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Digital alloy growth of AlInAsSb for low noise avalanche photodetectors

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The application of $Al_xIn_{1-x}As_ySb_{1-y}$ to near- and mid-infrared optoelectronic devices has been hampered by the challenge of realizing high quality films, due to the wide miscibility gap. However, it was recently shown that AlInAsSb can be grown within the miscibility gap over a moderate range of compositions by molecular beam epitaxy using the digital alloy technique. We have extended this approach to realize AlInAsSb digital alloys covering the entire direct bandgap range that is lattice-matched to GaSb (Al fractions ranging from 0% to ~80%). The broadly-tunable bandgap (0.24 eV at 0% Al to 1.23 eV at 76% Al), along with the type-I band alignments of this lattice-matched quaternary make it attractive for advanced mid-infrared and near-infrared detectors and sources. For avalanche photodetectors in particular, these materials exhibit low excess noise characteristics – comparable to that of silicon and their band engineering flexibility proved indispensable for demonstrating the first low-noise separate absorption charge and multiplication (SACM) avalanche detector operating at telecom wavelengths and the first working staircase avalanche photodetectors. Here, we describe the growth and electrical/structural properties of these enabling materials.

Biography

Seth Bank has received his BS from University of Illinois at Urbana–Champaign. He has done his MS and PhD degrees from Stanford University. After a Post-doctorate at UCSB, he joined the University of Texas at Austin, where he is currently an Associate Professor of ECE and holds a Temple Foundation Endowed Faculty Fellowship. His research focuses on the growth and application of novel heterostructures and nanocomposites to electronic/photonic devices. He has co-authored over 200 papers and presentations and has received PECASE, NSF CAREER, AFOSR YIP, ONR YIP, DARPA YFA, Young Scientist Award from ISCS, Young Investigator Award from NAMBE, and several best paper awards.

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