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Metamorphic Buffer Comparisons for M-HBT Grown by MBE

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InP substrate size, cost per square inch, and brittleness are potential limiting factors to wide spread commercial implementation of InP-based HBTs in high-speed optoelectronic applications. One approach to address these issues is to grow InP-HBTs on GaAs substrates using a metamorphic buffer (M-buffer). Due to the high current densities in these circuits, it is critical to develop a M-buffer with high thermal conductivity to avoid catastrophic circuit failure.

We present a comparative study of nominally identical metamorphic HBTs grown by MBE incorporating M-buffers of InP, InAlP, InAlAs and InGaAlAs alloys. The DC parameters of these M-HBTs compared favorably with the HBT grown on InP. All M-HBTs exhibit surface cross-hatch patterns, and AFM measurements show comparable RMS roughness values for the various M-buffers. Relative thermal conductivity comparisons have been drawn from device measurements under increasing bias conditions. Potential problems with standard graded M-buffer techniques will be discussed.