Analytical Instrumentation, Methods & Materials

Strain-Tunable Light Emitting Diodes Using Germanium

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WARF: P140041US01

Inventors: Max Lagally, Jose Sanchez Perez

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing tunable PIN diodes that are made of germanium heterojunction layers and can emit radiation over a range of wavelengths.

Overview

Germanium (Ge), a group-IV semiconductor material, is crucial to many established and potential technologies. In optoelectronics, Ge has been used as a photodetector material for on-chip data distribution. This is because it strongly absorbs near-infrared optical communication wavelengths and is compatible with silicon microelectronics. Additional device applications within the emerging field of group-IV photonics (including lasers and solar cells) are being tested as well.

The Invention

UW–Madison researchers have developed new tunable LEDs with germanium PIN heterojunctions. The diodes are made of an undoped (intrinsic) Ge layer between p-type and n-type doped Ge layers. The nano-thin structure can be epitaxially grown and then transferred to a flexible substrate.

Once bonded to the flexible substrate, the whole structure is stretched, causing biaxial tensile strain. Given sufficient strain, the Ge is transformed into a direct-bandgap semiconductor. When voltage is applied, radiation is emitted via electroluminescence. The wavelengths of the emitted radiation can be tuned by adjusting the amount of stretch (i.e., the amount of tensile strain) that is applied.

Applications

- Biological and chemical sensing (e.g., trace gas detection, environmental monitoring, medical diagnostics, industrial process control, etc.)
- Spectroscopy
- Secure free-space optical communications

Key Benefits

- More successful than prior germanium-based techniques
- Wavelengths are emitted in a technologically significant range (1.5 to 2.5 micrometers).
- Superior emission efficiency
- New diodes can support population inversion and provide optical gain.

Additional Information

For More Information About the Inventors

- Max Lagally

Related Technologies

- WARF reference number P04286US describes a method for creating a strained layer of silicon that also is applicable to germanium.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Optics
- Analytical Instrumentation, Methods & Materials : Sensors
- Semiconductors & Integrated Circuits : Design & fabrication

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