



Simplified Anisotropic Graphene Conductor Emits Terahertz Radiation

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WARF: P130002US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for fabricating versatile, easier-to-make devices that generate electromagnetic radiation over a broad range of frequencies.

Overview

Terahertz (THz) electromagnetic radiation penetrates cloth, paper and partially into the skin without the damaging effects of X-rays. Portable electronic devices capable of generating this radiation would be useful for quality control scanning, explosives detection and dental imaging. However, available THz sources are bulky and complex, operating at low temperatures or in a vacuum.

It is known that electromagnetic radiation may be generated by accelerating or decelerating charged particles like electrons. For example, synchrotron radiation occurs when the trajectory of high-speed electrons is curved, e.g., as the electrons pass through a magnetic field. This principle underlies free-electron lasers (FELs), which use a magnetic 'wiggler' to disturb electrons' paths. This disturbance converts the kinetic energy of the electron beam into electromagnetic radiation.

Similarly, materials with different 'charge carrier mobility' (i.e., electrons flow more or less easily through them) could be arranged to emit radiation in the THz frequency. Yet any new design must be cost-effective and practical.

The Invention

UW–Madison researchers have designed an electromagnetic radiation device that can generate THz frequencies using an electrically conducting thin film.

The film is made of graphene layered over a substrate patterned into stripes of two alternating materials, such as germanium and silicon dioxide. This causes the charge carrier mobility across the plane of the thin film to vary periodically. When voltage is applied to the film, electrons flow through, changing velocities and giving rise to a spatially varying electric field. This produces electromagnetic radiation from the exposed surface of the film as the electrons pass through.

The graphene layer can be grown or deposited directly on the patterned substrate using known nanomembrane or thin-sheet transfer techniques.

Applications

- Screening and security
- Sensors
- Detecting skin cancer and tooth decay
- Quality control examinations

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Key Benefits

- Works at room temperature in a continuous-wave (CW) mode
- Inexpensive fabrication process
- Devices are compact and can be mechanically flexible.
- Devices can be tailored to provide electromagnetic radiation over a range of powers and frequencies, including THz.

Additional Information

For More Information About the Inventors

- [Max Lagally](#).

Related Technologies

- [WARF reference number P08031US02 describes a device for generating electromagnetic radiation using a nanoscale conductive ribbon.](#)

Tech Fields

- [Analytical Instrumentation, Methods & Materials : Lasers](#)
- [Engineering : Micro & nanotechnologies](#)

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

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