InAs/InAsBi Superlattice Materials for Long Wavelength Infrared Optoelectronic Applications

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Inventors

Dr. Shane Johnson

Research Scientist

School of Electrical, Computer, and Energy Engineering

Preston T. Webster

Graduate Research Associate

School of Electrical, Computer, and Energy Engineering

Ankur R. Sharma

Graduate Research Assistant

School of Electrical, Computer, and Energy Engineering

Chaturvedi Gogineni

Graduate Research Associate

School of Electrical, Computer, and Energy Engineering

Nathaniel Riordan

Graduate Research Associate

School of Electrical, Computer, and Energy Engineering

Intellectual Property Status:

Pending

Contact

Bill Loux

Director of Business Development, Physical Sciences

Arizona Technology Enterprises, LLC (AzTE)

P: 480.884.1992

F: 480.884.1984

BLOUX@AZTE.COM

TECHNOLOGYVENTURES@AZTE.COM

Background

Infrared photodetectors have a wide range of applications including medical imaging, thermal sensing, spectroscopy, and night vision. Currently, the best photodetectors on the market have an active absorption region made from Mercury Cadmium Telluride (MCT). Although MCT photodetectors maintain the strongest absorption over the greatest spectral range, their performance-generated heat creates enough thermal noise that they must be cooled in order to function, making them costly and cumbersome. Historically, InAs grown on a GaSb substrate has made the best photodetectors that operate at room temperature. However, they are a type-II superlattice and consequently lack a superior level of absorption.

Invention Description

Researchers at ASU have developed dilute-bismide-based superlattice structures that form a semi-metallic layer for improved contacting in long wavelength infrared (IR) devices, as well as IR emission/absorption layers for IR sensing. Layering InAsBi between InAs achieves a "tuneable" long-wavelengh absorption made possible by the type-I band alignment of InAsBi relative to InAs. The InAs/InAsBi band structure can lead to superlattices with almost metallic-like electrical conductivity and connectivity that are more appropriate for use in IR devices. The active region of this photodetector can be grown arbitrarily thick, maximizing the overall signal to noise ratio and giving it a wide range of absorption cutoffs.

Potential Applications

- Infrared Detection
- Photonics
- Spectroscopy

Benefits and Advantages

- **Better Absorption** – Type-I band alignment and adjustable spectral range.
- **Greater Performance** – Reduced noise and enhanced electrical conductivity and connectivity between the layers while operating at room temperatures.
- **Lower Costs** – Common ions between the InAs/InAsBi active region and conventional GaSb substrate simplify interfaces without doping.