Photoluminescence Studies of Type-I and Type-II \( \text{In}_{0.27}\text{Ga}_{0.73}\text{Sb}/\text{In}_{x}\text{Al}_{1-x}\text{As}_{y}\text{Sb}_{1-y} \) Multiple Quantum Well Heterostructures Grown by MBE

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TEAM — Heterojunction bipolar transistors (HBTs) with lattice constant near 6.2\AA using the InAs/AlSb/GaSb family of semiconductors are of interest based on their promise for high-speed operation with low power dissipation. A unique aspect of these materials is the ability to engineer the bandgap energies and the conduction band offsets at the emitter/base and base/collector heterointerfaces by varying the In/Al and Al/Sb ratios. In this work low-temperature PL was performed on a set of \( \text{In}_{0.27}\text{Ga}_{0.73}\text{Sb}/\text{In}_{x}\text{Al}_{1-x}\text{As}_{y}\text{Sb}_{1-y} \) MQW heterostructures to provide a measure of the conduction band offsets (\( \Delta_{CB} \)) that are a critical design parameter for the HBTs. Excitation power studies revealed evidence for strong recombination at 0.56 eV within the InGaSb layers of the MQW structure with \( x,y = 0.52,0.25 \) and, thus, confirmed the type-I band alignment. In contrast, weaker PL bands at energies close to 0.4 eV and that exhibited strong shifts with increasing excitation power density were found from the nominally type-II MQW samples with \( x,y = 0.67,0.39 \) and \( 0.69,0.41 \). Neglecting small corrections (~15 meV) due to the electron and hole confinement energies, we estimate \( \Delta_{CB} \) of ~120-150 meV in these Type-II structures.

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