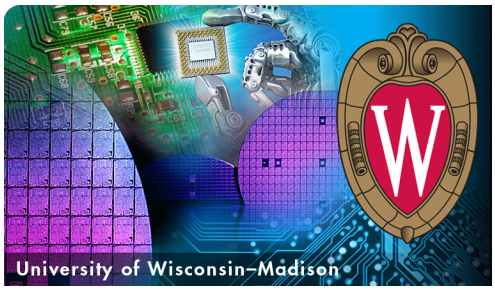

Graphene Nanoribbons with Ultrasmooth Edges

INVENTORS • Michael Arnold, Robert Jacobberger

WARF: P140329US01

View U.S. Patent No. 9,287,359 in PDF format.

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a bottom-up technique for growing graphene nanoribbons directly on a germanium substrate.

OVERVIEW

Graphene is atomically thin carbon film with unrivaled high tech potential. One of the strongest and most conductive materials known, it is stronger than diamond but capable of bending like rubber and supporting electron speeds a hundred times faster than silicon.

It has been proposed that one-dimensional graphene 'nanoribbons' will spawn next-generation technologies. They have already shown tremendous promise in nanoelectronics, solar energy conversion, sensing and other applications.

However, the full potential of graphene nanoribbons has not been realized because their properties are highly dependent on width and edge structure. Conventional 'top-down' methods in which nanoribbons are etched from sheets of graphene result in rough, defective edges. 'Bottom-up' methods are a promising alternative, but to be commercially viable they must be adapted to relevant substrates, such as insulators or semiconductors.

THE INVENTION

UW–Madison researchers have developed a new bottom-up technique for growing graphene nanoribbons with nearly atomically smooth armchair edges directly on germanium, a conventional semiconductor material. The nanoribbons are grown via chemical vapor deposition (CVD) from a mixture of common gases. The process yields aligned nanoribbons with very low edge roughness (< 1 nm), tunable widths to < 5 nm, and lengths of hundreds of nanometers.

The nanoribbon arrays can be released from the germanium and transferred to a second arbitrary substrate to fabricate a variety of semiconductor devices.

THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.

APPLICATIONS

- Fabricating graphene nanoribbons for nanoelectronics, optoelectronics, plasmonic waveguiding, photodetection, solar energy conversion, molecular sensing and catalysis

KEY BENEFITS

- Synthesis yields narrow, self-aligned nanoribbons with high quality, atomically smooth edges and tunable widths.
- Process is cost effective, scalable and compatible with prevailing infrastructure used in the semiconductor industry.
- Growth interface is free of contamination and charge traps.
- Aligned nanoribbon arrays can be transferred onto arbitrary surfaces.

STAGE OF DEVELOPMENT

The researchers have used their new method to successfully grow long, narrow graphene nanoribbons with ultrasmooth edges and tunable widths.

ADDITIONAL INFORMATION

Related Technologies

WARF reference number P110245US02 describes a bottom-up method for growing, smooth patterned graphene microstructures and nanostructures.

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

Tech Fields

Semiconductors & Integrated Circuits - Components & materials

CONTACT INFORMATION

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