Approaching the InP-Lattice Constant on GaAs

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Integrating different materials onto the Si platform brings new functionality to silicon. Using InP on silicon could allow the integration of optical and electronic (e.g., CMOS) devices. By growing high-quality GaAs on silicon, our group has been able to demonstrate a GaAs laser on silicon. Our research goal is to expand the lattice constant beyond GaAs and grow high-quality InP on GaAs. Having explored many materials systems and methods (e.g., InGaAs, InGaP, and InGaAlAs), to date, we have grown low-dislocation-density $\text{In}_{0.43}\text{Al}_{0.57}\text{As}$ on GaAs with a dislocation density of $1.4\times10^6/cm^2$, more than an order-of-magnitude fewer dislocations than in typical commercial metamorphic buffers. After achieving high-quality InP on GaAs, we will work to grow InP on Si. Bringing low-defect density InP onto Si may bring high-speed, InP-based devices into new markets because the processing and material-cost, for a given area will be drastically reduced and allow for high-frequency and/or low-power operation.

Figure 1: Plan-view TEM of $\text{In}_{0.43}\text{Al}_{0.57}\text{As}$ on GaAs with a dislocation density of $1.4\times10^6/cm^2$.

Figure 2: Cross-section of $\text{In}_{0.43}\text{Al}_{0.57}\text{As}$ on GaAs.