrates.

Related Intellectual Property

- View Divisional Patent in PDF format.

Tech Fields

- Semiconductors & Integrated Circuits : Components & materials

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846