



Graphene Nanoribbons with Ultrasmooth Edges

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WARF: P140329US01

Inventors: Michael Arnold, Robert Jacobberger

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.

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 compatible with existing semiconductor manufacturing processes.
• Aligned nanoribbon arrays can be transferred onto arbitrary surfaces.

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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

For More Information About the Inventors

- [Michael Arnold](#)

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](#)

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

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