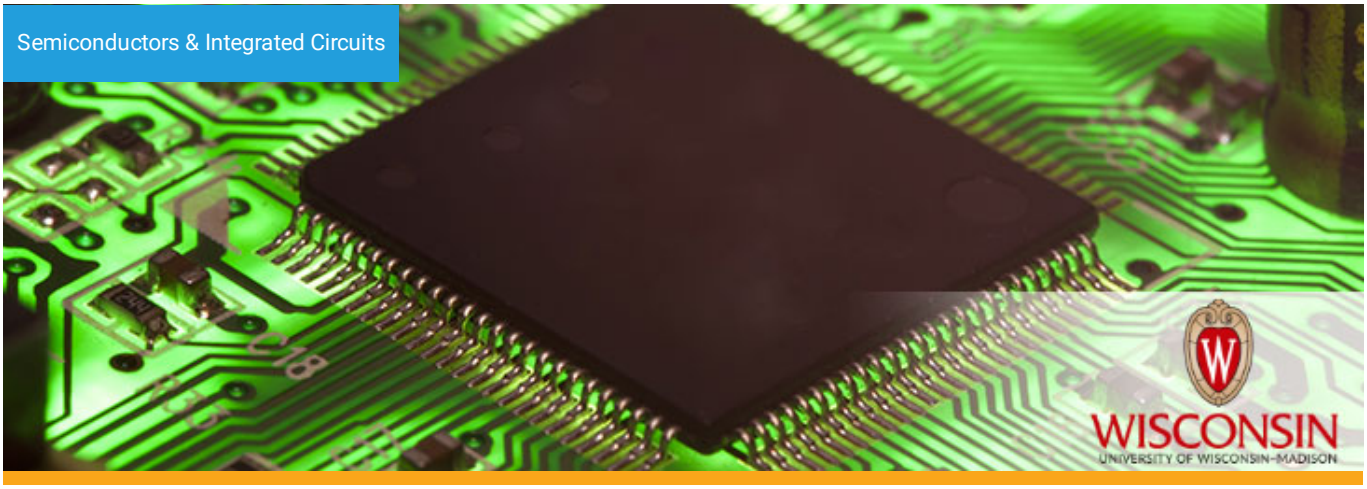
Semiconductors & Integrated Circuits



Bottom-Up Patterning of Smooth Graphene Microstructures and Nanostructures

View U.S. Patent No. 9,803,292 in PDF format.

WARF: P110245US02

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

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing methods to grow micro- and nano-structured graphene using a patterning mask.

Overview

One of the strongest, lightest and most conductive materials known, graphene is an atom-thick carbon film with unrivaled high-tech potential. It is stronger than diamond but capable of bending like rubber and supporting electron speeds a hundred times faster than silicon. For its remarkable properties, graphene may spawn innovations from microcomputers to super batteries.

Modifying graphene's structure is necessary to make it useful for semiconductor electronics, and unlike carbon nanotubes, its flat form lends itself readily to standardized tools. Etching is the typical patterning method, but on the microscale this can degrade graphene's fine edges. The defects associated with top-down processing have spurred interest in alternative approaches.

The Invention

UW–Madison researchers have developed methods for growing patterned, single-crystalline graphene microstructures and nanostructures. Desired features and dimensions are shaped using a growth barrier 'mask.'

First, a mask of suitable material (such as metal or metal oxide) is deposited in a desired pattern onto a substrate via any lithographic method. Graphene then is grown around the boundaries of the mask by chemical vapor deposition. The method can be used to produce a single layer or multilayer graphite.

Applications

- Semiconductor electronics
- Quantum computing
- Nanoelectronics
- Field effect and high electron mobility transistors
- Thin-film and flexible electronics
- Photodetectors and optoelectronics
- Solar and fuel cells
- Batteries
- 'Holey carbon' TEM (transmission electron microscopy) grids

Key Benefits

- Defined nanoscale patterning
- No damage from top-down etching

- Smoother graphene edges
- Higher electron mobility
- Method can produce million-sheet columns for precision bulk graphite.

Additional Information

For More Information About the Inventors

- Michael Arnold
- Padma Gopalan

Related Technologies

- WARF reference number P110246US01 describes a technique for repairing the disordered edges of etched graphene at practical temperatures.

Publications

- Safron N.S., Kim M., Gopalan P. and Arnold M.S. 2012. Barrier-Guided Growth of Micro- and Nano-Structured Graphene. Advanced Materials DOI: 10.1002/adma.201104195

Tech Fields

- Semiconductors & Integrated Circuits : Lithography

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