KUNGL TEKNISKA HÖGSKOLAN

Ultra High Speed InP Heterojunction Bipolar Transistors

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Abstract

This thesis deals with the development of high speed InP mesa HBT's with power gain cut–off frequencies up to and above 300 GHz, with high current density and low collector discharging times.

Key developments are Pd–based base ohmics yielding base contact resistances as low as 10 $\Omega\mu m^2$, base–collector grades to enable to use of InP in the collector, and an increase in the maximum current density through collector design and thermal optimization. HBT's with a linear doping gradient in the base are for the first time reported and compared to HBT's with a bandgap graded base. The effect of degenerate base doping is simulated, as well as the base transit time.

Key results include a DHBT with a 215 nm thick collector and an $f_\tau = 280$ GHz, and f_{max}=400 GHz. This represents the highest f_{max} reported for a mesa HBT. Results also include a DHBT with a 150 nm thick collector and an $f_\tau = 300$ GHz, and f_{max}=280 GHz. The maximum operating current density has been increased to above 10 mAμm while maintaining f_τ and $f_{max} \geq 200$ GHz.

A mesa DHBT process with and as much yield and simplicity as possible has been developed, while maintaining or pushing world–class performance.

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