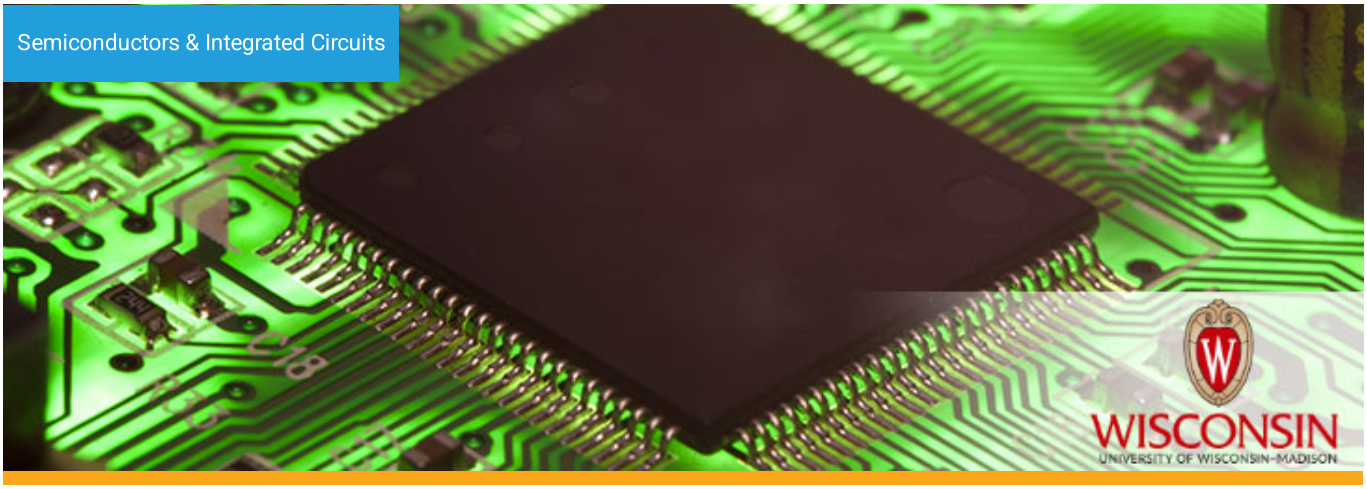

Low-Temperature Method for Smoothing the Disordered Edges of Graphene

View U.S. Patent No. 9,394,177 in PDF format.

WARF: P110246US01

Inventors: Michael Arnold, Padma Gopalan, Nathaniel Safron, Myungwoong Kim

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method that significantly reduces the temperature required for edge restructuring of graphene.

Overview

Graphene possesses tremendous electrical properties, making it suitable for numerous applications. The current method of fabricating this material involves growing or isolating a full sheet of graphene and then etching away the unwanted regions using a top-down ion etching process. This method causes the edges of graphene to become disordered, introducing dangling bonds, defects, chemical functionalization and roughness at the edges, all of which degrade graphene's electronic, optical, thermal and structural properties. It has been shown that defective and disordered edges of graphene can be repaired at temperatures between 1500 and 2000°C; however, these temperatures are too extreme for processing conditions that are common in electronic device fabrication. An improved method for creating this carbon-based material is needed.

The Invention

UW–Madison researchers have discovered a technique that reduces the required temperatures for edge restructuring of graphene. With this technique, the disordered edges of the material can be smoothed and straightened at temperatures below 1000°C. Because this technique effectively repairs the disordered edges, the current method of top-down etching can still be used to create graphene.

Applications

- Nanoelectronics
- Quantum computing
- Field effect transistors
- Thin-film flexible electronics
- Transparent electronics
- High electron mobility transistors
- Microelectromechanical systems
- Optoelectronics and photodetectors
- Solar Cells
- Sensing

Key Benefits

- Significantly reduces the required temperature for edge restructuring of graphene
- Efficiently decreases edge disorder in graphene structures
- Current methods of creating graphene remain applicable

Stage of Development

The researchers have demonstrated edge annealing to repair the edges of micron- and nanometer-scale features in graphene that was created via top-down reactive ion etching. Additionally, they have created nanoperforated graphene with atomically controlled edges.

Additional Information

For More Information About the Inventors

- Michael Arnold
- Padma Gopalan

Related Technologies

- See WARF reference number P100012US02 for an etching method to fabricate graphene.

Related Intellectual Property

- View Divisional Patent in PDF format.

Tech Fields

- Semiconductors & Integrated Circuits : Design & fabrication
- Semiconductors & Integrated Circuits : Lithography

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