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Electrical and optical studies on narrow band gap InAs/InGaSb superlattices

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Abstract

InAs/InGaSb superlattice (SL) materials are an excellent candidate for infrared photodiodes with narrow band gap energies to cover wavelengths from 5 µm to20 µm, i.e. out to the very long infrared wavelength (VLWIR) range. There are relatively few options for high performance infrared detectors to cover wavelengths longer than 15 µm, especially for operating temperatures above 15K. There are a variety of possible superlattice designs that will cover the VLWIR wavelength range, including designs with and without indium alloying of the GaSb layers. Transport modeling has shown that alloy scattering should not be a dominant factor in these superlattices so our focus is on designs with 25% indium in the gallium antimonide to achieve energy band gaps less than 50 meV with a superlattice period on the order of 68 Å. Similar to the work reported on InAs/GaSb LWIR and VLWIR superlattices, our designs employ InGaSb layers less than 7 monolayers in width. While the superlattice designs are strain balanced to the GaSb substrate, care was also taken to minimize strain spikes in the interfacial regions. High resolution transmission electron microscope images were analyzed to create strain mapping profiles of the SL layers and interfaces. By focusing on a narrow set of VLWIR SL designs, the deposition parameters for the molecular beam epitaxial SL growth could be carefully optimized.

Biography

Gail J. Brown is a Principal Physicist with the Nanoelectronic Materials Branch of the Materials and Manufacturing Directorate of the Air Force Research Laboratory. Dr. Brown has worked on developing semiconductor materials for infrared detector applications since 1980. Dr. Brown has co-authored more than 200 papers. She has co-chaired over 25 conferences and symposia on topics covering a variety of areas such as photodetectors, quantum sensing, semiconductor nanostructures for electronics and optoelectronics, and metamaterials. Dr. Brown is an Air Force Research Laboratory Fellow, a Fellow of the International Society for Optical Engineering and a Fellow of the American Physical Society.