Pressure-Dependent Photoluminescence and Strain Response of a 1.7 µm Cutoff InGaAsSb/AlGaAsSb Multi-Quantum Well

Sonam Yadav[1], Preston T. Webster[2], Rigo A. Carrasco[2], Christian P. Morath[2], Diana Maestas[2], Perry C. Grant[3], Jaden R. Love[1], Meghan A. Verano[1], and Stefan Zollner[1]

[1]*Department of Physics, New Mexico State University, Las Cruces, New Mexico 88003, USA*

[2]*Air Force Research Laboratory, Space Warfare Directorate, Kirtland AFB, New Mexico 87117, USA*

[3]*Arktonics LLC, Fayetteville, Arkansas 72701, USA*

The photoluminescence response of a molecular beam epitaxy-grown InGaAsSb/AlGaAsSb multi-quantum well heterostructure is investigated as a function of hydrostatic pressure up to 1.35 GPa at 10 K. Pressure-dependent photoluminescence measurements were performed using a diamond anvil cell, with pressure calibrated by ruby fluorescence. The emission peak exhibits a systematic blue shift with increasing pressure, with a measured pressure coefficient of approximately 77 meV/GPa. At the same time, the integrated photoluminescence intensity decreases with pressure, consistent with enhanced non-radiative recombination through a defect level located above the conduction-band edge at ambient pressure that becomes electronically active under compression. The strain in the quantum well is quantified using the Murnaghan equation of state, and analysis of the transition energy as a function of strain yields a hydrostatic deformation potential of approximately −4.4 eV. These measurements demonstrate the use of hydrostatic pressure as a sensitive probe of band-structure evolution, strain response, and defect-mediated recombination in quaternary III–V quantum-well heterostructures, providing insight relevant to the optimization of infrared optoelectronic materials and devices.