Abstract

This work focuses on the causes of the non-linear behavior of InP DHBTs from a technological point of view. The TCAD simulated devices are based on triple mesa structures with an emitter width of 500nm and type-I band alignment.

One significant cause of nonlinear behavior is the accumulation of electrons in the base region [1]. The reason for this is the type-I band alignment and base pushout, which impedes the transport of electrons. By mitigating the effects of this conduction band edge discontinuity and base pushout, the devices linearity is improved.

The severity of base charge accumulation was examined for three collector designs. A more pronounced base charge accumulation correlated with worse linearity. All three designs use InGaAsP in the collector region to reduce the conduction band edge discontinuity. The first design employs a continuous linear grading, representing an idealized transition from InGaAs to InP. The second design consists of a stepwise grading, which represents a manufacturable approximation to a continuous grading. Finally, a design is reviewed, which uses an electron affinity matched InGaAsP composition for the whole collector. A difference of 5dBm in linearity was observed when comparing the stepwise graded DHBT with the DHBT composed of a collector with constant InGaAsP composition.

Other causes for non-linear behavior, like the exponential nature of the base-emitter diode and non-linear change of the base-collector capacity, are briefly examined for the constant InGaAsP collector design.